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Marion COSTE

Health Capability studies in rural Senegal

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Composition du jury

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Professeur des universités, université de Lille

Jérôme WITTWER   Rapporteur, Président
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Fatoumata HANE   Examinatrice
Maitresse de conférences des universités, Université
Assane Seck de Ziguinchor

Jennifer J. PRAH   Examinatrice
Amartya Sen Professor of Health Equity, Economics, and
Policy, University of Pennsylvania

Mohammad ABU-ZAINEH   Directeur de thèse
Maître de conférence des universités, Université d'Aix-
Marseille

Sylvie BOYER   Co-directrice de thèse
Maîtresse de conférence des universités, Université d'Aix-
Marseille

Affidavit

I, undersigned, Marion Coste, hereby declare that the work presented in this manuscript is my own work, carried out under the scientific supervision of Mohammad Abu-Zaineh and Sylvie Boyer, in accordance with the principles of honesty, integrity and responsibility inherent to the research mission. The research work and the writing of this manuscript have been carried out in compliance with both the French national charter for Research Integrity and the Aix-Marseille University charter on the fight against plagiarism.

This work has not been submitted previously either in this country or in another country in the same or in a similar version to any other examination body.

Place Marseille, date 21 avril 2023

List of publications and participation to seminars and conferences

1) List of publications written as part of the PhD project

   1. Coste M. The Poor and the Healthy: Unpacking Health Capability in rural Senegal (job-market paper).
   2. Coste, M., Badji, M. A., Diallo, A., Mora, M., Boyer, S., & Prah, J. J. (2022). Applying the health capability profile to empirically study chronic hepatitis B in rural Senegal: A social justice mixed-methods study protocol. *BMJ Open*, *12*(4), e055957. https://doi.org/10.1136/bmjopen-2021-055957
   3. Coste M., Ndong C. Badji M. A., Diallo A., Boyer S., & Prah J. J. Investigating health capability among people living with chronic hepatitis-B virus (CHB) infection in rural Senegal: a social justice mixed methods study (being prepared for publication).
   4. Coste, M., Bousmah MaQ. Predicting health services utilization using a score of perceived barriers to medical care: evidence from rural Senegal. Accepted for publication at *BMC Health Services research*.

2) Participation to conferences and summer schools during the PhD

Summer schools

   1. 2022 Brocher Summer Academy. The Ethics of Health Valuation
   2. 2021 Paris School of Economics' summer school. Microeconometrics and Policy Evaluation
   3. Ecole d'Ete des Objectifs de Développement Durable 2020 sur les inégalités (AFD, IRD & AMU)

Conferences and seminars

   1. Webinar "*Approche par les capabilités*" the Union for African Population Studies (2023): oral presentation
   2. SESSTIM seminar (2023): oral presentation
   3. 18th Doctorissimes conference (2023): poster
   4. 2020 and 2022 conferences of the Human Development and Capability Association : oral presentations
   5. 2022 conference of the European Health Economics Association: 2 oral presentations
   6. 2022 conference of the AFRAVIH French-speaking association on HIV and viral Hepatitis: oral presentation
   7. 2022 World Bioethics Congress: oral presentation
   8. 2022 International Liver Congress: poster

9. Global Health Brownbag seminar at University City London (2022): oral presentation
10. AMSE Empirical Econometric Methods Sessions (2022): oral presentation
11. SESSTIM internal seminar (2022): oral presentation
12. AMSE PhD seminar (2020, 2021, 2022) : oral presentations
13. Health Policy Workshop at Indiana University (2021) : oral presentation
14. 2021 meeting of the ASsociation of Southern-European Economic Theorists: oral presentation
15. 2021 BiGSEM doctoral workshop at Biefield University: oral presentation
16. 2020 International Conference in Development Economics: poster
17. Webinar of the Health and Disability Thematic Group of the Human Development and Capability Association (2020)

Résumé

Cette thèse présente trois études empiriques sur les capabilités de santé, telles que conceptualisées et opérationnalisées par Prah (2010), pour répondre à l'objectif de développement durable des Nations Unies n°3 qui vise à « permettre à tous de vivre en bonne santé et promouvoir le bien-être pour tous à tout âge » (Nations Unies, 2015) en zone rurale au Sénégal. Le premier chapitre développe une estimation quantitative du modèle des capabilités de santé à l'aide d'une modélisation à équations structurelles afin d'examiner si les interventions et politiques de santé doivent cibler les ménages les plus pauvres en zone rurale en Afrique sub-saharienne. Le modèle tridimensionnel de capabilité de santé révèle que l'autonomie de décision (*empowerment*), qui contribue à un bon état de santé, est plus faible chez les individus qui vivent dans des ménages riches en ressources monétaires ou agricoles. Ces résultats amènent à repenser l'élaboration des politiques et interventions de santé, et proposent une nouvelle façon d'identifier les diverses caractéristiques individuelles et collectives associées avec des besoins (déficits) par rapport à l'état de santé, l'autonomie de décision ou l'accès aux soins de santé. Le deuxième chapitre présente une étude mixte en deux étapes visant à documenter l'ensemble des 49 éléments du profil des capabilités de santé de personnes vivant avec une infection chronique par le virus de l'hépatite B (VHB). Cette étude fournit un état des lieux complet de l'ensemble des facteurs qui jouent la capacité des individus à éviter la morbidité et la mortalité liées au VHB. En particulier, les résultats mettent en lumières des obstacles à l'entrée dans les soins externes au système de santé (par exemple l'insécurité économique et l'absence de protection sociale ainsi que les normes sociales). Le troisième chapitre élabore et valide un score d'obstacles perçus à l'accès aux soins pour mesurer la capabilité des individus à accéder aux soins de santé. Le score permet de prédire l'utilisation des soins de santé de primaire. Cette thèse démontre donc qu'il est à la fois faisable et utile d'appliquer de manière empirique les capabilités de santé.

Mots clés : capabilités de santé ; pauvreté ; autonomie ; accès aux soins ; hépatite B ; Sénégal ; Afrique sub-saharienne ; modèle à équations structurelles ; méthodes mixtes ; analyse factorielle.

Abstract

This dissertation presents three empirical studies of health capability, as conceptualized and operationalized by Prah (2010), addressing the United Nations Sustainable Development Goal n°3 to "ensure healthy lives and promote well-being for all at all ages" (UN, 2015) in the context of rural Senegal. The first chapter develops a quantitative estimation of the health capability model using structural equation modeling to investigate whether policy for health promotion should target poor households in rural sub-Saharan Africa. The tri-dimensional and overlapping health capability model provides evidence that empowerment, which contributes to optimal health outcomes, is lower in people living in resource-rich households. The results motivate rethinking policy design and interventions for health promotion, and offer a way ahead by identifying various and heterogeneous household and individual level characteristics associated with shortfalls (deficits) in health status, empowerment, and access to health care, respectively. The second chapter presents a two-stage mixed methods study documenting all 49 elements of the health capability profile in people living with chronic hepatitis B (CHB). It provides an uniquely comprehensive account of what is involved in the ability to avoid CHB-related morbidity and mortality. In particular, the study highlights threats to linkage beyond the healthcare system (such as generalized economic and social insecurity, and social norms). The third chapter elaborates and validates a score of perceived medical care as a measure of people's ability to access health care. This score is showed to predict primary care utilization. Overall, the dissertation demonstrates that it is both possible and illuminating to empirically assess health capability.

Keywords: health capability; poverty; empowerment; healthcare access; hepatitis B; Senegal; Sub-Saharan Africa; structural equation modelling; mixed methods; factor analysis.

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This PhD project started back in 2014 when I was first working on my master thesis in political philosophy at Paris-Sorbonne university, and my advisor Jean-Cassien Billier directed me towards a book on *Health and Social Justice* presenting Jennifer Prah's health capability paradigm. Je lui en suis très reconnaissante. I would like to take this opportunity to thank all the teachers from the Louis Barthou highschool in Pau who fueled

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List of acronyms

CBHI: community-based health insurance

CFA: confirmatory factor analysis

CHB: chronic hepatitis B

CHE: catastrophic health expenditures

CMU: universal health insurance (“*Couverture Maladie Universelle*”)

CRES : Senegalese Social and Economic Research Consortium (“*Consortium pour la Recherche Economique et Sociale*”)

DECAM: decentralized CBHI at the municipality level (“*DECentralisation de l'Assurance Maladie*”)

DHS: demographic and health surveys

EFA: explanatory factor analysis

GDP: gross domestic product

HCP: health capability profile

HCM: health capability model

HDI: human development index

HDSS: health and demographic surveillance system

ICP: chief nurse of a health dispensary (“*infirmier chef de poste*”)

IDI: in-depth interview

KII: key informant interview

LMICs: low and middle-income countries

MM: mixed methods

PBMC: perceived barriers to medical care

PNBSF: Senegalese government cash transfer program/family allowance (“*Programme National de Bourse de Sécurité Familiale*”)

OOP: out-of-pocket (health expenditures)

SDG: sustainable development goals

SDoH: social determinants of health

SEM: structural equation model

UDAM: Departmental Health Insurance Unit (“*Unité Départementale d'Assurance Maladie*”)

UHC: universal health coverage

UN: United Nations

US: United States

WHO: World Health Organization

Introduction

1. From health capital to health capability

1.1. Health economics and social determinants of health

1.1.1. The emergence of health economics

Health economics was first coined in a 1958 eponym article by Selma Mushkin and defined as a "special field of inquiry" "concerned with the organization of the market for health services and the net yields of investment in people for health" and "the '*optimum*' use of resources for the care of the sick and the promotion of health" (1). However, its emergence as a discipline is often attributed to the 1963 article by Kenneth Arrow arguing that the market of medical care presents "special economic problems" deriving from a dual uncertainty: uncertainty in the occurrence of health needs and episodes of illness, and uncertainty in the efficiency of the provision of medical goods to address these needs (2). From the very beginning, health economics is therefore concerned with, on the one hand, health promotion, and on the other, the regulation of healthcare markets. These fields overlap to the extent that the provision of healthcare goods and services contributes to preventing, and addressing health issues, thereby participating in health as an investment (3).

The 1982 Grossman model of demand for health (4) formalizes this relationship with health modeled as both a capital and an investment good[1]. In this model, the demand for healthcare is a function of socio-demographic and economic individual variables, self-assessed health, and the healthcare and insurance markets. There is mixed evidence on whether the model is empirically valid to predict spending on medical care (5,6), and the original model has been amended (7,8) and extensively criticized (9,10).

1.1.2. Social determinants of health

Be that as it may, the model has contributed to conceptualizing health as being influenced by a variety of factors, both at the individual and societal levels. The latter has

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[1]More precisely, in the Grossman model, individuals received an initial health endowment, which depreciates over time, and they can choose to invest in their health through the consumption of healthcare goods and services, or investment in a healthy lifestyle (diet, exercise, etc.) depending on a rational evaluation of costs and benefits. Variables that influence the demand for health care include a wide range of individual-level characteristics (age, education, time, place of residence, housing, income, unemployment, etc.). Perceived severity of the illness (self-assessed health status), as well as the healthcare system's quality and use and the insurance markets' quality also enter the demand function.

gained increasing attention under the designation of "social determinants of health" (SDoH) particularly through the 2008 Commission of the World Health Organization (WHO) on health equity (11). The initial report identifies several key areas relating to living conditions, which should be addressed to tackle inequities in health outcomes and prospects: early child development (including education), neighborhood and environment (urban versus rural living, pollution, infectious disease, housing, water, and sanitation), employment status and security, social protection, and the healthcare and health insurance systems. This list has been extensively supplemented and adapted to specific contexts – for instance, Galea has highlighted US-relevant topics such as gun violence or the opioid epidemics (12). The current WHO website cites many of the original SDoH as well as additional aspects of social life (inclusion, absence of discrimination and conflicts), and economic conditions (income, employment, and job security, working conditions, food, housing, and amenities) while emphasizing the importance of accessible and affordable high-quality health services (13).

1.1.3.   Limitations of standard approaches

Notwithstanding the contribution of the SDoH in identifying a wide range of structural elements that influence health prospects and outcomes, there is a growing literature identifying shortcomings associated with this approach. One main criticism of the SDoH is that attempts to quantify the isolated contribution of each element in relation to specific health indicators fail to account for dynamic interactions, interdependences, and cumulative influences. Accordingly, Figueroa has called for more integrated approaches, such as the development of a "polysocial risk score" (14). In his view, rather than attempting to isolate individual and societal factors, one should account for their inter-connectedness and complex relationships, and recognize that they matter in aggregate. He specifically argues for the application of recent advances in machine learning methods and polygenic risk scores to health promotion.

In addition, it has been argued, for instance by Jones and colleagues, that by implicitly assuming that resources and social conditions have a homogenous effect on health outcomes, SDoH cannot adequately address the equity concerns that prompted the initial WHO report – and fall short of social determinants of equity (15). Berwick has also argued to integrate a moral dimension as a necessary feature of healthcare professionals' leadership (16), and Coggon has stressed the importance of untangling the legal, moral, and political influences within SDoH (17).

These criticisms extend beyond the realm of the SDoH. In particular, Prah (2015) notes that Kenneth Arrow himself has acknowledged needs for integrating principles derived from ethics and culture into health economics – the field he largely contributed to establishing (18). She argues that "health capability economics" offers a way forward (*ibid*).

1.2. Health capability

1.2.1. Capability theory and the health capability paradigm

Sen advanced the concept of capability in the early 1980s (19). Capability theory stems from the basic idea that it is insufficient to investigate what people have and do not have (i.e., individual and societal resources) in relation to what they do and do not do (their "functionings"). Rather, the focus should be on what people are able to achieve – their capabilities (19–21). This is in part because it is necessary to account for people's ability to set goals and make decisions for themselves (their agency) as well as for their differential ability to transform resources into functionings (i.e., real achievements).

Health capability is theorized in the eponym 'health capability paradigm' first developed by Prah in a 1994-1998 PhD program culminating in a 1998 PhD (22) and comprehensively presented in a book (23). This conception is grounded in the Aristotelian idea that the end of society is human flourishing (*eudaimonia*[2]), which gives a special moral value to one's ability to be healthy (25). Health capability is defined as "the confidence and ability to be effective in achieving optimal health" now and in the future (26). It encompasses health status and outcomes (health *functioning*), and one's ability to make decisions and behave so that to promote one's health and the health of others (health *agency*). Indeed, the ability to make positive decisions in promoting one's health and experiencing positive health outcomes are both essential to one's ability to flourish.

Prah further identifies two *central* health capabilities, which have a preponderant moral importance. These central health capabilities are the ability to avoid (1) premature death and (2) escapable morbidity due to their more essential contribution to flourishing. They are to be prioritized over other non-central health capabilities, which are also to be promoted, though once central health capabilities have been secured for all individuals. Another important notion attached to health capability, is that equity (and fairness) guides policy and institutions, and is defined and measured with respect to shortfall inequality (23). Shortfall inequality gives priority to people or conditions that are, as currently observed, further away (largest shortfalls in achievements) from a reference level of optimal potential – an attainable ideal. These principles create the basis of health capability as a theory for social justice. From this theory, health capability is first conceptualized, and then operationalized, so as to path for empirical applications.

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[2] "The ultimate end of human acts is eudaimonia, happiness in the sense of living well, which all men desire; all acts are but different means chosen to arrive at it"(24).

1.2.2. Conceptualization: the health capability model

The first step to move from theory to practice is to define health capability as a conceptual model. Specifically, Prah offers a *conceptualization* of health capability as a cradle-to-grave, intrinsically dynamic concept, which is created at the overlap of four main elements (see Figure 1). These elements are:

One's own biological and genetic capital, including current health status and risk factors;

- The intermediate social context: social norms, groups and networks and living conditions and of childhood development, etc.;
- The public health and healthcare systems, and
- The macro social-political and economic environment – which encompasses stability, opportunities, institutions and human rights.
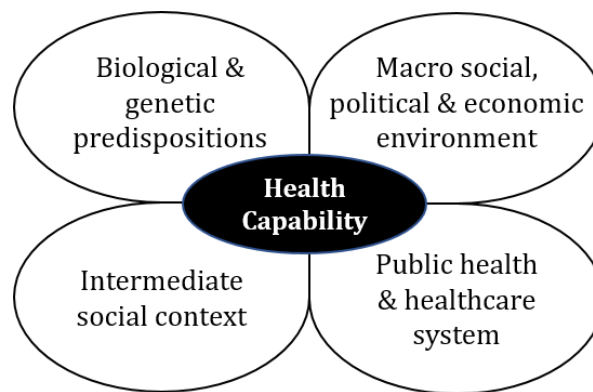
Figure 1. The Health Capability Model

This conceptual model illuminates that health capability is only effective when all four sets of conditions are met. In other words, one's ability to thrive, to be effectively confident and able to experience optimal health requires favorable biological and genetic predispositions, as well as an enabling intermediate social context, in conjunction with high quality and accessible public health and healthcare systems, and in a context of stable and secure political, social and economic environment. The health capability model (HCM) is therefore a useful conceptual tool to identify elements and conditions that are to be present in order to create, and promote, health capability.

1.2.3. Operationalization: the health capability profile

The second step in applying health capability is the *operationalization* of health capability into a measurable individual profile, which can then be aggregated across individuals. This health capability profile (HCP) defines the strengths and conditions that together, constitute the health capability *profile* of an individual. Figure 2 lists eight

internal capabilities (black names in white rectangles), which correspond to socially dependent individual characteristics and skills, and seven external capabilities pertaining to the broader social and institutional environment (in the black rectangles). Each of these fifteen health capabilities is further separated into one (or several) agency (or agencies) or functioning(s)– full details are provided in Prah's 2010 article (26).

As an example, the external capability of utilization and access to health services encompasses two functionings, that is the presence of a poor health condition observed through (i) serious symptoms and/or (ii) morbid symptoms, and three agencies that document the ability to receive healthcare when needed, specifically, (1) perceiving a need for healthcare, (2) the existence of appropriate health services, and (3) the absence of barriers (for example monetary, geographical socio-cultural or other types of barriers) to access and utilization.

Health Status and Health Functioning	Health Knowledge	Health-Seeking Skills and Beliefs, Self-Efficacy	Health Values and Goals	(Perceived) Self-Governance and Self-Management
Effective Health Decision-Making	Intrinsic Motivation	Positive Expectations	Social Norms	Social Networks and Social Capital
Group Membership Influences	Material Circumstances	Economic, Political, and Social Security	Utilization and Access to Health Services	Enabling Public Health and Health Care Systems

Figure 2. The Health Capability Profile

In sum, the profile presents a comprehensive catalog of all the elements that are to be present within, and around, an individual for this person to experience optimal health capability. As such, it constitutes a guiding tool for empirical applications.

1.2.4. Empirical applications and health capability economics

The health capability profile has been partially employed to study women's political participation in India (27), and adapted to reframe addiction as capability failure (28). However, an in-depth empirical application would require that the profile be adapted to the specific context and health issue under investigation, and to be documented as a whole. Consequently, health indicators that enter the profile's capability of health functioning – the first of the fifteen health capabilities – would be one of many outcomes under consideration. In the broader field of economics, this would lead to a shift from health economics – where health status measures and indicators, or only health care measures and indicators, are the (main) independent variables, to health capability economics, with multidimensional and inter-related outcomes.

Indeed, Prah (2015) advances health capability economics as an emerging field (18). One of its key features is to move away from market competition and self-interested maximizations of rational individuals, in order to better incorporate ethical considerations and societal concerns (altruism, trust, cooperation, institutions) in health. It builds on the notions and principles established in the "heath capability paradigm"(23), including central health capabilities and shortfall inequality, on the conceptual framework of the health capability *model*, and on the elements detailed in the health capability *profile* to address current health issues (26).

2. Empirical setting

2.1. Rural Senegal and the Niakhar Health and Demographic Surveillance System

Senegal is a country in Western sub-Saharan Africa, with a population of over 17 million inhabitants, a 24.9 billion USD gross domestic product in 2020, which ranked 167th out of 189 countries as per the Human Development Index (29). In Senegal, more than half of the population lives in rural areas.

Figure 3. Location and administrative map of Senegal

2.1.1. The Senegalese cash transfer program (PNBSF), and program for universal health insurance (CMU)

In 2013, Senegal launched both a national cash transfer program ("*Programme National de Bourses de Sécurité Familiale*" – PNBSF) and a program for universal health insurance ("*Couverture Maladie Universelle*" – CMU). Currently in its fourth phase, the PNBSF provides quarterly cash transfers of 250,000XOF (about 400 USD) to households locally identified as the poorest, conditional on school enrollment. The implementation of the PNBSF is conducted the Ministry of Community Development, and Social and

Territorial Equity (*Ministère du Développement communautaire, de l'Equité sociale et territorial*) also now in charge of the deployment of the CMU program (30)[3].

The CMU program relies on the combination of several components presented in Figure 4. First, free health-care initiatives are limited to specific populations or health services: fees for consultations and medications for children under five and the elderly (over 60 years old), Cesarean delivery – but not vaginal delivery – and dialysis are fully covered in public health facilities. In addition, public servants benefit from a medical scheme and formal employees and their dependents benefit from a mandatory employer-based insurance[4], who together represented an estimated 11% of the population in 2018 (31). On paper, individuals recognized as "indigents[5]" following a casework, either by the prefecture or the hospital social services, can also apply for *ad hoc* waivers of healthcare invoices. The remaining 50% of the population not covered by other schemes, including workers from the informal sector, are supposed to be covered by community-based health insurance (CBHI) schemes, though membership is on a voluntary basis.
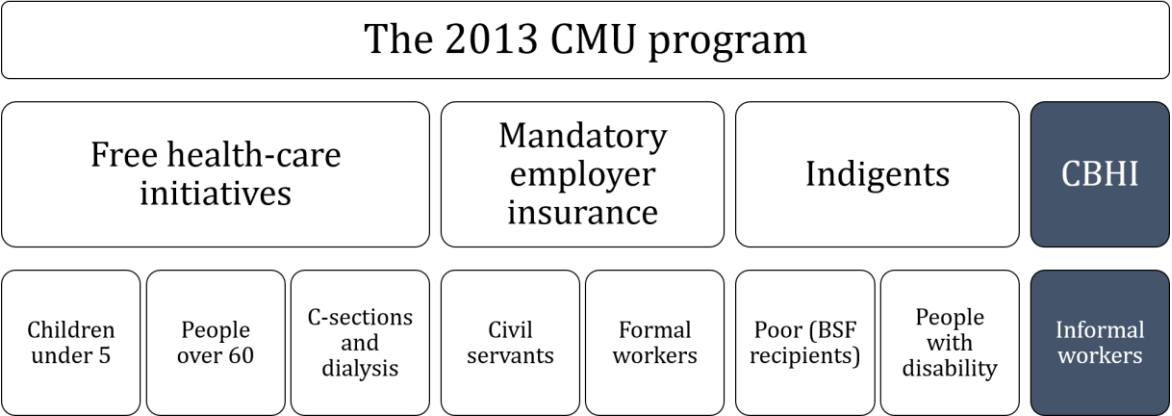
Figure 4. Components of the 2013 CMU program

The government subsidizes 50%, 71% and 100% of CBHI's insurance premiums for regular, elderly, and indigent members, respectively[6]. Membership to a CBHI is annual and provides 80% subsidy on generic drugs and health-care user fees at the contracted local facilities and 50% subsidy on branded drugs in local pharmacies, which have an agreement with the CBHI.

Two types of CBHI schemes have been implemented: DECAM municipality-level CBHI (*Décentralisation de l'assurance maladie*) and the UDAM 'Departmental Health Insurance Units' (*Unité départementale d'assurance maladie*). The DECAM were the first to be widely deployed with a municipality-level model based on volunteer management (32), though with limited success in improving universal health coverage, in part due to low and

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[3] The CMU program was previously implemented by the Ministry of Health and Social Action (Ministère de la Santé et de l'Action Sociale).

[4] The civil servants' scheme covers fees in the referral hospital, health posts and dispensaries but not private pharmacies, unlike the mandatory private sector health insurance, which covers all these.

[5] Indigents refer to the poor (including, but not limited to, recipients of the PNBSF national cash transfer program) and people with disability.

[6] The government also covers 100% of CBHI premiums for members under 5 years of age.

discontinuous enrollment (33,34). In contrast, the professionalized departmental-level UDAM established in the rural departments of Foundiougne and Koungheul have demonstrated administrative and financial viability following the closure of the 4-year project initially funded by the Belgian cooperation (35).

2.1.2.   Brief history of the study setting

The Niakhar Health and Demographic Surveillance System (HDSS), located 150 kilometers southeast of the capital, Dakar, is a 60-year-old demographic observatory covering 30 rural villages and over 45,000 inhabitants (36). Research activities within the Niakhar HDSS include annual recording of the birth, marriages, deaths and migrations of its population, and the regular implementation of surveys and controlled (vaccination) trials (37).

Accordingly, the Niakhar HDSS has been described as a "laboratory" for research in health and social sciences, and undoubtedly constitutes a "study site with a [specific] history"(38). Indeed, people living in the Niakhar HDSS are accustomed to be offered participation in various studies, with memories of research fueling either trust (through continuous partnership), or distrust (in villages with memories of bad research experiences)(39). This exposure to repeated studies and health interventions is likely to have affected the population's health-related knowledge and beliefs. For example, Faye's study on representations of malaria in children revealed an elaborate syncretism between traditional fears of curses and allergies to pollen, and biomedical knowledge of the mosquito as a vector of fever associated with serious attacks and complications (40).

2.1.3.   Key features of the study population

Over 90% of residents of the Niakhar HDSS are of Sereer sining ethnicity (Sereer of the Sin region). Among Sereer sining, housing units (concessions, or *mbind* in Sereer) encompass one or several production units (*ngak* the Sereer for "kitchen", meaning people who eat together, hereafter household) (41). Compared with other rural Senegalese societies, Sereer sing women have a preponderant role in managing domestic activity and resources. Women also participate in the agricultural production, and many of them undertake seasonal migration from a very early age to work as servants ("*bonnes*") in urban areas (42).

In the Niakhar HDSS, migration is a widespread phenomenon, and often the result of a collective strategy to cope with a shortage of arable lands and the slow deterioration of agricultural and pastoral practices and yields. Temporary migrations, where individuals leave for a specific activity but are still considered as full-fledged household members, are especially common. However, even permanent migrants to other regions of Senegal or countries still contribute to the household's revenue, in particular to cover wedding's dowries and funeral expenses.

2.1.4. Health facilities in the Niakhar HDSS

The Niakhar HDSS counts three semi-urban villages, Diohine, Toucar, and Ngayokheme, where health dispensaries are located – they are indicated with red crosses on the map of Figure 5. In Senegal, health dispensaries are the first level of permanent health facilities: they are run by a chief nurse ("*Infirmier chef de poste*", ICP), alongside an assistant nurse, a midwife, and community healthcare workers (matrons, "*relais*" and *bajenu gox*). The second level of health facilities is health centers (posts) with at least one physician working there. Inhabitants of the Niakhar HDSS of the Ngayokheme municipality (in green on the map) go to the Niakhar health center located in the town Niakhar, just outside of the area. People living in the Diarère municipality (in beige on the map) go to the center located in the city of Fatick– 10 km away by paved road, where the regional referral hospital is also implanted. Health centers and the hospital are indicated with blue and green crosses respectively. Municipalities also determine affiliation to either the Ngayokheme or the Diarère DECAM offices (indicated with stars).
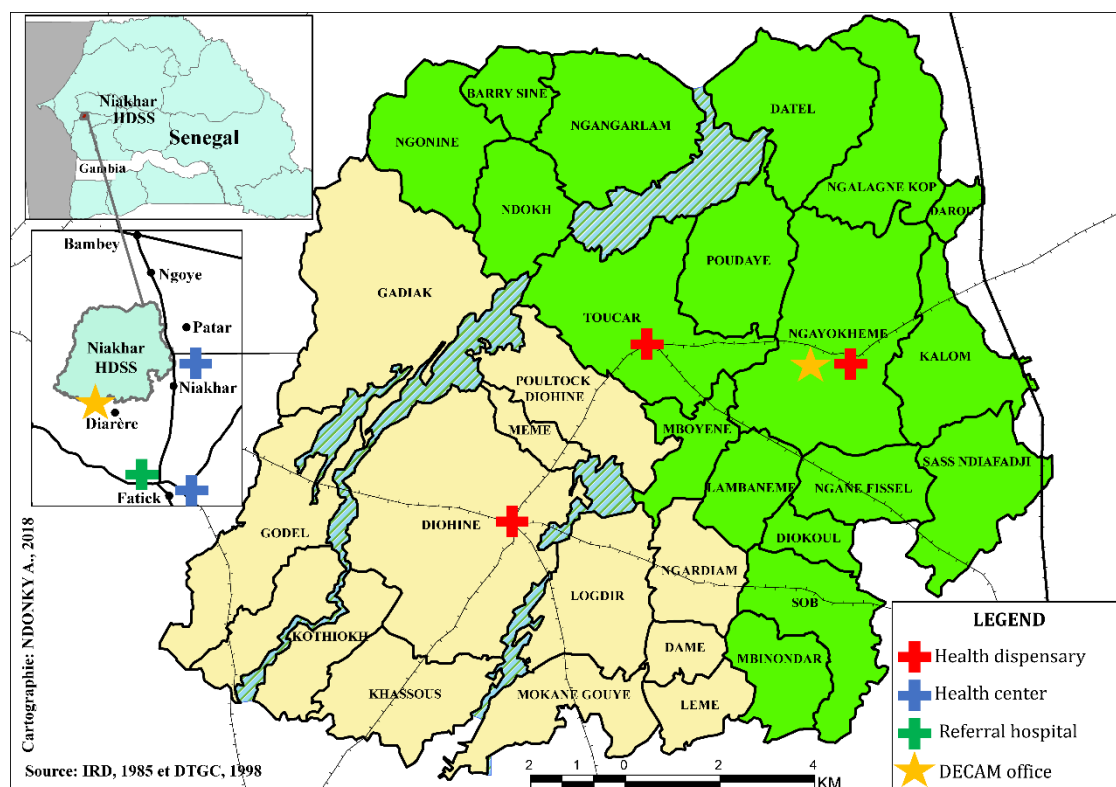
Figure 5. Map of the Niakhar HDSS and nearby health facilities[7]

This thesis analyzes data collected as part of two recent empirical studies conducted in the Niakhar HDSS.

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[7] Curtesy of A. Ndonky

2.2. Empirical studies

2.2.1. Chronic hepatitis B in rural Senegal: the AmBASS-PeCSen study

Worldwide, chronic hepatitis B (CHB) is one of the most deadly infectious diseases preventable through vaccination, and the one that has the highest burden in Senegal, with an estimated 8-10% of the population affected (43). In sub-Saharan Africa, Senegal was the first country to set up a program dedicated to addressing viral hepatitis in 1998. It introduced a 3-dose vaccination schedule in 2003-2004, with an additional dose to be administered within 24 hours of birth since 2016 (44). The region of Fatick, where the Niakhar HDSS is located, was chosen as a pilot for the decentralization of CHB management at the regional level, which was launched in 2018 (see Figure 6). The 2019-2023 strategic plan jointly designed by the Hepatitis Program and the Ministry of Health identifies the following priorities: raising awareness, strengthening epidemiological surveillance, preventing transmission, and, finally, improving diagnosis and treatment (45).

| 1998 | National Viral Hepatitis Program | 2004 | Hepatitis vaccine in the EPI | 2016 | Hepatitis vaccine at birth | 2018 | Decentr-alization of CHB care |
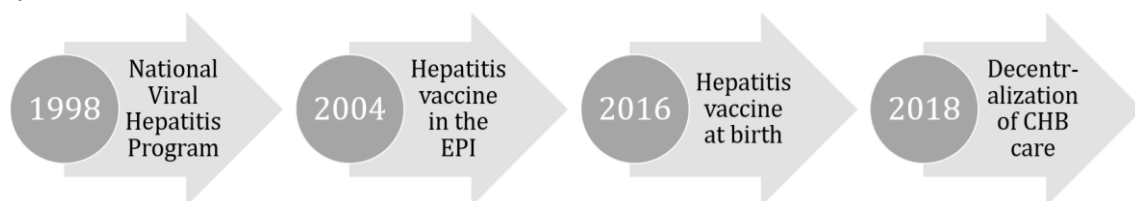
Figure 6. Timeline of the implementation of CHB-relevant policies in Senegal

The ANRS12356 AmBASS survey aimed at evaluating the prevalence and socioeconomic burden associated with CHB infection in the general population, in rural sub-Saharan Africa. Between October 2018 and July 2019, 300 households were randomly selected in 12 villages of the Niakhar HDSS, and all their residents were invited to participate in at-home testing for CHB infection using dried blood spots and administered socio-economic questionnaires (46).

Following post-test counseling and result delivery, CHB patients were offered a clinical examination and full biological check-up to assess the stage of their disease and treatment eligibility, and referred to the healthcare system for follow-up and management(47). Patients were referred to the local health centers or to the regional hospital if eligible for treatment. In addition, those with a positive viral load were offered to join the Sen-B prospective cohort at the Fann hospital in Dakar to benefit from free follow-up.

After initial referral, the PeCsen study documented linkage-to-care and subsequent visits for over 2 years, between July 2019-February 2022 (indicated in orange squares in Figure 7). In the Fall of 2021 and Spring of 2022, an anthropologist (female, 39) and facilitator (female, 62) conducted in-depth individual interviews with former AmBASS participants, also as part of the PeCSen study. Participants were selected following

purposeful sampling to obtain a diversity of profiles (gender, age, education level, occupation, CHB status, and therapeutic itinerary).
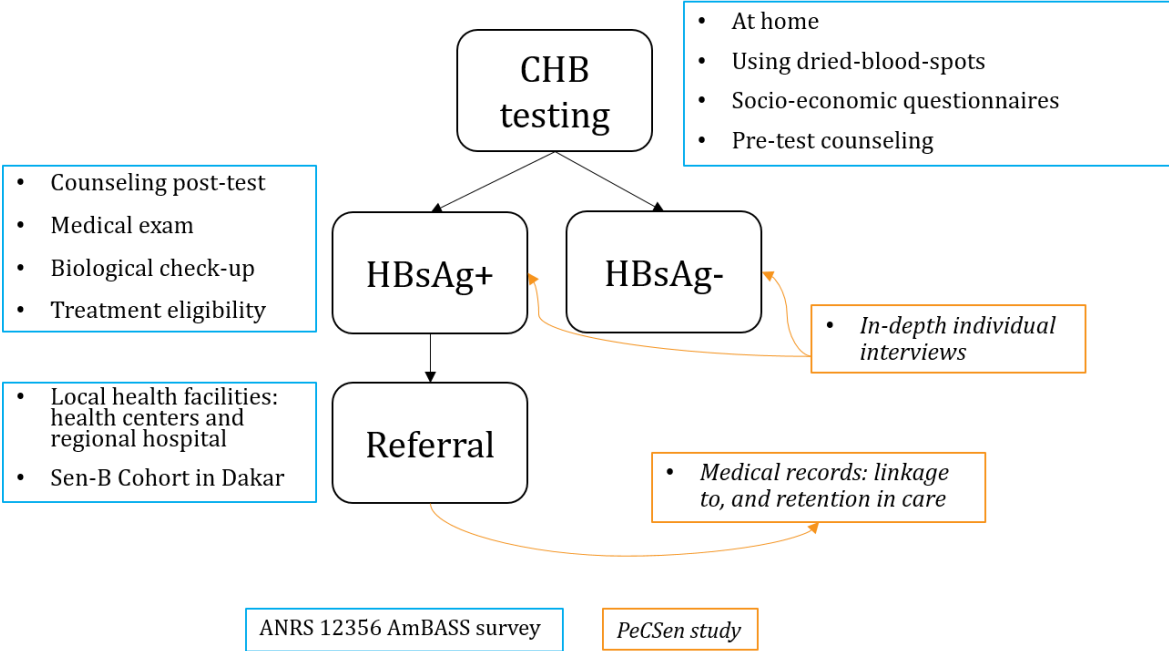
Figure 7. Sequence and data collection of the AmBASS-PeCSen study

The PhD candidate worked as a project manager for the ANRS12356 survey. In this position, she contributed to the final design of the data collection tools and procedures, oversaw the pilot study, and conducted frequent monitoring visits on the field. After data collection was completed, she cleaned the household and adult questionnaires' datasets and significantly contributed to the elaboration of, and funding application for the PeCSen study. She personally handled the management of the project and oversaw recruitment, training, data collection, and analysis.

As part of the PeCSen study, she interviewed community healthcare workers, nurses and physicians in charge of CHB management and conducted surveys in all the health facilities involved in CHB management to document the availability of human and monetary resources and equipment. All data collection tools, specifically questionnaires administered as part of the AmBASS survey, interview guides and the health facility survey are presented in the final Appendix at the end of the manuscript.

2.2.2. Evaluation of the DECAM system: the CMUtuelleS survey

The CMUtuelleS survey documented the implementation of DECAM in the Niakhar HDSS. Participants were selected among three groups: (1) voluntary subscribers to the DECAM scheme (exhaustive sampling), (2) beneficiaries of the PNBSF, which includes eligibility to free enrollment at the local DECAM office, and (3) control participants that neither were PNBSF recipients nor enrolled in a DECAM scheme. In total, 1787 adult participants living in 1002 households were recruited. A household level questionnaire

administered to the head of the household or nearest available member documented socio-economic and demographic information and expenditures over the past 12 months. In addition, all participants reported their economic status, health and quality of life, health insurance status, knowledge and preferences, utilization and perceived quality of health services as well as standard socio-demographic characteristics in an individual adult questionnaire[8]. The questionnaire also documented self-reported awareness of eligibility to free subscription in the DECAM system among PNBSF recipients, so as to differentiate effective PNBSF-based enrollment versus *de jure* eligibility to such enrollment (48). The PhD candidate participated in the elaboration of the CMUtuelleS survey questionnaire, and introduced the section on perceived barriers to healthcare seeking.

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[8] Some participants to the CMUtuelleS survey were also randomly selected to participate in a module on behavioral economics, which is not part of this work.

3. Research questions and outline

There is no literature on how to apply health capability to study health topics in a specific empirical setting. This is the gap that this thesis aims to fill through the investigation of issues relevant to the United Nations Sustainable Development Goals (SDG) of "ensuring healthy lives and promoting well-being for all at all ages"(49), in the context of rural Senegal.

The overall methodological objective of this dissertation is to present empirical studies of health capability – as conceptualized into a model and operationalized into profile by Prah (2010) – that can serve as examples. This work also aims to assess the value-added of such health capability studies, and the extent to which they address some of the concerns about limitations of conventional approaches.

Additionally, this work addresses the following empirical research questions:

- How can we ensure healthy lives for all at all ages? Are there different groups of people who should be targeted by public policies for health promotion, why, and how should they be targeted?
- How is the health capability profile of individuals living with CHB optimized? How can we prevent morbidity and mortality secondary to CHB, through policy and programmatic changes at the individual, regional, and institutional levels?
- How can we measure progress towards and deficits in *ability to* access health facilities and health services – a main aspect of universal health coverage?

These empirical questions are tackled through three self-contained and interrelated studies, which fit in with the SDG 3 of "Ensuring healthy lives" (*ibid*) – as displayed in Figure 8.

In the first chapter, I address the first set of empirical questions by considering the concept of health capability as defined in the health capability model to unpack the puzzling relationship between household poverty and individual health outcomes. To do so, I build on studies that employ structural equation model (SEM) strategies to estimate capabilities as latent variables (50–53). Specifically, I estimate three latent variables corresponding to dimensions of the health capability *model* developed by Prah (2010)(26). The three latent variables are health status (corresponding to biological capital), perceived obstacles to healthcare seeking (measuring the health care system's dimension), and empowerment in decision-making within the household (as a proxy for the intermediate social context). These dimensions are estimated on 725 adult individuals living in a small rural area in Senegal (ANRS12356 AmBASS survey dataset) – the local feature of the dataset does not allow for modelling heterogeneity in the fourth dimension; *viz.*, the macro-level environment. The model seeks to identify, and investigate heterogeneity in, variables associated with shortfalls in the three health capability

dimensions, while accounting for interactions among them. This offers a new methodology to simultaneously identify people experiencing shortfalls in health status, empowerment, and healthcare access, which can then be employed to implement differentiated yet complementary policies for "ensuring healthy lives" as per the 3rd SDG (see Figure 8). This chapter also provides an illustration of the value-added of considering the conceptual health capability model for health policy and practice.

The second chapter moves onto the application of the health capability *profile.* The *profile* is applied in the same empirical context to tackle the second set of empirical questions, i.e. the elimination CHB-related morbidity and mortality. Specifically, the study presents a detailed methodology for the adaptation of the health capability profile's framework to people living with CHB in rural Senegal. The study design relies on a two-stage data collection, and on the integration of both quantitative (in the general population through the ANRS 12356 AmBASS survey) and qualitative data (40 in-depth individual interviews). Data collection involving local community healthcare workers and health professionals provides additional information on the external health capabilities, and resources available within local health facilities. Data analysis is multilayered. It includes the development of flow diagrams to document comprehensive health capability profiles at the individual level. Health capability scores measure levels of development in each of the fifteen health capabilities and a crosscutting analysis summaries strengths and weaknesses at the health capability level. This study, therefore, contributes to informing behavioral and policy changes in line with target 3.3 of SDG 3, which sets to "end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and *combat hepatitis*, water-borne diseases and other communicable diseases" (49). It also constitutes the first example of a comprehensive empirical application of health capability using the profile.

The third study focuses on the external capability n°14, specifically the utilization and access of health services relates to target 3.8 of SDG 3 committing to "achieving universal health coverage" (UHC) (49). In the profile, this health capability encompasses people's ability to obtain, and the absence of barriers to access and utilize health services when needed (agency n°2 and n°3, respectively). This chapter builds a score of perceived obstacles to medical care (PBMC score) as a measure of these elements. This score is computed following stepwise descendant exploratory analysis using data from 1787 adults living in the Niakhar HDSS (the CMUtuelleS survey). The score's predictive validity is assessed with respect to foregoing of health consultation and treatment, health utilization among individuals having experienced a recent episode of illness, and among women with a live birth in the past two years. Finally, the structure and external validity of the score are confirmed in the AmBASS dataset. This chapter thereby complements Prah's (2012) alternative framework to document financial protection in health (54) in offering a novel measure for another important aspect of UHC attainment.
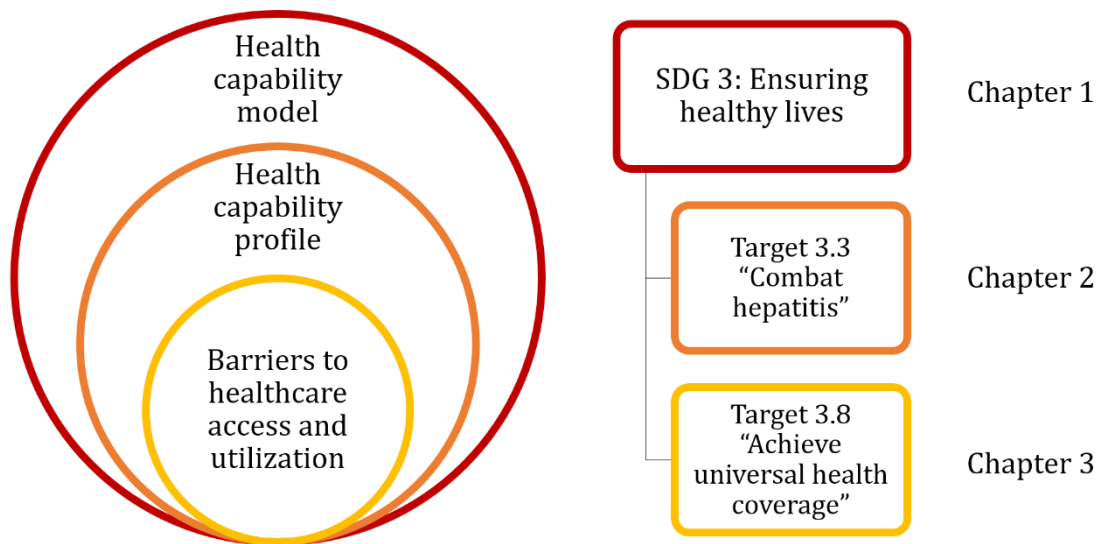
Figure 8. Outline of the health capability studies in relation to SDG 3 and its targets

A final section offers a general discussion, reflecting on the contributions of this thesis, its research and policy implications. This chapter also discusses some limitations of the current work and results. It highlights perspectives for future research and concludes by advancing policy recommendations.

Chapter 1: Structural Equation Modeling of Health Capability[9]

Abstract

What should be the focus of health policy and interventions in sub-Saharan Africa? Despite the well-documented relationship between economic resources and health outcomes, recent evidence demonstrates that people with health needs are primarily not found in poor households. This paper considers the health capability model to investigate the relationship between individual-level and household poverty and health outcomes through the estimation of a structural equation model (SEM). The SEM strategy allows the estimation of three health capability dimensions as latent variables from observed indicators (measurement model) on 725 adult individuals interviewed in the AmBASS survey. The structural part of the model identifies variables associated with shortfalls in each of these health capability dimensions, while accounting for interactions among them. The results reveal empowerment increases with *individual earnings*, and is significantly associated with improved health status whereas individuals living *in resource-rich households* are more likely to experience lower levels of empowerment, while reporting better health, and optimal access to health services. This suggests that empowerment is a missing puzzle piece in the complex relationship between health and poverty in rural sub-Saharan Africa. The results also highlight significantly differentiated needs among sets of capability conditions: access to healthcare is impeded in households with limited resources and in rural villages; health status is suboptimal in older individuals and members of larger households; and empowerment is lacking in younger, single, childless individuals, those living in agricultural households, or in semi-urban villages. In addition, the model identifies cumulative vulnerabilities in women and permanent residents. A SEM-based consideration of health capability dimensions therefore offers a way forward of pinpointing individuals by focusing on a differentiated yet complementary set of policy and interventions for the promotion of health status, decision-making latitude, and access to healthcare, respectively.

JEL classification: C31, I14, N37.

Keywords: poverty; empowerment; access to health care; health status; health capability; structural equation model; sub-Saharan Africa; Senegal.

1. Introduction

It is well documented that socio-economic conditions and resources affect health, and that poor people experience significantly worst health outcomes (11). In particular, a number of studies have provided evidence of a causal relationship between income and life expectancy (55,56). In sub-Saharan Africa (sSA), most policies and interventions for health promotion have aimed at reducing poverty, for instance through cash transfer programs, and/or have targeted people or groups of people who experience higher levels of poverty. For example, since 2013, Senegal has been implementing a cash transfer program for poor households *(Programme National de Bourses de Sécurité Familiale – PNBSF)*, which includes free subscription to community-based health insurance schemes. However, results from a 2019 study conducted across 30 countries in sSA suggest that health-oriented social programs targeting households with lower resources might be missing most of their targets (57): the authors show that nutrition-based programs for poor households would be mostly reaching individuals who are adequately nourished[10].

Several elements might explain this conundrum. First, these programs are offered at the household level. In sSA, households are complex units in which a large number of individuals pool together a variety of resources, including agricultural production, housing, durable goods and monetary resources. The latter may encompass income from household members who are employed – in a context where a great number of workers have informal and/or seasonal jobs – and remittance from relatives who live away, or abroad[11]. Income therefore only provides a partial, and sometimes inaccurate, account of the household's socio-economic conditions, which has prompted the development of multidimensional measures of poverty (59). Contrasting income poverty with multidimensional poverty allows for a more accurate identification of households that can be considered as poor (60).

However, household-level multidimensional measures of poverty fail to address another concern, specifically the existence of intra-household inequalities (61). For example, a recent study using disaggregated consumption data in Senegal sheds light on significant intra-household consumption inequality, and provides evidence of its impact on individual poverty statuses[12] (63). This has led to attempts to develop measures of poverty that are, all-at-once, context-specific, individual-level and multidimensional (64–66).

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[10] According to their estimations, only 40% of children in the poorest households are stunted and only 15% of women are underweight.

[11] Remittances can have a significant impact on, and out of, poverty (58).

[12] The authors find that intra-household consumption inequality make up for 14% of total inequalities in Senegal. A previous study also identified a relationship between intra-household inequality and individual poverty risk in highlighting heterogeneous impacts of adult death on economic outcomes for children(62).

The misalignment between household-level poverty and individual health needs may also lie in the existence of other factors that play into people's health. More broadly, this argument relates to Sen's seminal Tanner lectures on "Equality of What?", in which he critiques narrow analyses focusing on the *means* or resources available to people (19). He, instead, urges a focus on the *ends and the means*, the 'doings' and 'beings' that people are able to achieve with those resources – their capabilities. For example, in the context of low and middle income countries (LMICs), empowerment within the household has been identified as an important determinant of women's health and well-being, independently from household resources (67,68).

Latent variables approaches and structural equation models (SEM) have been presented as an adequate framework, both conceptually and econometrically, to estimate, and explain capabilities (53). SEM have been applied to estimate basic capabilities in specific countries and populations, such as Bolivian children (knowledge and living conditions) (51), women in West Bengal (health, autonomy and knowledge) (50), or young people in the occupied Palestinian territories (health awareness, living conditions and utilities) (52). However, none of these studies explicitly modelled dimensions of health capability in the general population.

This chapter investigates the following research questions: can a multidimensional model of health capability unpack the relationship between household poverty and individual health needs, and inform the role played by empowerment? Can these results inform how to focus policy and interventions for health promotion?

2. Methods

2.1. Econometric model

The econometric model is adapted from Krishnakumar and Ballon's estimation of capabilities using a SEM strategy (51). The different dimensions of health capability are modelled as latent variables and estimated using 'indicators' (questionnaire items), which correspond to functionings in the original model (see Figure 9).
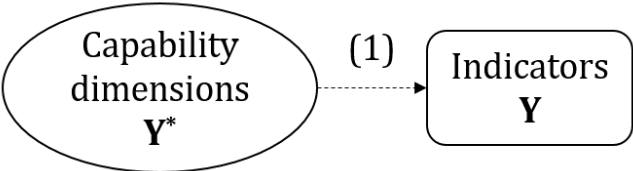
Figure 9. Measurement part of the econometric model

In the structural part of the model, the capability dimensions interact with each other to create an *overlapping* health capability model(26). They also interact with demographic and socio-economic variables ('exogenous variables'). The full model is represented in Figure 10.
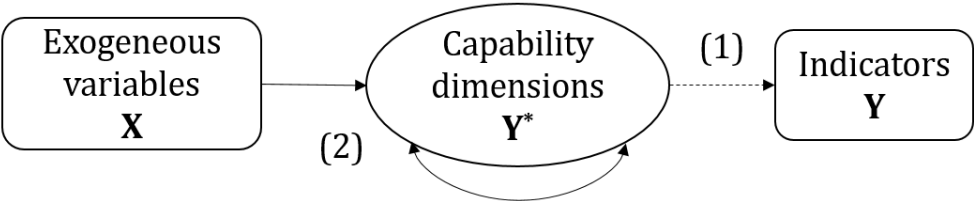
Figure 10. Full econometric model

Accordingly, in a first set of equations, the measurement part of the model, or qualitative response model, analyzed the relationship between observed variables (i.e., indicators) (Y), and corresponding health-related capabilities (latent variables, Y^*) for individual i.

$$(1)\ Y_i = v + \Lambda Y_i^* + \xi$$

The measurement part used a confirmatory factor analysis (CFA), which is the preferred method to confirm or reject a given theory, in this case the HCM (69). In addition, an exploratory factor analysis, a technique usually performed to generate new

data-driven models, was conducted for robustness check purposes. In order to select the final set of indicators for each of the dimensions in the CFA, correlation matrices are examined. Redundant items (values > 0.85 in the correlation matrix) were combined to create a new variable. Internal consistency; i.e., the extent to which a given set of items relates to a unique concept, was assessed using the Cronbach alpha reliability test, with values above 0.8 considered to represent good internal consistency (70).

The second part of the model, the structural part, consisted of a set of equations that specifies latent variables (Y^*), one for each capability dimension through interactions with the other two capability dimensions, and with a vector of exogenous socioeconomic and demographic variables (X).

$$(2)\ Y_i^* = \alpha + \beta Y_i^* + \Gamma X_i + \varepsilon$$

The econometric model's identification strategy comprised two steps. First, drawing from Abu-Zaineh and Woode (52), all exogenous variables were introduced as direct effects on each of the three health capability dimensions in a Multiple Indicator Multiple Causes (MIMIC) model. Only direct effects between exogenous variables and latent capabilities significant at the 10% level were retained in a final model in which interactions between latent factors are introduced. Introducing these interactions was essential to account for the overlap between the different health capability dimensions theorized by the HCM. The variance of latent variables was fixed at 1 to allow for identification.

In line with the literature on SEM, the χ^2 test, the Root Mean Square Error of Approximation (RMSEA) (71), as well as the Comparative Fit index (CFI) (72,73) and the Tucker-Lewis Index (TLI) (74) were all used to evaluate the goodness-of-fit of the model. Even though authors have warned against using strict thresholds to evaluate the goodness of fit (75–77), it is generally agreed that a RMSEA value below 0.05 together with CFI and TLI values above 0.97, indicates a good fit of the model. Analyses were performed with the MPlus software version 7.2 using oblique rotations and means and variance-adjusted weighted least squares (wlsmv) estimations, which have been found to provide reliable results with categorical indicators in the absence of missing data (78–81).

2.2. Empirical application

The study employs data from the ANRS 12356 AmBASS cross-sectional survey, which was conducted between October 2018 and July 2019 in 12 of the 30 villages covered by the HDSS to document the burden of chronic hepatitis B (CHB) virus infection in the area (46). Three-hundred households were randomly selected to be representative of the area's population in terms of gender and age groups. All residents in these households were invited to participate in the study, which included CHB testing and the collection of socioeconomic data. Heads of household or next of kin were interviewed to collect data on agricultural production and household resources. Short standardized individual

questionnaires were administered to the parents or legal guardians of 1,588 participants born after 1 September 2003 (hereafter children), while older participants (n=1,530, hereafter adults) answered a more detailed questionnaire, including items on demographic and socioeconomic characteristics, self-reported health status, and healthcare use and consumption. An additional module on health-related capabilities was included halfway through data collection and administered to 724 participants born before 1 September 2003 (hereafter adults), who constituted the study sample in the present analysis.

2.2.1. Capability dimensions: definitions and measurement

In the HCM, health capability is placed at the crossroads of four inter-related dimensions, and should be measured at the individual level to encompass people's perceptions and life experiences (26). As the AmBASS survey was restricted to the Niakhar HDSS, its dataset does not document individual differences for one of the HCM dimensions, specifically the economic, political and social environment at the regional or national levels. However, it does provide valuable information about the three other dimensions through people's self-assessment of their: (i) **health status** (measured by current self-reported health); (ii) **healthcare access** (measured by perceived barriers to access healthcare services), and (iii) **empowerment** within their intermediate social context, measured by decision-making latitude within the household (see Figure 11).
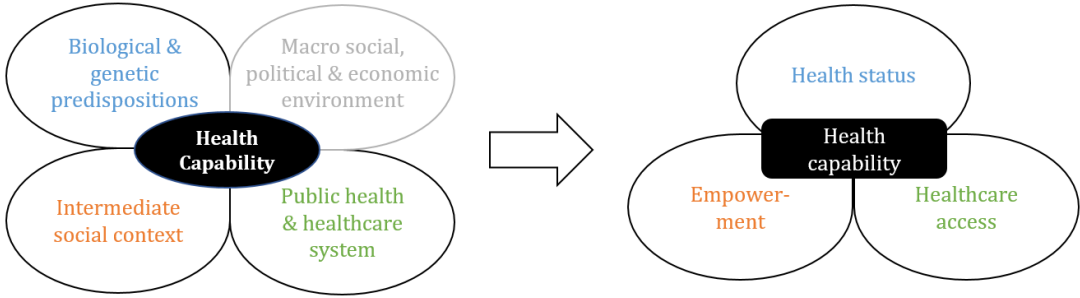
Figure 11. Adaptation of the health capability model to the AmBASS dataset

The questionnaire module on self-reported **health status** included all 12 questions from the Short Form Health Survey version 2 (SF12v2) (82), a revised, and shortened adaptation of the SF36, one of the most commonly used surveys for collecting self-reported data on health-related quality of life. Current self-reported health was assessed for 8 components (physical functioning, role-physical, role-emotional, mental health, bodily pain, general health, vitality, and social functioning). The ANRS 12356 AmBASS questionnaire also contained a question on current fatigue ("*Can you evaluate your current level of fatigue: are you not at all tired, a little tired, very tired, or exhausted?*"). These nine

components were recoded into nine binary variables coded 0 to indicate a shortfall (for example, any non-zero level of fatigue), or 1 for an optimal level (not at all tired).

People's ability to **access healthcare** services was estimated through perceived barriers to accessing local healthcare services. Drawing from phrasing used in Demographic and Health Surveys (83), participants were asked "*When you are sick, or when you look for health-related information, are any of the following a big problem, a small problem, or no problem at all: (1) knowing where to go, (2) getting permission to go, (3) getting the money to pay, (4) the distance to the healthcare facility, (5) having to find transportation, and (6) not wanting to go alone*". Binary variables with the value 0 documenting a shortfall in access to care (small or big problem), and 1 indicating an optimal level (no problem at all) were derived from these answers.

Individual decision-making latitude is a useful proxy to investigate underlying social norms, as well as people's **empowerment** within their household and community (67,84). In the AmBASS survey, it was measured using the four DHS-based "final say" questions: "*In your kitchen, who has the last word when a decision needs to be made about (1) your own health, (2) daily life (food, meals, work, etc.), (3) a major purchase (equipment, cattle), and (4) visiting friends or relatives: you, you together with someone else, or someone else?*". These responses were recoded as binary variables with the value 0 when there was a shortfall in decision-making participation (someone else had final say), and 1 when the individual had a say (either alone or with someone else).

2.2.2.   Economic resources and measures of poverty

Asset indices were computed via multiple component analysis as weighted sums of categorical variables for whether a household possessed certain assets or characteristics (85,86). They summarized the household's living standards and agricultural resources, respectively (for more details on the construction of the indices see Appendix A1). Lower levels on these indices can be interpreted as the household being relatively more poor, with respect to the dimension (i.e. living conditions or agricultural resources), compared to other households in the Niakhar HDSS.

Earnings over the past 12 months were recorded in the AmBASS survey through household and individual questionnaires (46). Individual earnings were documented as the sum of income from paid farm work, independent agricultural work, and from other economic activity (including temporary and/or informal work) in the past 12 months in all adult participants. A variable of household monetary means was computed as the sum of earnings from sales of agricultural production (millet, peanuts, niebe, bissap and other crops) and sales of livestock (fowl, small stock and cattle), money from relatives and abroad, PBNSF grant money, rental income, and all individual earnings of adult household members, over the past 12 months. The ratio of this sum on the number of household residents yielded per head monetary means. Natural logarithm of these monetary measures entered the structural part of the model.

Data at the household level also included household size and recipient status for the Senegalese cash transfer program for low-income families (PNBSF) at the time of the

survey. In addition, two binary variables documented the economic status of individual participants, specifically sole ownership of a field for farming, and economic activity outside of common household fieldwork (here after 'non-agricultural activity').

2.2.3.   Other socio-demographic variables

Participants in the AmBASS survey provided standard demographic information including their age, gender, matrimonial status, and parental status. The standardized individual questionnaires also documented education level, and village of residency (rural or semi-urban (i.e., Ngayokheme, Toucar or Diohine where semi-urban facilities are located)). Finally, a variable for temporary migration recorded absence from the Niakhar area for between eight days and six months for work or study purposes in the previous year.

3. Results

3.1. Sociodemographic and economic characteristics of the study population

Participants were between 14 and 89 years old, with a median age of 35 (see Table 1). Most of them (57.2%) were women, 421 (58.2%) were married, and 428 (59.4%) had at least one child. Just over half had received primary education, but only 15.9% had attended secondary school. The majority (56.2%) lived in one of the three semi-urban villages covered by the HDSS, and over a quarter of participants were sole owners of a field for farming, in addition to a common field shared with other members of the household. Approximately one third of participants (34.7%) had temporarily left the Niakhar area for work or study purposes in the previous year, and 27.9% had a job other than farming. One in seven (17.3%) participants lived in a household that received the PNBSF. Household size ranged from three to 34 members, with a mean of 16 members. Mean sum and per head household monetary means were about 1,800,000 XOF (2,700 USD) and 110,000 XOF (165 USD) respectively. The agricultural resources index, and living conditions index averaged at 0.11 and 0.17 in the study population.

Table 1. Description of the study population (n=724)

	N (%) Mean [s.d.]
Individual variables	
Age (years)	35 [17.5]
Gender	
Men	310 (42.8)
Women	414 (57.2)
Married	421 (58.2)
Parent (at least one child)	428 (59.4)
Education	
No formal education	344 (47.8)
Primary school	262 (36.4)
Secondary school and above	114 (15.8)
Village of residency	
Semi-urban	407 (56.2)
Rural	317 (43.8)
Temporary migration	251 (34.67)
Sole owner of a field for farming	184 (25.4)
Non-agricultural job	202 (27.9)
Individual earnings	191,606 [647,169.4]
Household variables	
BSF recipient	127 (17.5)
Household size	16.2 [6.6]
Sum of household monetary means	1,807,149 [4,466,242]
Per head household monetary means	109,351.7 [223,874.5]
Agricultural resources index	0.11 [1.09]
Living conditions index	0.17 [0.94]

s.d.: standard deviation.

3.2. Descriptive analysis and internal consistency of the capability dimensions

Sets of items to estimate each of the three health capability dimensions studied were selected after examination of the correlation matrix (combination of items with values > 0.85) and Cronbach's alpha coefficients. Results are displayed in *Table 2*. Further details are available in Appendix A2.

Table 2. Final selection of items to estimate health capability dimensions

Health capability dimension	Nb. of items	Cronbach's α coefficient	Correlation Matrix [Min-Max]
Health status	3	0.8110	0.5171-0.6749
Healthcare access	5	0.8659	0.4910-0.7440
Empowerment	4	0.8724	0.5223-0.7765

For **health status**, the final set comprised a role-physical and role-emotional combined variable, bodily pain, and social functioning. This set yielded a Cronbach's alpha coefficient of 0.8110, indicating good internal consistency. The correlation matrix had values between 0.5171 and 0.6749, suggesting no redundancy. Among the study participants, over a third (37.3%) declared a shortfall in role-physical or role-emotional, 142 (19.6%) said that bodily pain interfered with their normal work, and a quarter (24.8%) reported interference with their social life (see *Table 3a.*).

The highest Cronbach's alpha coefficients (0.8283) were obtained with five items documenting perceived as barriers to **accessing healthcare services** (see *Table 3b*). The correlation matrix did not identify redundancies or outliers (values ranging from 0.4918 to 0.7440). The main participant-reported barriers to **healthcare access** were the distance to the healthcare facility (25.1%) and transportation (20%). Just over one hundred individuals (14.4%) declared that not wanting to go alone to a healthcare facility was a problem, while 13.7% declared they found it difficult to know where to go. Finally, 95 participants (13.1%) mentioned problems getting permission to go and seek healthcare.

The four-item set for **empowerment** exhibited very good internal consistency with a Cronbach's alpha coefficient of 0.8724. In addition, with values between 0.5223 and 0.7765, the correlation matrix did not indicate any need to combine or eliminate any of the items. Almost half the participants (48.8%) declared they had no say in decisions about their household's daily life, and 338 (46.7%) reported no participation in decisions about major purchases (see Table 3c.). Two-hundred and seven (28.6%) said they did not participate in decision-making concerning their own health, while 170 (23.5%) declared they had no say about going to visit relatives or friends.

Table 3. Descriptive statistics of the indicators selected to estimate capability dimensions in the study population (n=724)

Indicators	N *(%)*
a. Health status	
Role-physical and role-emotional *(m=5)*	
Shortfall	*270 (37.3)*
Optimal	*449 (62.0)*
Bodily pain *(m=1)*	
Shortfall	*142 (19.6)*
Optimal	581 (80.4)
Social functioning *(m=10)*	
Shortfall	177 (24.8)
Optimal	537 (75.2)
3b. Empowerment	
Decisions about health	
No participation	207 (28.6)
Participation	517 (71.4)
Decisions about daily life	
No participation	353 (48.8)
Participation	371 (51.2)
Decisions about major purchases	
No participation	338 (46.7)
Participation	386 (53.3)
Decisions about visits to relatives/friends	
No participation	170 (23.5)
Participation	554 (76.5)
c. Healthcare access	
Not wanting to go alone *(m=2)*	
A problem	104 (14.4)
Not a problem	618 (85.4)
Distance to the healthcare facility *(m=3)*	
A problem	182 (25.1)
Not a problem	539 (74.5)
Finding transportation *(m=2)*	
A problem	145 (20.0)
Not a problem	577 (79.7)
Getting permission to go *(m=2)*	
A problem	95 (13.1)
Not a problem	627 (86.6)
Knowing where to go *(m=2)*	
A problem	99 (13.7)
Not a problem	623 (86.1)

3.3. Structural Equation Model

This section presents the overall HCM applied to the ANRS 12356 AmBASS survey based on the two main parts of the SEM model described in Section 2.1 above. Figure 12 displays the final structural model. The variables secondary education, having a non-agricultural job, and benefiting from the PNBSF were not included in the final structural model (see Appendix A3 for more details). Goodness of fit measures indicated a very good fit of the data, with an estimated 0.025 RMSEA (0.018-0.032 90% confidence interval, with a 100% probability of being below 0.05) and CFI and TLI values both above 0.98 (0.991 and 0.990, respectively). The Chi-Squared Test score of 273.668 (a zero p-value, 188 degrees of freedom). Results for the two parts of the SEM are provided in the two subsections below.

3.3.1. Measurement part of the model

Table 4 reports the raw estimates and standardized coefficients for the loadings of the sets of pre-selected indicators on each of the three latent health capability dimensions (health status, empowerment and healthcare access). In line with the results on internal consistency, all loadings were high (> 0.8) and significant at the 1% level, which means that each indicator provided a substantial and significant contribution to the estimation of the corresponding latent factor. The three-factor exploratory factor analysis yielded similar results. These are displayed in Appendix A4.

3.3.2. Structural part of the model

Table 5 presents the standardized estimates of the final structural part of the model. Total effects are the sum of direct effects between exogenous variables and dimensions of health capability (these are reported in the Appendix A5), and of indirect effects mediated by other (latent) variables.

Total effects revealed significant heterogeneity in the variables associated with deficits in the three dimensions of health capability. Self-reported health decreased with age and household size (-0.027 and -0.022 in 'health status' for each additional year of life and household member, respectively). Self-reported health was higher in individuals who underwent temporary migration (+0.339, p-value <0.01) and those living in households with relatively more agricultural resources (+0.170 for a 1 point increase in the agricultural resources index). Through the mediation of empowerment (+0.129 in 'health status' for a 1 point increase in empowerment), self-reported health was lower in women (-0.102, p-value<0.05). Finally, self-reported health was lower in individuals reporting better access to healthcare services (-0.103 decrease for a 1 point increase in perceived access).

Empowerment increased with age (+0.017 in 'empowerment' dimension for each additional year of life), marriage and parenthood (+0.445 and +0.634, respectively). It was

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lower in women and in individuals who attended primary school (-0.788 and -0.324, respectively), and higher in individuals who temporarily migrated (+0.486). Finally, empowerment increased with individual earnings (+0.029 for a 1 point increase in natural logarithm), whereas it was lower in individuals with more household agricultural resources (-0.318 for 1 point increase in the agricultural resources index).

Healthcare access increased with semi-urban residency (+0.580 compared with residency in a rural village), sole ownership of a field for farming (+0.781), and household living conditions (+0.173 for a 1 point increase in the living conditions index).

Backtracking and focusing on measures of poverty, empowerment increased with individual earnings, but decreased with household agricultural resources (otherwise associated with higher health status). Living conditions and sole ownership of a field for farming increased healthcare access, but neither were associated with health status or empowerment.
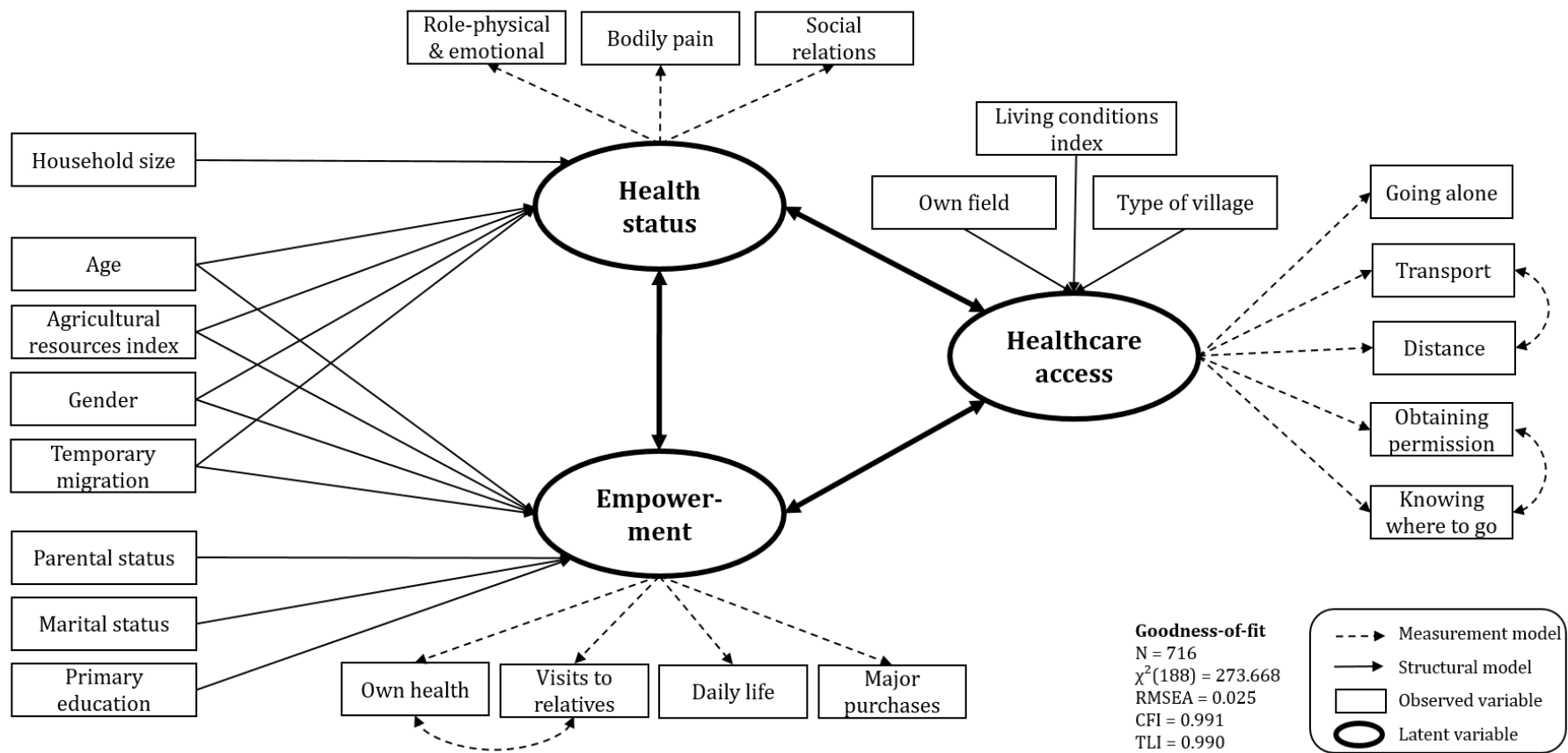
Figure 12. Full structural equation model of health capability in rural Senegal

Table 4. Measurement model estimates of the confirmatory factor analysis (CFA)

	Health status		Empowerment		Healthcare access	
	Raw	*Std.¤*	*Raw*	*Std.¤*	*Raw*	*Std.¤*
Role-physical & emotional	0.931***	0.958***	–	–	–	–
Bodily Pain	0.803***	0.849***	–	–	–	–
Social functioning	0.942***	0.966***	–	–	–	–
Final say on own health	–	–	0.946***	0.970***	–	–
Final say on daily life	–	–	0.029***	0.961***	–	–
Final say on major purchases	–	–	0.955***	0.976***	–	–
Final say on visits to relatives	–	–	0.830***	0.899***	–	–
Going alone	–	–	–	–	0.949***	0.958***
Transportation	–	–	–	–	0.876***	0.895***
Distance	–	–	–	–	0.858***	0.879***
Getting permission	–	–	–	–	0.890***	0.907***
Knowing where to go	–	–	–	–	0.889***	0.906***

¤Raw estimates multiplied by the standard deviation of the indicator, and divided by the standard deviation of the latent variable; ***p-value significant at the 1% level.

Table 5. Total effects of the structural part of the model

	Health status		Empowerment		Healthcare access	
	Raw	*Std+*	*Raw*	*Std+*	*Raw*	*Std+*
Health status	–	–	–	–	–	–
Empowerment	**0.129****	**0.155***	–	–	–	–
Healthcare access	**-0.103****	**-0.099****	–	–	–	–
Age	**-0.027***	**-0.411***	**0.017***	**0.212***	–	–
Being a women	**-0.102****	**-0.044****	**-0.788***	**-0.282***	–	–
Being married	0.058*	0.025*	**0.445***	**0.159***	–	–
Being a parent	0.082*	0.035*	**0.634***	**0.225***	–	–
Household size	**-0.022****	**-0.123****	–	–	–	–
Attended primary school	-0.042	-0.018	**-0.324****	**-0.117****	–	–
Semi-urban residency	-0.060*	-0.026*	–	–	**0.580***	**0.261***
Temporary migration	**0.339***	**0.139***	**0.486***	**0.167***	–	–
Own field for farming	-0.081*	-0.030*	–	–	**0.781***	**0.308***
Individual earnings	0.004*	0.018*	**0.029***	**0.116***	–	–
Per head monetary means	-0.006	-0.011	-0.045*	-0.073*	–	–
Agricultural resources	**0.170***	**0.159***	**-0.318***	**-0.249***	–	–
Living conditions	-0.018	-0.015	–	–	**0.173***	**0.147****

+Std.: Standardized coefficient that measures the change in units of the latent dimension per one unit change in the value of the exogenous variable; p-value significant at the 1%***, 5%** or 10%* level.

4. Robustness checks

4.1. Indicators in the measurement part of the model

The model was estimated for alternative sets of indicators in the measurement part of the model (see Appendix A6). First, empowerment was redefined as the ability to make decisions autonomously (i.e. having the last say alone versus with someone or not at all), rather than having the ability to participate in the decision making process. In a second robustness check, indicators were coded as categorical variables to indicate large, small, or no shortfall in the respective dimensions of health capability – instead of binary variables (optimal versus shortfall)[13]. In a third robustness check, the dimensions of health capability were estimated on larger sets of indicators. This model included the item on "having the money to pay" for 'healthcare access' dimension, and used the 6-item set presented in *Table A2.1b* for 'health status' dimension (i.e. adding variables on combined vitality and mental health, on general health and on fatigue).

All three models presented significantly worse goodness-of-fit measures (see *Table A6.1*). The main results were not affected (see *Table A6.2*). More precisely, in all three models, empowerment increased with individual earnings, and decreased with household agricultural resources. Empowerment decreased with monetary means per head in the last two models only (-0.51 coefficient, p-value significant at the 10% level in the first model).

In the first model, empowerment defined in terms of autonomous decision-making was much lower in women than in the main model (-1.417 versus -0.785). Empowerment's positive association with health was also stronger than when empowerment is defined in terms of participation in decision-making (0.175, p-value=0.001 versus 0.131 p-value=0.022). In model (2), health status was higher in parents and married individuals, it also increased with individual earnings and decreased with per head monetary means – all this, through the mediation of empowerment. Despite worst goodness-of-fit measures, using categorical indicators is conceptually attractive: such a model accounts not just for the existence, but also for the severity of shortfalls in dimensions of health capability. In the third model, loadings were low (<0.700) on the additional indicators, namely having the money to pay, combined mental health and vitality, general health and

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[13] For empowerment this corresponded to having no say (large shortfall), some say alongside someone else (small shortfall) or having the say alone (no shortfall). Similarly, items on perceived obstacles for healthcare access documented a big problem, a small problem or not a problem at all. Finally, questions on self-reported health and current fatigue reported large shortfalls (a lot of impairment, always or often diminished or in pain), small shortfalls (a little impaired, sometimes or rarely diminished), or no shortfalls (no impairment or pain, never diminished).

fatigue. Results of the structural part of the model were, however, aligned with those of the main model.

4.2. Interactions among dimensions of health capability

The model was estimated with alternative interactions among the dimensions health capability (i.e. health status, healthcare access, and empowerment) as presented in Figure 13. These included: (1) two-way interactions among all dimensions, (2) interactions from empowerment through healthcare access, and towards health, (3) interactions from health status and healthcare access towards empowerment, and finally (4) interactions from health status and empowerment to healthcare access.
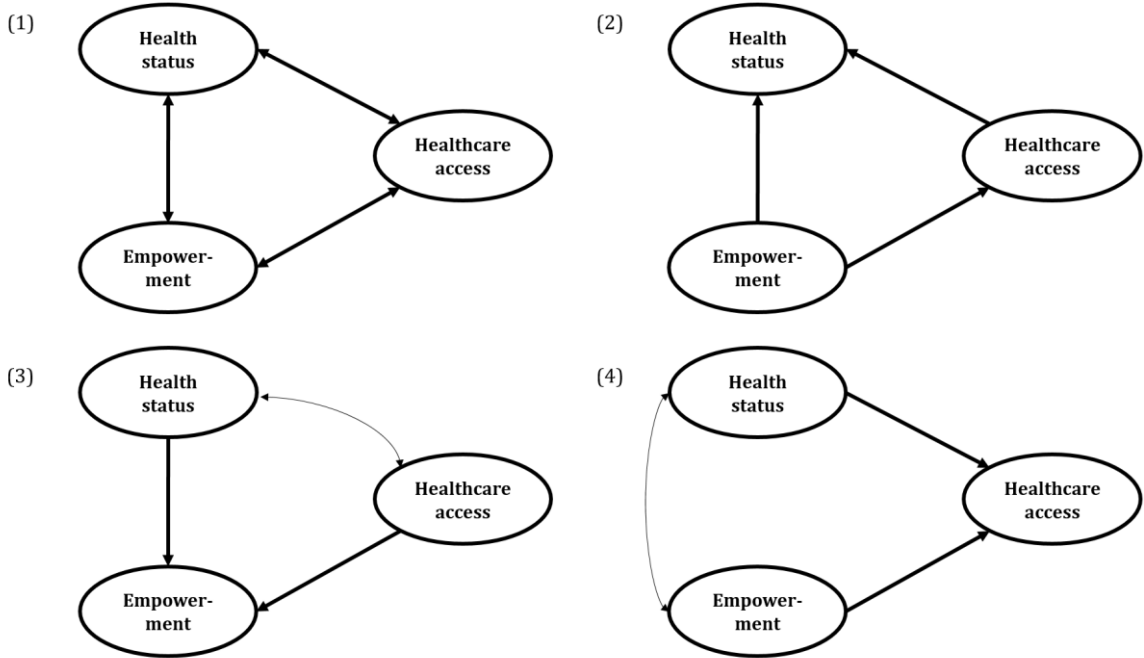
Figure 13. Alternative interactions among dimensions of health capability

All four alternative models displayed worse, albeit still acceptable, goodness-of-fit measures – as reported in Appendix A7 (see *Table A7.1*). The estimated negative coefficients between healthcare access and empowerment, highlighted heterogeneity between these two dimensions of health capability (see *Table A7.2*). In all these models, empowerment decreased with household monetary means and agricultural resources, and increased with individual earnings. In model (3), empowerment was also lower in households with relatively better conditions, through the mediation of healthcare access.

4.3. Subpopulations

The final model was estimated in three subpopulations (see Appendix A8): adults (n=593 participants aged 18 years and older at the time of the survey), women (n=414), and men (n=310). Compared with the main model, goodness-of-fit measures were slightly worse for the model estimated on adults and on women, and slightly better for estimations on men – though all remained in the acceptable range (i.e. RMSEA < 0.04, CFI and TLI > 0.98 as displayed in *Table A8.1* in the Appendix). Results of the structural part of the model were similar when estimated only in the adult population (see *Table A8.2*), with the exception of the coefficient between empowerment and health status (0.115, p-value=0.59, significant only at the 10% level)[14]. In all three subpopulations, empowerment was lower in individuals living in households with relatively more agricultural resources. Women's empowerment decreased with household monetary means per head, and marital status. Men's empowerment was higher in individuals with temporary migration, and in parents. In contrast, living conditions were not associated with improved healthcare access. In light of the low sample size, these results neither confirmed nor ruled out gender differences in the variables associated with shortfalls in dimensions of health capability. Such potential variations warrant further investigation.

4.4. Measures of poverty

Asset indices do not provide information on absolute levels of poverty within a community but rather focus on inequality between households i.e. these are *relative* indices (87). The model was, therefore, also estimated with relative measures of poverty (see Appendix A9). Indices for living conditions and agricultural resources were replaced with binary variables of relative poverty (1), income and per head monetary resources were replaced with relative poverty in these two variables (2), and a sum of household monetary resources was put in place of per head monetary means (3).

Models including these measures of poverty displayed relatively similar – and equally acceptable – goodness-of-fit measures (see *Table A9.1*). In model (1), individual earnings and relative poverty in agricultural resources were associated with higher empowerment whereas relative poverty in living conditions was associated in lower access to healthcare. No association was found between health status and these two variables (detailed results are provided in *Table A9.2*). Empowerment increased with household monetary poverty, and decreased with poverty in terms of individual earnings (model (2)) and with the sum of household monetary means (model (3)) – similarly than in the main model.

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[14] This also affected the indirect effect between female gender and health status (coefficient=-1.06, p-value =0.068).

5. Discussion

The current study simultaneously estimated and characterized health status, empowerment and healthcare access in an effort to unpack the relationship between household poverty and individual health outcomes in rural sSA. This is the first study to use a SEM strategy to estimate a multidimensional model of *health* capability in both men and women (26). The econometric specification accounted for interactions between the three above-mentioned factors of health capability, and analyzed direct and indirect associations with sociodemographic and economic variables previously identified as determinants of health status, such as age, gender, education, place of residence, and living conditions, as well as with several individual and household-level measures of poverty.

5.1. Promoting health capability in rural Senegal

Results reveal a variety of shortfalls in dimensions of health capability unknown to unidimensional models. Some findings are particularly interesting; first, variables associated with shortfalls significantly varied between health capability dimensions. For instance, gender and temporary migration are characteristics associated with self-reported health and empowerment, but not healthcare access. Similarly, exhibiting higher levels of personal motivation for health is associated with shortfalls in both healthcare access and empowerment. However, it does not affect health status.

The final model estimates also show opposing characteristics of shortfalls in health capability dimensions. For instance, living in a household with relatively high agricultural resources is a feature of optimal current self-reported health, and is associated with shortfalls in participation empowerment. Empirically, these are intuitive results: households with more agricultural resources (livestock, fields for farming, and equipment) can better feed their members; in turn, this may contribute to better health status. However, decision-making processes are likely to be more complex in such a household – and therefore translate into lower empowerment at the individual level – due to the high quantity of resources to manage. This hypothesis is consistent with our result that living in a household with relatively better living conditions (quantity and quality of durable goods, housing characteristics, etc.) is associated with optimal access to healthcare. This may be partly influenced by possible ownership of a means of transportation.

Focusing on poverty, empowerment is lower in individuals living in households with more agricultural resources (yet associated with higher self-reported health), and per

head monetary resources. In contrast, empowerment increases with individual earnings, and is positively associated with health status. Living conditions and sole ownership of a field for farming increased healthcare access, but neither were associated with health status or empowerment. These results are robust to alternative specifications of the measurement model (i.e. health capability dimensions estimated with explanatory factory analysis, with different sets of items or categorical variables), to alternative interactions among health capability dimensions, as well as to estimations in subpopulations, or using binary variables for dimensions of poverty. Overall, they suggest that empowerment is (one of) the missing puzzle piece in the complex relationship between health and poverty in rural sSA.

Most empirical results are in line with the literature. For example, lower levels of empowerment in younger women have already been documented in sub-Saharan Africa, for instance in a 2011 study in Ethiopia (88)[15] or in the most recent study by Sougou et al. on the Senegalese 2017 DHS data (89). Specifically, the authors found higher odds of autonomous decision-making in older women (age 45-49), and in women with income generating activities – echoing this model's results of lower adds of participation in decisions in women, a likelihood which increases with age and with individual monetary resources. One difference is that this chapter focuses on decision-making participation (i.e. making decision on one's own or alongside someone else) rather than autonomous decision-making – which is, however, investigated in the robustness analyses. The empirical results from the present study also provide further evidence of a relationship between access to healthcare and social capital (through decision-making latitude) which has been documented elsewhere (90) including in Sub-Saharan Africa (91). Finally, it is not surprising that better living conditions and ownership of factors of production (sole ownership of a field for farming) optimize access to healthcare, as does living in a semi-urban village where the local health dispensaries are located.

Some of the present study's results are specific to the Niakhar area, where seasonal migration to urban areas is associated with better health outcomes and living conditions (92,93). More specifically, the study highlights a relationship between temporary migration from the area and optimal levels in both self-reported health and empowerment. Indeed, the absence of a relationship between perceived barriers to healthcare access and self-reported health status contrasts with the literature on health and access to healthcare (94–99). This may be because access to healthcare is measured through the perceived ability to obtain care from local dispensaries, which only provide basic care (one head nurse, no doctor), whereas in the health capability paradigm there is a demand for equal access to high-quality care (23). In addition, most of the abovementioned studies measured health through mortality data and not self-reported health. In the Niakhar area, most people first consult traditional healers, even for serious diseases (100). These are all possible reasons why optimal access to local healthcare facilities is not associated with self-reported health status in the present study.

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[15] The Ethiopian study identified matrimonial and parental status as additional demographic variables that affect participation in household decisions.

5.2. Contributions to the literature

This paper contributes to several strands of the literature. First, it is the first study to develop a SEM strategy to explicitly consider *health* capability (26). It thereby contributes to the literature on empirical applications of the capability approach to the health field (101). Previous studies relate to the literature on applications of the capability *approach*, rather than on health capability *theory*— they include the development of self-reported measures or questionnaires of capability (102–105) or the presentation of econometric methods to estimate conversion rates (106). This paper bridges this literature with studies estimating basic capabilities in women or young people using SEM approaches (50–52,107).

Additionally, this study extends previous work capability-inspired indices for women's health agency and empowerment, including a decision-making index in Ethiopian women (88) or an index of women's perceived obstacles to access healthcare in Burkina Faso (108). This chapter brings in these indices as one possibility for measuring dimensions of health capability (specifically, perceived obstacles to healthcare seeking, and decision-making latitude as a proxy of empowerment). Compared with previous studies, these indices are estimated in both men and women, and in relation to health status, thereby creating a truly multidimensional conception of health capability(26).

As a consequence, this study offers an attractive alternative to traditional approaches of measuring determinants of health, which have been criticized for their over-reliance on univariate analyses of the impact of either healthcare consumption or variables identified as potential social determinants of health status as the sole outcome (14). In contrast, SEM-based estimations of health capability are intrinsically multidimensional with health status (as a proxy biological and genetic capital) as just one *dimension* of health capability. This illustrates the conceptual breakthrough offered by the consideration of health capability. People's health status is just one of the functionings that can be observed as an indirect measure of their latent health capability. Health functioning is also only just one of several elements that are required to create one's ability to be confident and effective in achieving optimal health throughout one's life. The health capability paradigmatic shift also consists in moving away from attempts to quantify the segmented contribution of individual components (e.g. education, or income) on health outcomes, and setting to explore and characterize multiple, complex relationships among dimensions of health capability.

Finally, this study addresses a gap in the literature in reconciling evidence that empowerment contributes to improved health outcomes and well-being (67,88), and that individuals experiencing health needs do not necessarily live in the poorest households (57). Indeed, the results highlight that individuals living in resource-rich households are more likely to experience suboptimal levels of empowerment, while reporting better health, and better access to health services (which increase with relatively more agricultural resources, and better living conditions, respectively). This paper accounts for the existence of intra-household inequality (61,63,66), and recognizes the necessity to

integrate the multidimensionality of poverty at the individual level (64,65). The results show that it is equally important to account for the multidimensionality of health capability at the individual level. Such an approach is required to incorporate the complexity of health capability into policy and intervention design for effective health promotion.

5.3. Policy implications

This chapter has important policy implications. Firstly, it highlights that, in the empirical context of rural Senegal, health promotion requires a set of differentiated, yet complementary, policy and interventions. In other words, this evidence suggests that a single policy, for example that 'poor' households are uniform, fails to address significant deficits in health capability dimensions. Notably, the variable on PNBSF recipient does not enter the structural part of the model (i.e. is associated with neither of the three dimensions of health capability at the 20% level). This result echoes recent work from the Senegalese Social and Economic Research Consortium (*Consortium pour la Recherche Economique et Sociale* – CRES) on misallocation of the cash transfer program to lower-middle class households, and evidence on the absence of its impact on health service utilization – in part due to implementation failures (48). In addition, these results reaffirm that it is imperative to develop multidimensional and individual level measures of poverty, and to account for (inequalities in) empowerment in the design of health policy and interventions.

A SEM-based model of health capability offers a way forward in informing policymakers on both the content and target of policy and interventions that promote overall health capability, in the context of rural Senegal. Its explanatory power highlights the multiple, complex and sometimes contradictory influences that play into people's health. In a context where resource scarcity emphasizes the need to accurately target vulnerable populations, this health capability model also identifies groups of people who accumulate shortfalls in several dimensions – specifically women and permanent residents in the Niakhar HDSS. This SEM strategy, therefore, provides uniquely detailed information on how, and who to target through policy and interventions for effective health promotion.

This model is applicable to cross-sectional data, and relies on (self-reported health, last say in decision-making and perceived barriers to medical care) that are suitable to, and easily documented in rural Senegal. Similar estimations of health capability models can be replicated to characterize deficits and progress in health status, empowerment, and health care access – for instance using DHS data available in women in over 90 countries, and over time (83), which could be more widely implemented to include men.

5.4. Limitations

This study has limitations. First, it did not investigate one of the four HCM dimensions, specifically the macro-level socio-economic and political environment, which undoubtedly affects health capability as well as the relationship between poverty and health outcomes. For example, research reports from the CRES highlight important differences in poverty rates between rural and urban areas (109), and documents the impact of the overall historical and legal environment (such as the cultural legacy of the *Nder* women and the 2010 law on parity in political representation) on socio-economic gender inequality (110). This incompleteness is because the AmBASS study covered a relatively small area (12 of the 30 villages covered by the Niakhar HDSS), whereas the full application of the HCM would require national and/or international data. Another consequence of using a local dataset is that empirical findings on shortfalls in health capability have limited external validity. They cannot be generalized to the rest of Senegal, or to other sub-Saharan countries. Nevertheless, they are illustrative of rural areas in the region.

Secondly, health capability dimensions were measured through self-reported variables (self-reported health, self-reported participation in decision-making and perceived access to healthcare). Although the health capability places a great deal of importance on individuals' perceptions and life experiences, some authors have raised concerns about basing studies solely on subjective beliefs. In particular, it has been argued that self-reported shortfalls in health status (such as self-reported morbidity) is heavily influenced by individuals' social experiences, and can sometimes be misleading (111). Ideally, subjective data should be complemented by objective observations, data on effective decision-making and data on healthcare use. These data were not available in the AmBASS dataset. Neither were expenditures. However, asset indices and binary variables on non-agricultural activity and sole ownership of a field for farming were included alongside monetary measures at both the individual and household levels.

Thirdly, broad health capability dimensions were estimated using specific indicators (e.g., intermediate social environment measured through empowerment in decision-making), which did not cover the full extent of the dimensions. For instance, the healthcare dimension encompasses the availability and the quality of local, regional, and national healthcare facilities and healthcare professionals as well as the governance of the overall public health system, including a wide range of stakeholders (Ministry of Health, health insurance companies, international donors, etc.).

Future studies should try to provide a comprehensive and multi-faceted assessment of the interacting elements that constitute health capability, for instance by applying the health capability *profile* (HCP), which operationalizes the HCM into 15 elements and over 40 sub-elements of internal and external health capabilities (26). Such a detailed analysis may require a qualitative (27) or mixed methods approach (112).

6. Conclusion

Despite its limitations, this SEM-based model of health capability offers new insights into how to characterize, and address deficits in health status, empowerment, and access to healthcare. Reported results can also help prioritize the allocation of resources and inform the content of interventions in resource-limited contexts through the identification of cumulative vulnerabilities, and shared levers for health capability.

Finally, the results reaffirm that it is imperative to develop multidimensional and individual level measures of poverty, and to account for (inequalities in) empowerment in the design of health policy and interventions. This study provides evidence that it is equally important to account for the multidimensionality of health capability at the individual level. Indeed, such an approach is required to move away from the 'one policy (for example towards the poor household) fits all' mindset, but instead to incorporate the complexity of health capability into policy and intervention design for effective health promotion.

Chapter 2: Investigating health capability in people living with chronic hepatitis B, a social justice mixed-methods study[16]

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[16] Part of this work (specifically, the study protocol) has been published in BMJ Open, jointly with A. Diallo, M. A. Badji, M. Mora, S. Boyer, and J. J. Prah (112). The bulk of the methods, discussion, and result sections are being prepared for publication.

Abstract

The health capability profile (HCP) developed by Prah (2010) is an operationalization of the health capability model into a comprehensive catalog of fifteen health capabilities –key individual and societal strengths and features that, together, promote people's ability to be healthy. Worldwide, over 800,000 annual deaths are attributable to chronic hepatitis B (CHB) virus infection. In Senegal, where 10% of the adult population lives with CHB, low knowledge and out-of-pockets costs have been identified as barriers to the life-long monitoring required to avoid CHB-related morbidity and mortality. This study presents an empirical application of the HCP to investigate abilities and conditions that constitute the ability to avoid CHB-related morbidity and mortality of adults living in rural Senegal. A thorough review of the HCP was conducted to adapt all fifteen dimensions to the empirical context of CHB in rural Senegal. A module was designed as part of a cross-sectional survey administered to 725 individuals interviewed in 2018-2019 (quantitative data) – a sample representative of adults living in the Niakhar area in rural Senegal. 40 semi-directed interviews (qualitative data) were conducted with survey participants to document all fifteen elements of the Profile. Additional qualitative data were collected to document resources available in health facilities, and to account for the perspective of healthcare professionals and community healthcare workers. All data were integrated employing flow diagrams and 0-100 health capability scores and levels of development to document and quantify strengths and vulnerabilities, within and across individuals.

Quantitative scores highlighted significant shortfalls in CHB-related knowledge and social, economic and political security, followed by material circumstances and social norms on decisional latitude. Individual health capability profiles and flow diagrams revealed lower levels of internal capabilities development in young and/or illiterate adults, and in women. Low CHB-related knowledge was detrimental to linkage to care when tied into traditional or alternative medicine. In contrast, knowing someone who died from CHB or identifying CHB infection as particularly dire was a strong lever for individual and family mobilization towards linkage to and retention in CHB management. High material circumstances and knowledge did not stand out as determinants of linkage to care (rather, they were associated with several cases of denial). Finally, even the strongest profiles displayed residual vulnerabilities attached to shortfalls in economic and social security (i.e., absence of social protection schemes, and poor job quality).

The Health Capability Profile provides an accurate and comprehensive understanding of people's complex lived experiences. The rich empirical results can help inform and prioritize policy changes in targeting the most vulnerable populations (youth, women, illiterate adults) and addressing areas of shared vulnerabilities (non-evidence based knowledge, and absence of social protection). As an empirical investigation, this study can serve as a model for future adaptations to different health issues or settings.

Keywords: health capability profile; social justice mixed-methods study; chronic hepatitis B; Senegal; sub-Saharan Africa; rural.

1. Introduction

1.1. Chronic hepatitis B (CHB) virus infection: a global public health issue

According to 2017 WHO estimates, over 800,000 annual deaths worldwide attributed to cirrhosis and liver cancer secondary to chronic hepatitis B (CHB) (113), CHB has been referred to as "the silent epidemic" whose burden is comparable to those of HIV, tuberculosis or malaria (114). In 2016, the WHO General Assembly committed to viral hepatitis elimination by 2030 with a three pillars strategy: prevention, testing, and treatment. Primary prevention of CHB infection relies on vaccination with an efficient vaccine available since the 1990s. The vaccine is usually administered in a three doses schedule – including a birth dose in some endemic areas, and has been found to be cost-effective, including in low-and-middle income countries (115). The second pillar, testing, is key to identify people who are CHB patients since CHB infection is often asymptomatic in its early stages (116). Third, life-long monitoring is essential to know when, if ever, life-long anti-viral therapies should be prescribed to control virus replication, and avoid CHB-related complications, specifically liver damage, cirrhosis and even liver cancer(117,118). Halfway assessments of reaching the WHO targets of a 90% reduction in new cases and a 65% reduction in mortality by 2030 have called for global investments (119), regional strategies (120), and a focus on countries with the greatest burden (121).

1.2. CHB response in Senegal

CHB prevalence is the highest in the Western Pacific region (6.2%) and in Africa (6.1%) (113). Senegal was the first country in the Sub-Saharan African region to set up a National Viral Hepatitis Program in 1998. In this country, an estimated 8 to 10% of the population currently lives with CHB (122). Hepatitis B vaccination was introduced in the expanded program on immunization starting in 2004 through the three doses pentavalent vaccine, with the addition of an extra dose within 24 hours of birth since 2016. Non-institutional stakeholders include the "Saafara Hépatites" patients association and the gastroenterology and hepatology Senegalese society (SOSEGH) that gathers medical experts. Anti-viral therapies that can control viral replication (but do not cure from chronic infection) are offered at a subsidized monthly price of 5,000 CFA (about 8 USD), and in 2018 the Ministry of Health together with the National Viral Hepatitis Program announced the decentralization of CHB care to regional hospitals and reference healthcare facilities at the district level (45).

Despite the country's early response, the mobilization of civil society, and the existence of both preventative and curative options, Senegal is one of the only African countries to have seen an increase in estimated CHB prevalence between the late 1950s and the early 2000s (123). Nowadays, liver disease secondary to viral hepatitis remains one of the leading cause of cancer (124), particularly among adult Senegalese men and women who were born before the successful implementation of the vaccination program (125).

1.3. Standard approaches to CHB-related morbidity and mortality in Sub-Saharan Africa, and in Senegal

Most studies conducted in Sub-Saharan Africa have focused on the role of health services organization and delivery and identified long waiting times (126), delays in administration of the birth dose (44,127), opportunistic rather than systematic vaccination (128), or insufficient screening (129) as major barriers to reaching the WHO target of CHB elimination by 2030 (120). Individual factors associated with CHB infection in sub-Saharan Africa include demographic characteristics such as age, gender or education level (130–132), customs, specifically home delivery, scarifications/tattooing, circumcision or shared items(133,134), and medical history of surgery, injectable medication, or family history of liver disease(135,136).

In Senegal, previous studies have particularly highlighted limited hepatitis B-related knowledge, both among lay population (100) and healthcare workers, from nurses in local dispensaries (137) all the way to physicians working in Dakar hospitals (138). Factors related to health services organization and delivery, such as the fact that CHB testing and bi-annual follow-up exams remain costly (up to 75 USD for the latter) and are rarely available at local healthcare facilities, have also been documented as potential obstacles to CHB prevention and linkage-to-care in Senegal (139).

Finally, societal factors such as stigma attached to CHB infection and discrimination of CHB patients have long been a blind spot of studies conducted in the African region (140). To the best of our knowledge, it remains undocumented in Senegal despite recent evidence in Ghana(141,142), Zambia (143), Uganda (144) or Cameroon (145).

Compartmentalizing these factors and focusing on individual or social indicators in an *ad hoc* and fragmented manner, fails to provide a full picture of what dynamically plays into people's ability to avoid CHB-related morbidity and mortality in their complex lived experiences. A thorough investigation requires a more comprehensive, multi-dimensional and in-depth framework, such as the health capability profile (26).

1.4. The Health Capability Profile: A multi-dimensional and in-depth framework

The health capability profile is the operationalization of the health capability model, applied in the first chapter, into a measurable profile. The model conceptualizes health capability at the overlap of four dimensions. The profile makes an exhaustive inventory of all the elements that are relevant to health capability experiences at the individual level. More precisely, the health capability profile identifies eight internal health capabilities (individual abilities) and seven external health capabilities (societal abilities or conditions), that interact with each other and together create people's ability to effectively achieve optimal health given one's biological predispositions, one's cultural and socio-economic environment, and available healthcare services and public health infrastructure (26) (see Table 6). The profile is an interactive framework that examines the combination, interrelatedness and interdependence of internal (individual) and external (societal and environmental) health capabilities in relation to risk of diseases, and resilience towards health and wellness.

The health capability profile generates an understanding of the integrative and multi-dimensional experience for individual health conditions, risk factors and health-related behaviors, the individual abilities of self-efficacy, perception, knowledge or motivation, and societal conditions – including, but not limited to, social norms, social networks, and material circumstances.

Table 6. The Health Capability Profile

Health Capabilities	
Internal	*External*
- Health status and health functioning (2) - Health knowledge (4) - Health-seeking skills and beliefs, self-efficacy (3) - Health values and goals (4) - Self-governance and self-management and perceived self-governance and management to achieve health outcomes (5) - Effective health decision-making (4) - Intrinsic motivation - Positive expectations	- Social norms (6) - Social networks and social capital for achieving positive health outcomes (3) - Group membership influences - Material circumstances (6) - Economic, political, and social security - Utilization and access to health services (5) - Enabling public health and health care systems (3)

Each health capability comprises one or several (number in parenthesis) domains.

The health capability profile builds on important advances of the biomedical model of disease (146), health belief models (147,148) and social determinants of health (SDoH)

(11,149–151). However, compared with these alternative frameworks, the health capability profile builds on the basic idea that manifestations of diseases are the result of complex, cumulative interactions of various capabilities, while recognizing the agentive nature of individuals.

Indeed, the canonical 1991 Dahlgren-Whitehead 'Rainbow Model' of health determinants is useful in identifying several layers of factors that may (jointly or not) influence health outcomes(152). However, it implicitly assumes one-directional influences from higher layers (first general conditions, followed by social networks, individual behavioral factors, and eventually constitutional factors) towards health. It eludes interactions among factors of any given level, as well as two-way influences between individuals, their communities and environment. This is why authors, such as Figueroa (2020), have argued that "most efforts to precisely quantify the influence of individual social determinants of health have failed, largely because the causal pathways are numerous, interconnected, and complex."(14) (p.E1). In addition, in failing to allow for the heterogeneous effects of similar attributes or resources, the SDoH does not account for the differential or cumulative needs and vulnerabilities of each individual that is required for equity considerations(15). In fact, the SDoH provides an analysis of inequalities in socio-economic resources and associated health outcomes – they fall short of the identification of inequities in health capabilities that require individual interventions, population-based programs and macro-policy interventions.

In contrast, an attractive feature of the health capability profile is precisely that it focuses on the identification of gaps between observed health capabilities, and an optimal level of health capability. It is therefore a very useful tool to contribute to the emerging field of implementation science (153–155), which seeks to ensure that evidence-based research (here, optimal health capabilities) translate into practice (observed health capabilities). In particular, the profile takes a step forward in going into details about what it lacking and what is working, and how to address all shortfalls and build on strengths in dimensions relevant to overall health capability.

Lastly, unlike standard approaches, the health capability profile explicitly contains a normative dimension. Drawing from the concept of human flourishing , the health capability paradigm reasons that individuals and societies work together towards the reduction of escapable morbidity and premature mortality – central health capabilities (23). It advances normative principles on how to intervene to improve individual health capability profiles – tracking this overtime with the aim of moving from risk to resilience, individual and collective (23). The health capability profile can provide powerful guidance for health policy design and evaluation.

Objectives

The overall objective of this study is to study CHB-related morbidity and mortality in rural Senegal using the health capability profile.

The secondary objectives are twofold. First, there is a methodological aspect, which is to empirically apply the health capability profile. More precisely, this study seeks to demonstrate the steps, and tools that can be employed to adapt a general conceptual framework (the health capability profile), to investigate a contextualized public health issue, specifically CHB in rural Senegal. This includes reframing the profile in terms of the clinical or cultural aspects that are relevant to the empirical setting, selecting an appropriate study design, and elaborating data collection tools and a data analysis strategy.

Secondary objectives are also of an empirical nature:

- To quantify and characterize gaps between observed and optimal health capabilities relevant to CHB in rural Senegal, and document interactions among these health capabilities.
- To distinguish strengths and vulnerabilities that are particular to CHB patients, in particular in relation to entry into, and retention in CHB care. This includes an ethnographic perspective to account for cultural and social aspects that are at play in rural Senegal.
- To identify marginalized CHB-related health capabilities (at the community-level) and marginalized individual health capability profiles, and to investigate examples of advanced levels of development of CHB-related health capabilities.
- To draw from the profile to help inform and prioritize short- and long-term policy change towards the elimination of CHB-related morbidity and mortality; in other words, towards CHB-related Health Capability for all people living in rural Senegal.

2. Methods/Design

2.1. Study Setting

The study takes place in the Niakhar Health and Demographic Survey System (36) (HDSS), in Senegal, a rural area located 135km east of the capital, Dakar. The HDSS covers 30 villages, home of over 45,000 inhabitants (2018 census), which has been under demographic surveillance since 1962. Mortality tables and immunization records are available for all residents. The Niakhar HDSS, situated in the middle of the Fatick region, has a long history with the Senegalese hepatitis B response. Between 1978 and 1981, the area hosted one of the first hepatitis B vaccine trials conducted in Africa (37), and in July 2018, the Fatick region was appointed a pilot region for the decentralization of CHB care by the Senegalese National Viral Hepatitis Program (45). More recently, the ANRS 12356 AmBASS survey on the burden of CHB took place between October 2018 and July 2019 in the Niakhar HDSS. Three hundred households were randomly selected, and all residents over 6 months of age were invited to participate in hepatitis B home testing, and to be interviewed using standardized face-to-face questionnaires (46). In a second step, participants who tested positive for CHB undertook further exams to assess the stage of their disease, and treatment was provided to those eligible. In total 3,118 participants representative of the Niakhar HDSS population were recruited, among which 1,505 were born before September 2003 (hereafter adults), and 206 tested positive for CHB (a 7.1% CHB prevalence in the general population; 12.6% in the adult population)(156).

2.2. Adaptation of the conceptual framework

The Health Capability Profile's general framework – previously developed by Prah (2010) was adapted to the context of this empirical study, specifically CHB in rural Senegal (see Table 7). First, the profile focuses on information relevant to CHB infection in the Niakhar area including hepatitis B transmission routes – blood and sexual fluids –, the natural history of the disease as well as risk factors and behaviors, in particular alcohol use, a main factor associated with liver fibrosis in Western Africa (157) as is peanut consumption (158), the Niakhar area's main cash crop. Prevention of CHB-related morbidity and mortality is also at the heart of the adapted profile through a focus on knowledge of, access to, and utilization of hepatitis B testing and vaccination, CHB care and anti-viral treatment options.

Secondly, the profile expresses elements of rural Senegal and the Niakhar HDSS, such as social norms in relation to the cultural and religious beliefs of the population of Sereer ethnic group and majority Muslim (36) or the importance of traditional medicine (100). Similarly, social capital and networks emphasize informal neighborhood groups, extended households, weekly markets, going to the mosque and membership in football teams, whereas material circumstances account for the area's hot weather, unpaved roads, informal work, and seasonal work migration (92). In particular, the profile captures the impact of geographic mobility (in terms of knowledge, economic capacity, etc.), and its relationship with the socio-cultural construction of the etiology of hepatitis B as well as with possible treatment routes (in Niakhar and elsewhere). Additionally, the profile appeals to all stakeholders involved in CHB care and policy at the local level – specifically community-based healthcare workers (*bajenu gox*), healthcare providers, and the center of traditional healers.

Table 7. Adaptation of the Health Capability Profile to CHB in Rural Senegal

Health status and health functioning
1. Self-reported health status
2. Health conditions: CHB-related health conditions (CHB status, and disease evolution if applicable; hepatitis B vaccination status; risk factors, including alcohol use, etc.) and other health conditions
Health knowledge
3. Knowledge on one's own hepatitis B and vaccination status
4. Knowledge on hepatitis B transmission routes, disease evolution, vaccination, testing, and treatment
5. Knowledge on behaviors that are CHB risk factors (alcohol use, nutrition, obesity)
6. Modes of health and CHB information gathering: health care providers, Internet, newspapers, radio, patients' associations, traditional healers, etc.
Health seeking skills and beliefs, self-efficacy
1. Belief in one's ability to avoid hepatitis B infection, or transmission and CHB-related complications
2. Ability to acquire CHB-related skills, and apply them: learning to monitor CHB condition and avoid infection or transmission (vaccine, hygiene, etc.)
3. Confidence in ability to perform or abstain from CHB-related health behaviors such as avoiding alcohol use, adapting diet, etc.
Health value and goals
1. Valuing one's health in general
2. Valuing the prevention of hepatitis B infection and transmission or CHB-related complications
3. Valuing CHB-related lifestyle or behaviors: change in diet (including alcohol use), hygiene, etc.
4. Recognizing and countering social norms detrimental to CHB prevention and monitoring
Self-governance and self-management and perceived self-governance and management to achieve health outcomes
1. Ability to be in control of one's life, to set and reach objectives in general
2. Ability to handle one's workload within the extended household [children, household work, farming, etc.] and outside [job or studies, etc.]
3. Ability to control one's behaviors for health or CHB-related purposes e.g., avoiding peanuts-rich family meals, or situations that involve alcohol
4. Ability to seek out support (help from family, neighbors) and obtain resources (transportation, financial means, etc.) to access CHB-related care
Effective health decision-making
1. Ability to use CHB-related knowledge and available resources to avoid infection, transmission or disease evolution
2. Ability to weigh the short- and long-term costs and benefits of CHB-related behaviors and actions, including alcohol use
3. Ability to identify CHB-related symptoms (in particular jaundice) and pursue vaccination, testing, follow-up and/or treatment.
4. Ability to make healthy choices in relation to CHB: reducing alcohol consumption, not sharing hygiene equipment, etc.
Intrinsic motivation to achieve desirable health outcomes
Quantifying motivation to avoid hepatitis B infection, transmission or CHB-related complications, and exploring whether it is internally (personal assessment) or externally (e.g., pressure from relatives or healthcare providers) motivated.
Positive expectations about achieving health outcomes
Optimistic or pessimistic viewpoint on personal life and CHB-related health prospects (avoiding infection, transmission and/or complications).

Social norms
1. Social norms on hepatitis B in relation to national and international recommendations
2. Favorable or unfavorable views on hepatitis B vaccination, on people living with CHB, alcohol use, and condom use
3. Quantification and characterization of people that undertake CHB vaccination and testing or adapt diet (including reducing alcohol consumption)
4. (Anti-)Discrimination of people living with CHB and of people seeking to access prevention or care (e.g., people with alcohol use disorder)
5. Norms on decisional latitude or power in relation to health in general, and CHB in particular
6. Changes, and resistance to social norms relevant to CHB (e.g., vaccination, alcohol use, healthcare access)
Social network and social capital
1. Ability to ask for instrumental help (e.g. delegating tasks for CHB care purposes), and ability to talk about one's problems including CHB status
2. Existence of patients' association, or other groups/networks that can support and provide information to people in relation to CHB
3. Existence of social networks or groups of people that have a detrimental impact in relation to CHB (discriminatory practices, false information, etc.)
Group membership influences: Membership to any kind of community organization (union or political party, sports team, association, informal), or informal group that may provide instrumental or emotional support, or counterbalance/augment social norms relevant to CHB.
Material circumstances
1. Economic activity (formal or informal, part or full-time), and monetary resources
2. Neighborhood's quality of life and resources including access to healthcare facilities
3. Water source, waste management and latrines system
4. Housing status and quality (in particular crowding and heat protection)
5. Availability and quality of food (specifically dependency on peanuts)
6. Other CHB patients and other sources of pollution or disease in the immediate environment (soil, air, malaria…)
Economic, political, and social security
1. Economic security: availability, quality and security of jobs (temporary vs. permanent, wage, unemployment protection and insurance, sick leaves)
2. Political security: existence of institutions and elected representatives that represent the people's interests, and prevent violence and criminal activity
3. Social security: existence and quality of financial, old age, or disability protection schemes (e.g., pensions, access to bank accounts)
Utilization and access to health services
1. Symptoms of CHB-related health issue (jaundice, advanced liver disease)
2. Other serious or morbid symptoms of poor health
3. Perception of a need to see a healthcare provider (vs. traditional medicine or none)
4. Existence of CHB-related health services: availability of vaccination, testing, CHB follow-up exams and consultation
5. Barriers to access: geographic accessibility, waiting times, costs, etc.
Enabling public health and healthcare systems
Extent to which healthcare facilities and health authorities (ministry representatives, health care professionals and facilities) are doing the following:
1. Giving information and helping people take charge of CHB prevention and monitoring
2. Helping protect people from CHB infection, transmission and complications
3. Being efficient in providing CHB-related care, and being accountable if not

2.3. Study Design

This study follows a sequential social justice mixed-methods design (see Figure 14) in that the Health Capability Profile guides the design and conduct of the research (56, 57). A full understanding of the various health capabilities and the overall health capability of a person requires data on objective abilities and situations (e.g., CHB status, CHB knowledge, economic circumstances, etc.), as well as information on subjective experiences (including, but not limited to, perceived competency, motivation, expectations, group membership influences, perception of a need to seek health services etc.). The need for objective and subjective quantitative and qualitative data from the individual and institutional and community perspectives necessitates a mixed-methods design that combines quantitative and qualitative data collection.

The first step of the study relies on an explanatory core design (160,161) with individual-level quantitative data collection followed by qualitative data collection in the form of individual interviews. The quantitative survey provides an overview of gaps and optima in health capabilities associated CHB-morbidity and mortality in the study area (objective data) and is used for the purposeful sampling of participants invited for qualitative interviews. The subsequent qualitative data collection was designed in collaboration with anthropologists at the Cheikh Anta Diop University in Dakar. Qualitative data help refine and complete quantitative results with in-depth, dynamic, and comprehensive health capability profiles, including information on personal experiences (subjective data) as well as interactions between health capabilities at the individual level, both of which cannot be properly documented with standardized questionnaires. In contrast, in-depth one-on-one interviews (IDI) are particularly appropriate to gather perceptions and representations of CHB-related health behaviors, beliefs and obstacles to entry into care.

In addition, relevant stakeholders and elements of the Profile need to be accounted for. This includes individuals, healthcare system and healthcare professionals and community representatives. We therefore complement individual-level data collection with institutional and community-based data collection through a health facility survey of CHB resources in the healthcare system and in-depth interviews with local CHB stakeholders. Whenever possible, these interviews take place as focus groups in order to confront point of views and thereby identify convergence and divergence on health capability development, in particular among representative of local healthcare workers or community leaders.

In a second step, information from interviews (qualitative data) and from individual and health facility surveys (quantitative data) are all integrated following a mixed methods convergent core design (160).
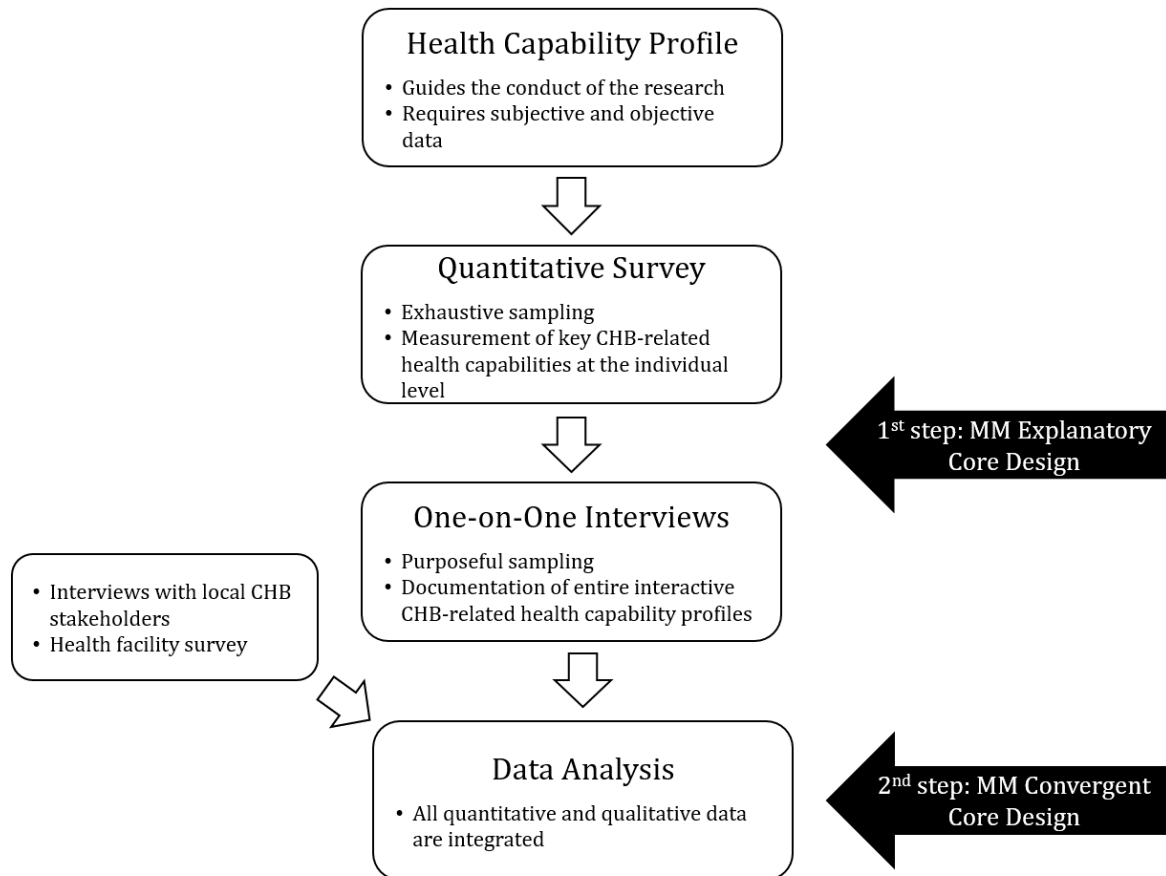
Figure 14. Sequential social justice mixed methods study design

The quantitative survey took place between January and July 2019. The subsequent conduct of the one-on-one interviews, focus groups and health facility survey was significantly delayed by the COVID-19 epidemics; it eventually started in July 2021 and was completed by the end of March 2022.

2.3.1.   Quantitative survey (pilot module)

The ANRS12356 AmBASS survey was amended to include a pilot module based on the health capability profile, in conjunction with a review of empirical studies to identify items that could document health capability domains given the study area and participants. This pilot module only documented some of the elements of the profile; as such, it is not an example of an exhaustive quantitative survey based on the capability profile.

In the pilot module, health status and health functioning was assessed using self-reported health (SF12v2 health survey (82)), CHB status and BMI in all participants; in addition a clinical and biological check-up (to identify liver disease stage) and CHB-risk factors are explored for participants who tested positive for CHB. Health-related knowledge was documented through general knowledge on CHB including transmission routes, clinical complications, hepatitis B vaccine and knowledge of hepatitis B testing.

Health seeking skills and beliefs, and self-efficacy were measured with questions on perceived health competency (162). The module also assessed intrinsic motivation to achieve desirable health outcomes and social norms. Data on living conditions included the household's economic status and monetary resources, type of neighborhood, water access, housing and living conditions, food security, and the CHB status of the other household members. Finally, access to, and utilization of, health services were documented using symptoms of poor health in the past 3 months or disability, healthcare utilization among people with a recent episode of illness, and a 36 months follow-up of linkage to care among people living with CHB, and obstacles to healthcare seeking are measured through self-reported barriers to healthcare seeking (108). The pilot health capability module was embedded in the demographic and socio-economic quantitative data collection of the 12356 ANRS AmBASS survey (46) is presented in Appendix D.1. It was administered to all 725 adult participants included after January 2019. Trained interviewers recorded answers using tablets equipped with the VoxCo software. The PhD candidate reviewed the literature to identify the above-mentioned questions, scales or items that document elements of the profile in the context of rural Senegal. She designed the section of the survey on health capability, oversaw training of the field team, and conducted several monitoring visits.

2.3.2.   One-on-one interviews (comprehensive application)

All health capabilities of the profile were clarified, expressed in the context of rural Senegal, translated into French (official language of Senegal), and reworded as an open-ended question that is accessible and meaningful to all study participants in order to build the interview guide. For example, the external dimension on enabling healthcare and public health systems will be investigated through the question, "What is your perception on the work the healthcare facilities and health authorities (ministry representatives, physicians, dispensaries, health center, regional hospital and hospitals in Dakar) are doing in helping you taking care of your health, including when it comes to hepatitis B?". The interview guide also includes an extensive list of clarification questions meant to guide interviewers in covering all 49 components in the profile (see the Appendix D.2 for the complete discussion guide).

The preliminary interview guide was discussed, clarified and translated in Wolof and Sereer during pilot interviews conducted with the participation of members of the Safaraa hepatitis patients' association. One-on-one semi-structured interviews were recorded and conducted in Sereer (local language of the main ethnic group), Wolof (spoken by a majority of the Senegalese population) or French according to the participant's own preference. Recordings were erased after transliteration, and translation – for interviews conducted in Wolof and Sereer – by the research team. The selection of the AmBASS survey participants invited for a one-on-one semi-structured interview followed a purposeful sampling strategy, first, in order to interview individuals that represent the

population's diversity in terms of age, gender, education level, occupation, CHB status, and healthcare utilization, and second, to represent the population's diversity in terms of CHB-health capability profile and health capability capital. Participants were contacted for interviews using these criteria, until data saturation was reached – it was expected that saturation would happen at around 35 to 40 in-depth individual interviews (IDI) (163).

2.3.3. Interviews with local CHB stakeholders

Additional interviews were conducted with healthcare staff involved with hepatitis B prevention or care for patients living in the Niakhar area and community health counselors of the Niakhar area to complement information on CHB-related external health capabilities. More specifically, these interviews were used to collect objective, community level data on CHB-related social and cultural norms, social networks and group membership influences, the political, economic and social security and the availability, safety, efficiency and accountability of health services, and of the overall healthcare system (including health and cultural beliefs and behaviors). The discussion guide for key informant interviews (KII) is presented in the final Appendix (Appendix D.3) at the end of the manuscript. The PhD candidate (female, 29) conducted the interviews with healthcare workers.

2.3.4. Health facility survey

The survey made an inventory of resources available in all the health facilities involved with CHB patients living in the Niakhar area: the public dispensaries of Diohine, Ngayokheme, and Toucar, the Diohine private dispensary, the Niakhar and Fatick health centers, the Fatick regional hospital, and the Dakar reference hospitals for advanced liver disease secondary to CHB (exhaustive sampling). The survey drew from a micro-costing methodology to document the availability and use of resources mobilized or mobilizable for CHB care, specifically human resources (headcount, general as well as specific CHB training, workload and salary base of physicians, healthcare workers, and administrative staff), equipment and facilities, medical imaging, biological exams (laboratory facility, staff, and machinery), and medication. The health facility questionnaire is also presented in the final Appendix and was designed and administered by the PhD candidate.

2.4. Data analysis plan and data integration strategy

Following a synergistic approach (164), data was analyzed to produce quantitative, qualitative, and mixed method results (see Figure 15).

Type of data   Expected outcomes

Quantitative

Mixed

Qualitative

Quantification of gaps and optima in health capabilities in the general population

Documentation of whole health capability profiles

Interactions among health capabilities
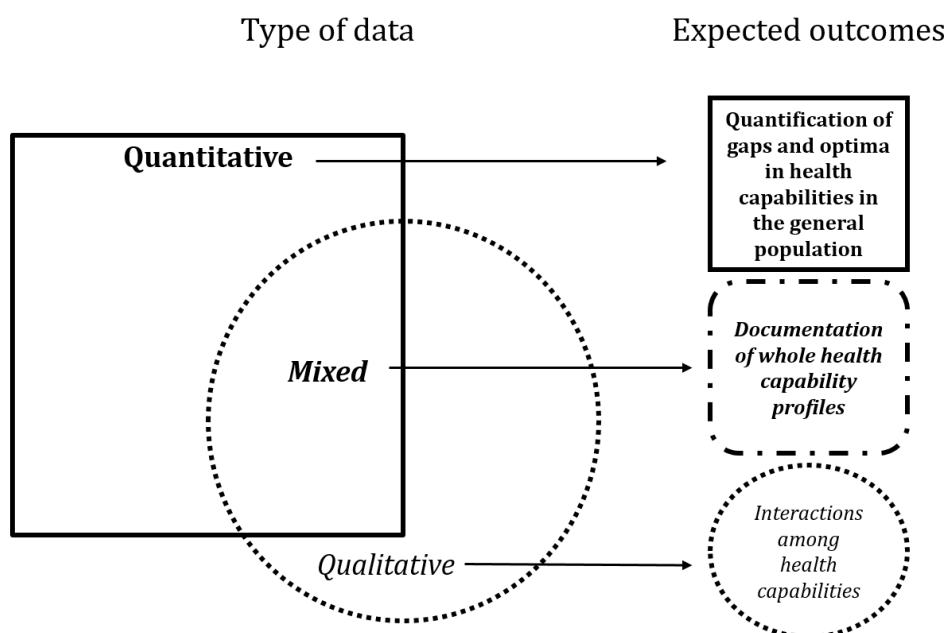
Figure 15. Illustration of the synergistic approach

The data analysis plan was multilayered:

- pilot analysis of quantitative data (scores) focused on gaps and optima at the health capability level in the general population;
- qualitative data was employed to analyze comprehensive health capability profiles at the individual level;
- qualitative and quantitative data were integrated at the health capability level to identify cross-cutting strengths and vulnerabilities, and guide programmatic, behavioral and policy changes

2.4.1.   Quantitative data (pilot analysis)

A preliminary, pilot analysis focused on quantitative data analysis. Quantitative data from the socio-economic and demographic survey was transformed into 0-100 scores for the following health capabilities: health functioning, health knowledge, health seeking skills and beliefs self-efficacy, intrinsic motivation, social norms, material circumstances, social and economic security, access and utilization of healthcare services. The full scoring process is presented in detail in Table B1.1; it followed two guiding principles:

(1) Employing the full 0-100 scoring range, from 0, for an absence of capability, to 100, which corresponds to full capability development, which corresponds to the optimal level (normative standard), though realistic in the sense that this level is

attainable for capable individuals in the study setting under enabling circumstances[17]

(2) All items belonging to a given health capability were weighted equally, except for elements or sub-dimensions that were epidemiologically or practically particularly relevant to people's ability to avoid CHB related morbidity and mortality in the study setting. In that case, the relative weight of items reflects the items' importance in avoiding CHB-related morbidity or mortality in rural Senegal[18].

2.4.2.   Qualitative data

The analysis of the qualitative case studies relied on deductive content analysis, a systematic research method describing and quantifying phenomena based on an established theory (165,166). Deductive content analysis ensures methodological rigor: through the theoretical framework, a common template is clearly defined to serve in analyzing a variety of situations or research questions (167). Here, we employed the Health Capability Profile as the "theory, theoretical framework or conceptual model to analyze the data by operationalizing them in a coding matrix"(p.17) (163). The fifteen health capabilities and their corresponding functionings and agencies defined the categories and subcategories used as initial codes to thematically analyze each IDI. Interviews were dissected into meaning units (fragments) ranging from a few words to full sentences. The meaning units were then attributed to one or several health capabilities.

2.4.3.   Data integration (main analysis)

Quantitative and qualitative data followed a process of data integration to produce a mixed methods analysis of whole health capability profiles at the individual level in participants to both the quantitative survey and one-on-one interviews. The data integration strategy relies on the use of health capability stages of development, scores and flow diagrams – these tools were all developed as part of the study. Individual-level qualitative and quantitative data were scored using an indicative table (see Table 8) developed from the Dreyfus model of skill acquisition and its adaptation to clinical competence (168), and the community readiness model (169). The scoring process relies on stages of development and 0-100 scores for each capability. These scores were then

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[17] For instance, a participant who fully disagrees with all 5 items for perceived competency would get a 0 score, one who fully agrees a 100, one who is neutral a *lower* intermediate score. 100 is the optimal level, but it is realistic, i.e., it can be documented for a participant who feels fully competent.

[18] As an example, knowledge of transmission routes and vaccination account for 60% of the total score on CHB-related knowledge as prevention of the disease is key in a context where there is limited therapeutic interventions for advanced liver disease. Similarly, the economic dimension of material circumstances accounts for 30% of this health capability's score because CHB management requires a significant amount of monetary resources. In contrast, as decisions are usually collective, a greater shortfall in capability reflects the inability to participate in the decision-making process altogether, rather than the inability to make decisions on one's own.

averaged into two types of indices, specifically individual indices across all fifteen capabilities, and capability-level indices across individuals.

First, as presented in the scoring table, we defined eight stages of development ranging from an absence of capability (nil stage of development) to optimal capabilities, and interspersed with basic, intermediate and advanced stages of development. The scoring of capabilities in terms of developmental stages is aligned with the conception of individuals as agents that develop over time, and with the broader idea of the promotion of flourishing through 'human development'.

Second, these stages of development corresponded to ranges on a 0-100 score for each capability and each participant (see Table 8). The 100-maximum score, or optimal level, corresponds to a normative but realistic and attainable goal that accounts for the context, both at the macro- and individual-levels. More precisely, external capability refers to societal and environmental conditions as experienced by individuals. For internal capabilities, optimality corresponds to the level of expertise that can be attained by a layperson, for instance in individuals involved in delivering expert patient programs (170–172). Again, scores employed the whole 0-100 range.

The stages of health capability development and associated scores were detailed for each of the 15 health capabilities (see Table B1.2).

Table 8. Indicative health capability development scoring table

Score	Stage of capability development	Internal capability "The individual is…"	External capability "The conditions are…"
0	Absence/Nil	Naive	Unpropitious
10	Basic 1	Novice	Non-hindering
25	Basic 2	Advance beginner	Promising
40	Intermediate 1	Autonomous	Propitious
55	Intermediate 2	Competent	Favorable
70	Advanced 1	Experienced	Facilitating
85	Advanced 2	Proficient	Enabling
100	Optimal	Expert	Fully enabling

Third, indices were derived with average scores for each of the fifteen health capabilities across individuals in order to document areas of shared strengths or vulnerability that can help inform and prioritize intervention, programs and policy. We also averaged scores at the individual-level to quantify the overall level of health capability development (i.e., the overall health capability set). This allowed for the identification and characterization of profiles at each end of the health capability set (i.e., strong versus vulnerable profiles). These aggregated scores (or indices) complemented, but did not replace, the detailed analysis of health capability profiles.

Dynamic flow diagrams were also developed following the scoring guidelines presented in Table B1.2 to integrate quantitative and qualitative data at the individual-level. We placed health capabilities on a nil to optimal development continuum (from left to right, see Figure 16). Interactions among health capabilities were depicted using green and red arrows (i.e., positive or negative interactions, respectively) to represent processes of mutual influences and cumulative building.
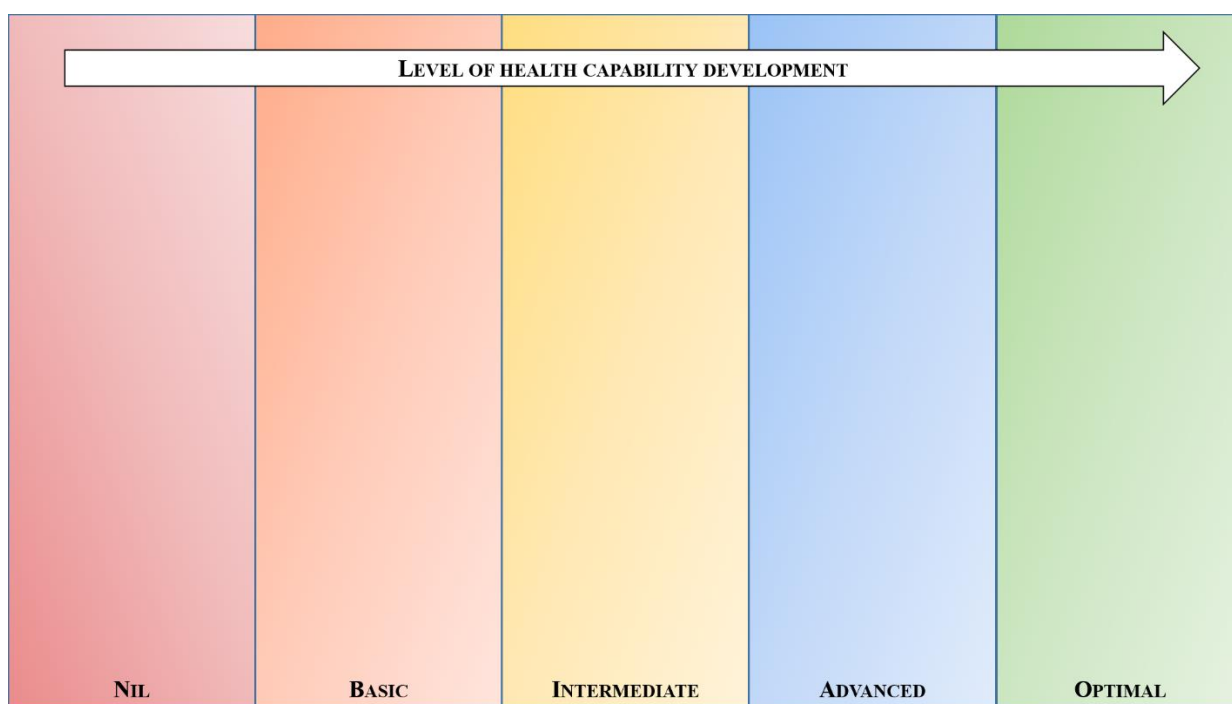
Figure 16. Flow diagram's template

Finally, a crosscutting analysis combined the above-mentioned integrated data as well as the additional information from interviews with national and local CHB stakeholders, and the health facility survey. Strengths and vulnerabilities at the health capability level were identified to help inform and guide interventional, programmatic and policy changes.

3. Results

3.1. Pilot results: CHB-related health capability scores in the general population

Highest levels of development are observed in health seeking-skills and beliefs, and access to, and utilization of healthcare services, with mean scores of 83.08 and 80.95 out of 100, respectively (see Table 9). Health functioning and intrinsic motivation scores also demonstrate advanced levels in development with mean scores of 70.37 and 74.81. In contrast, the scores revealed significant shortfalls in social and political security (17.24 out of 100) and CHB-related health knowledge (12.26 out of 100). Finally, both material circumstances and social norms are at an intermediate level of development with a mean value of 39.97 and 47 out of 100, respectively and characterized by significant heterogeneity among the population as displayed in Figure 17.

Table 9. 0-100 health capability scores in the general population

Health capabilities	Score in the general population (n=724)	
	Mean (std. dev.) [Min-Max]	Median [IQR]
Health functioning	70.37(10.56) [21.24-79.77]	74.87[25;76.16]
CHB-related knowledge	12.26(23.61) [0-95]	0 [0;10]
Health seeking skills and beliefs, self-efficacy	83.08(22.02) [0-100]	85[5;100]
Intrinsic motivation	74.81 (16.09) [0-100]	80[60;90]
Social norms	47.00(33.37) [0-100]	55[15;70]
Material circumstances	39.97(13.88) [5-75]	40 [30;50]
Social and economic security	17.24(12.67) [0-65]	10[10;20]
Access and utilization of local healthcare services	80.95(11.30) [10-100]	85[75;90]
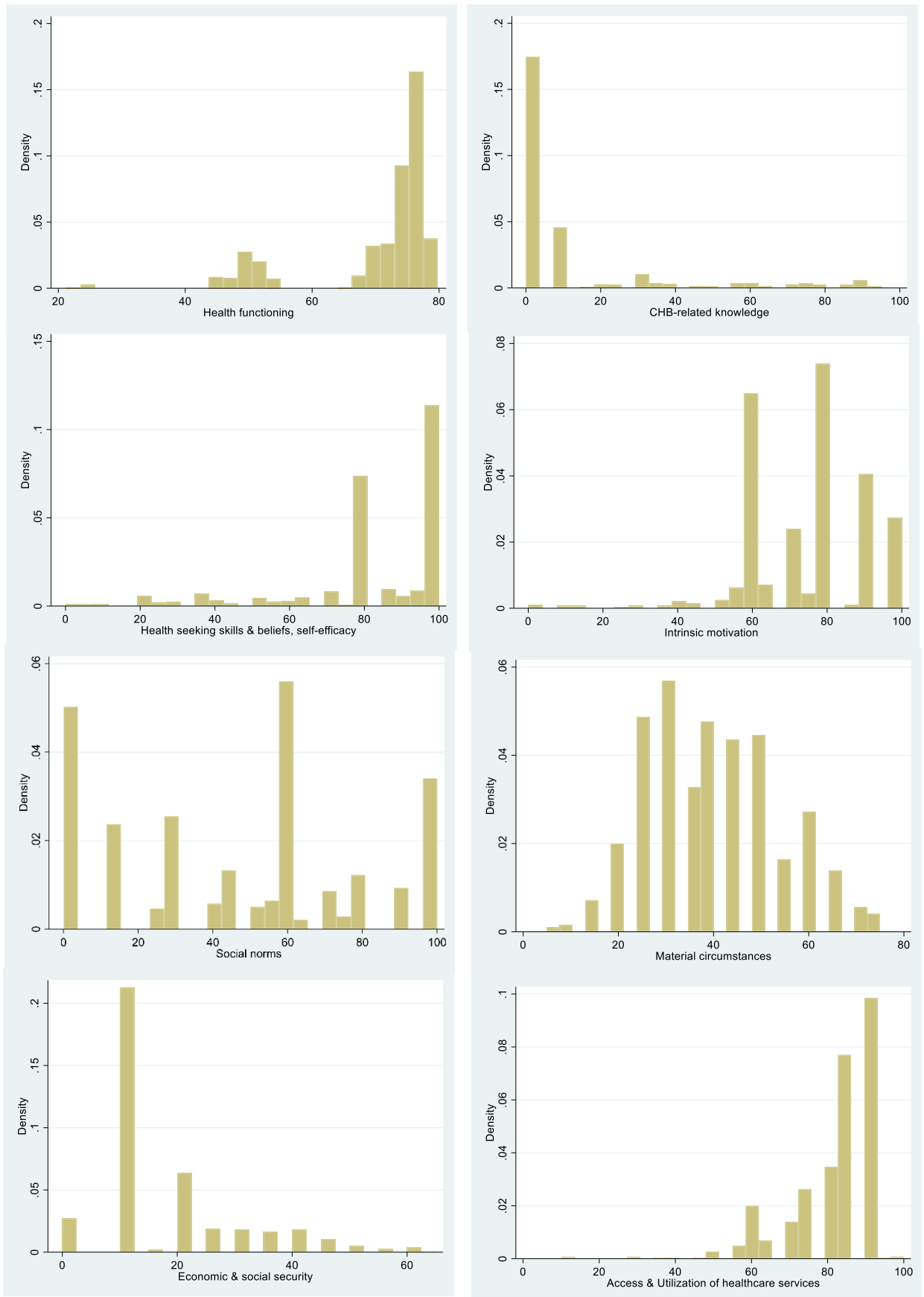
Figure 17. Scores of health capability in the general population

3.2. Main results

3.2.1. Individual CHB-related health capability profiles

Interviewees represented a diversity of profiles in age, sex, educational attainment (none, literacy, primary school or above), economic status (farmers, students, tradesman, teacher, etc.), CHB status, and therapeutic itinerary (history of testing or not, linkage to care in local health facility or the Fann hospital in Dakar or lost to follow-up). Saturation was reached after 40 IDI, which lasted between 15 and 48 minutes (average duration: 27 minutes). Participants' characteristics are presented in the Appendix in Table B2.1. We developed flow diagrams for each of the IDI – these are displayed in the Appendix (see Figures B3.1 to B3.40 in Appendix A2). Flow diagram's key features and individual overall (average) health capability scores are reported in Table 10[19].

The profiles revealed significant heterogeneity in the characteristics and levels of health capability development. Individual health capability scores ranged from 32 out of a 100 (participant 1161, a young woman unable to initiate CHB follow-up without her absent older brother's consent) to 76 out of 100 for participant 12 — the only patient who attended all three recommended visits for CHB management at the local health facility in Niakhar. The flow diagrams present nuanced analyses, and allow for multiple causes, fleeting of vulnerability, and resilience despite adverse circumstances. For example, participant 196 missed an appointment after having invested his money elsewhere, despite a strong profile and 72 overall score. In contrast, participant 1840 who exhibited multidimensional vulnerability and, despite a lower intermediate 46 HCP score, had managed to continue treatment for over a year.

At odds with SDoH, we also documented high material circumstances in people lost to follow-up, and low knowledge in most people successfully referred for CHB management. More precisely, shortfalls in CHB-related knowledge seemed to affect linkage and retention in care when tied into traditional or alternative medicine (shamanism or prayers in the charismatic movement). In non-CHB patients, history of CHB testing was prompted by life events (recent pregnancy, university, and military service), and often documented in vulnerable profiles, which presented significant obstacles to standard healthcare access and utilization.

Table 10. HCP scores and key features of the flow diagrams following data integration

ID SEX, AGE	HCP SCORE	KEY FEATURES OF THE FLOW DIAGRAM
		CHB patients linked to care (n=12)
12 F, 49	76	Overall strong profile: resources, support, motivation, self-efficacy, and excellent knowledge participating in retention in care

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[19] Detailed health capability scores for all 40 participants are provided in Appendix A4.

		Vulnerabilities: symptoms and economic/social insecurity
164 M, 17	55	Confined vulnerabilities: young age, and poor family Overall strong profile: motivation, supportive family, follow-up in Dakar
196 M, 28	72	Excellent knowledge, worked in CHB study, optimistic and competent, salaried job, "intellectual" Missed an appointment: sick mother and money invested elsewhere
381 F, 29	46	Multidimensional vulnerability: low knowledge, prevalent social norms, limited resources, and current pregnancy are threats to retention Values health, perceives CHB severity, favors standard curative medicine
1141 M, 57	46	Underlying vulnerabilities: limited knowledge and resources Strong profile: social support, motivation, positive expectations, rejects detrimental social norms, decision-making and governance facilitate follow-up
1522 F, 23	36	Strengths attached to convent membership: trust in Catholic dispensary, positive expectations, supportive family despite divergent beliefs Low knowledge and perceived competency and passive behavior
1840 M, 20	46	Vulnerability in low material circumstances, knowledge & governance Virtuous circle of enabling healthcare staff, social capital, and internal capabilities (motivation, values, optimism) facilitating treatment continuation
2100 M, 60	69	Extremely strong profile: vicious circle of optimal skills and conditions Residual vulnerability in health functioning (CHB patient with symptoms), social insecurity (pension but no insurance), and traditional Sereer beliefs
2533 F, 46	48	Multidimensional vulnerability: low knowledge, security and resources, trust in traditional medicine when standard care fails, fear of CHB-death Strengths in supportive family, health prioritized & governed, high motivation
2666 M, 36	53	Extremely strong profile: avoiding cirrhosis is a top priority, learned a lot since testing, mobilizing resources to manage CHB accordingly Residual vulnerability in self-employment, no insurance, CHB status & fatigue
2795 F, 33	47	Virtuous circle of enabling healthcare systems and social capital, and optimal internal capabilities facilitating linkage to care Vulnerability in economic security, knowledge & self-efficacy
2909 F, 49	55	Multidimensional vulnerability threatens retention: low knowledge, freedom, security, decision-making and distrust towards blood sampling (vs. treatment) Cohort staff, well-off family and prioritization of health strengthen the profile
Positive examples in non-CHB patients (n=5)		
31 F, 22	57	Vulnerability in social networks, self-efficacy, and economic & social security Optimal motivation, values and governance build on enabling healthcare systems and social norms to ensure access and utilization
296 F, 24	35	Multidimensional vulnerability: low knowledge, motivation, expectations, decision-making skills, detrimental social norms and healthcare systems History of CHB testing, positive self-efficacy, and health values
626 M, 33	45	Group membership jeopardizes decision-making and social norms Excellent knowledge, strong internal capabilities, and favorable circumstances Ambivalent influences on healthcare access and utilization
762 M, 44	34	Vulnerable profile: low monetary resources and social support impede access to health services; disability further weakens the profile Strengths in motivation, knowledge, self-efficacy, and positive expectations
1212 M, 51	54	Optimal internal health capabilities which enable optimal access & utilization Residual shortfalls in economic & social security, and social norms
CHB patients lost to follow-up (n=23)		
109 M, 40	60	Significant shortfalls in social norms, knowledge and realistic expectations impede healthcare utilization, which in turn jeopardizes health functioning despite strong internal capabilities, favorable social network and circumstances
115 F, 48	47	Detrimental group membership & social norms, low motivation, expectations, governance and decision-making impeded health services utilization despite favorable circumstances and social capital and strong values & self-efficacy

120 F, 35	47	Multidimensional vulnerability from social norms, which affects expectations and knowledge, and impeded healthcare utilization. Strength in material circumstances, social networks, functioning & governance
182 M, 19	38	Young age impedes internal capabilities development, and prevent healthcare access, in conjunction with economic insecurity and detrimental social norms Strength in health values, expectations and enabling healthcare system
387 M, 29	33	Strong internal capabilities (values, self-efficacy, motivation) to get better when sick; vulnerability in external capabilities (security, social capital & norms) affect decisions, knowledge & governance
406 M, 18	33	Young age causes shortfalls in internal capabilities (self-efficacy, motivation, knowledge, decision); low social capital, resources, and social norms also prevent healthcare access despite positive values & expectations
839 F, 58	38	Extremely unpropitious conditions (social and economic insecurity), lead to poor knowledge, expectations and governance, impeding healthcare access, despite advanced internal capabilities: beliefs, values, motivation and decisions
909 F, 19	41	Vulnerability in economic means, self-efficacy & decision (young age) which affect knowledge and ultimately referral to Dakar hospital despite governance, positive expectations, supportive teacher, healthcare workers & family
925 M, 18	39	Multidimensional vulnerability in external capabilities: economic insecurity, limited resources associated with distrust towards blood sampling Strong internal capabilities (motivation, values, governance) and social support
937 M, 69	48	Relatively strong profile driven by internal capabilities (health values, motivation, self-efficacy, governance) and army group membership Refusal to use healthcare facility driven by non-evidence-based decision making
1108 M, 63	44	Limited knowledge, expectations and low efficacy and decision-making skills combined with economic insecurity jeopardize healthcare utilization – absent for follow-up—despite favorable social norms, capital, motivation and values
1160 F, 39	38	Extreme vulnerability stemming from poor household, limited decision-making ability and social norms Strength in health value, self-efficacy, governance and influence from religion
1161 F, 18	32	Limited economic resources, low knowledge and self-efficacy (youth), alongside inability to decide without brother's approval prevent visit to hospital in Dakar despite enabling healthcare systems and optimal health values & goals
1235 F, 44	39	Significant shortfalls in external capabilities: poor household, no job, defiance towards people and CHB test result which overflows on low knowledge, and governance, despite positive expectations and intrinsic motivation
1566 M, 27	39	Illiteracy prompts shortfalls in motivation, decision-making, self-efficacy & knowledge and detrimental social norms lead to refusing follow-up exams Strengths in expectations, health values, governance and social capital
1619 M, 19	44	Multidimensional vulnerability: detrimental social norms, economic vulnerability and youth-related shortfalls in internal capabilities alongside competing goals impede follow-up despite social capital and governance
1670 M, 35	47	Strong profile with optimal beliefs, motivation, decision-making and health goals, together with favorable material circumstances facilitate healthcare utilization – late follow-up due to error in result delivery, and low knowledge
1747 F, 58	30	Shortfalls in decision-making, expectations and knowledge discourage linkage to care in Dakar in a context of shared decision-making and suspicion towards CHB management. Strengths in monetary resources, motivation & self-efficacy
1833 M, 18	35	Youth, low CHB knowledge and motivation, alongside economic insecurity, family in traditional healing and poverty impede linkage to CHB care Strength in perceived governance, self-efficacy and positive expectations
1843 F, 48	44	Relatively strong profile, with high internal capabilities (decision-making, health values & expectations, governance) alongside favorable social capital & norms Own status undisclosed, poverty and low self-efficacy prevented linkage to care
1920 M, 35	49	Despite optimal beliefs, governance and decision-making, with favorable social networks and healthcare systems refused follow-up and hides CHB status

		Self-medicates in a poor household, deciding with father, a traditional healer
1929 M, 60	39	Disabling material circumstances & social norms, low decision-making skills knowledge & motivation, and competing goals delayed linkage to care Strengths in supportive family, expectations, self-efficacy & governance
1877 F, 66	39	Widow with shortfalls in motivation, decision-making skills and knowledge, conflicting goals, negative expectations and limited resources, which delayed linkage to care, despite positive group membership & self-efficacy

The combination of objective data (e.g., CHB test result) and subjective data (participant's perception of their own health and status) was essential to identify, and understand several cases of denial, such as participant 1235 who believes that the sun tampered with her test result. Another striking example is participant 937 who, despite having lost a close friend due to CHB-related complications and demonstrating excellent knowledge on the natural history of CHB, rejected the (positive) test result, on the ground that any blood disease should have been diagnosed during one of his many previous blood tests.

Lower levels of internal capabilities development were identified in younger (see for instance, participants 182 and 406 who present similar profiles), women, and/or illiterate participants who tended to exhibit greater shortfalls in self-efficacy, knowledge, and decision-making skills. In contrast, knowing someone who died from CHB (son for participant 2666, uncle for participant 164), fear of CHB-related death (participant 2533) or identifying CHB infection as particularly dire ("worse than malaria" for participant 381) was a strong lever for individual and family mobilization towards linkage to and retention in CHB management. Finally, even the strongest profiles displayed residual vulnerabilities attached to shortfalls in economic and social security (i.e., absence of comprehensive health insurance and social protection schemes, and poor job quality).

3.2.2. Cross-cutting analysis at the health capability level

We interviewed nurses and physicians in charge of CHB testing and management for people living in the Niakhar area (see Table B2.2) We also conducted a focus group with community healthcare workers in charge of door-to-door sensitization for general health promotion (community relays), and child and maternal health promotion (*bajenu gox*) chosen by purposeful sampling to represent all three health posts of the Niakhar HDSS (the list of participants to the focus group is presented in Table B2.3). These interviews lasted between 19 and 54 minutes – 84 minutes for the focus group.

Healthy facility surveys documented that rapid testing for CHB was available in all health facilities at under 5 USD (2,500 to 3,000 CFA), a cost that can be partially subsidized by community-based health insurance (CBHI) schemes, and that all health professionals were aware of, and received some form of training for, CHB management. The survey also recorded shortages in healthcare staff, which led to reduced activity at the Diohine public

health dispensary[20] and limited availability of abdominal ultrasound[21], as well as outsourcing of the DNA viral load's quantification with a private laboratory. Consequently, the out-of-pocket cost of viral load was about 50 USD (33,000 to 35,000 CFA), and was not eligible for waivers by social services, or subsidies by CBHI.

All these elements were integrated in the thematic, deductive content analysis of the individual interviews to present a comprehensive analysis of strengths and vulnerabilities in CHB-related health capabilities in rural Senegal, which is displayed in Table 11.

Because of the purposeful sampling of participants invited for IDI (i.e., selection of participants at both ends of the health capability's development spectrum), absolute values of cross-sectional scores were difficult to interpret. However, these scores remained useful to identify shared vulnerabilities in economic, political and social security, health knowledge, group membership influences, and effective decision-making (scores ≤ 40 indicating basic levels of development), and areas of relative strengths in health functioning, self-governance and self-management, and health values and goals (scores ≥ 55 indicating an upper intermediate level of development). No score reflected advanced levels of development, stressing the significance and multidimensionality of shortfalls in CHB-related health capabilities.

In addition, for each of the fifteen health capabilities, the profile provided a comprehensive list of strengths, and of weaknesses. For instance, strengths in health-related values and goals –the most developed health capability – included the prioritization of health in general, the valuation of preventing serious conditions or episodes of illness, including death by liver cancer or cirrhosis, and health-related goals focusing on medical consultations, drugs prescription and a balanced lifestyle (diet, exercise, etc.), and the recognition of, and push back against, social norms discouraging health seeking behaviors. However, the profile also identified a number of shortfalls with respect to an optimal level of health related values and goals (vulnerabilities), specifically the existence of conflicting goals such as cooking for the family or working and earning money, the rare prioritization and prevalence of CHB-specific goals and behaviors (e.g., change in habits or diet to avoid CHB-related complications), and of concerns for preventative care, and prevention in general as well as residual defiance towards blood sampling and vaccination.

Similarly, the profile documented positive examples and strengths in the least developed health capabilities, specifically economic, political, and social security. It highlighted stable jobs in some private firms or in the public sector, the democratic election process, and the existence of social services, cash transfer programs, and free care initiatives, notwithstanding significant vulnerabilities and challenges associated with

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[20] In the Spring of 2022, the dispensary was only catering to emergency births following the recent transfer of the head nurse. Most patients were followed-up at the nearby Diohine Catholic private dispensary.

[21] In the Spring of 2022, ultrasounds were only available on a regular basis at the Fatick regional hospital: patients followed up at the Niakhar health center were supposed to go to the Fatick health center on Monday mornings, when one of the hospital's radiologists offers weekly on-site imagery consultations.

poor job quality and informal work, the existence of political corruption and insufficient investments in public services, and the absence of a universal social safety net.

The cross-sectional analysis was exhaustive in encompassing objective measures, perceptions and representations at the individual level (IDI), and at the healthcare system and community levels (KII and health facility surveys) in relation to the overall ability to avoid CHB-related avoidable morbidity and premature mortality.

Table 11. Strengths and weaknesses in CHB-related health capabilities in rural Senegal

HEALTH CAPABILITY	SCORE	STRENGTHS	VULNERABILITIES
Health status and health functioning Self-reported health status Health conditions	55	- Good self-reported health - Most CHB patients are asymptomatic	- Scattered health issues: disability (blindness from birth), headaches or bodily pain - Stomach aches are common in CHB patients - Other symptoms include fatigue and dizziness
Health knowledge Own hepatitis B and vaccination status CHB transmission routes, evolution, vaccination, testing, and treatment CHB risk factors Modes of information gathering	33	- Own status sometimes described through parallel with HIV/AIDS as an invisible, dormant, "blood disease" - Recognized as the disease of the bellies, swollen bellies, "pregnant men", and often heard of people who died from it - Smoking and alcohol sometimes mentioned as risk factors - Some awareness of the existence of a vaccine - Exercise and diet named as related healthy behaviors - Main modes of reliable information gathering are radio, posters on baobabs, and healthcare professionals	- Denial and/or low awareness of own CHB status - Name hepatitis B not recognized, no denomination in Sereer - Confusion with "*païs*" (yellow eyes/fever) or completely different diseases: stroke, diarrhea - Confusion on modes of transmission: salamander pee, dirty water or cutlery, tapeworm – often associated with sorcery: cursed food, magic wind, etc. - Rumors or from the elderly advising to consult shamans or traditional practitioners
Health seeking skills and beliefs, self-efficacy Belief in one's ability to avoid CHB complications Ability to acquire CHB-related skills and knowledge Ability to perform behaviors	42	- Widespread confidence in avoiding disease or getting better in the case of sickness - Ability, and willingness to follow advice from health providers, and acquire new skills if needed - Scattered confidence in understanding own body and ability to adopt healthy behaviors (diet, exercise), and translation into behavior changes (changing diet, getting vaccines, etc.)	- Self-depreciation of individuals describing themselves as illiterate or "immature" - Some fatalism with respect to disease/illness or death : God's will as opposed to individual behaviors - Limited ability to acquire skills and knowledge (not asking questions, waiting to be told how to behave, forgetting information, etc.)
Health values and goals Valuing one's health in general Valuing the prevention of CHB complications Valuing CHB-related lifestyle or behaviors	58	- Health in general is highly prioritized - Preventing serious sickness, including in relation to CHB-complications (i.e., death by liver cancer or cirrhosis) is a major concern - Goals in relation to health behaviors focus on consultation, medication and lifestyle (e.g., diet and exercise)	- Conflicting goals: family, meals, work or money - Avoiding CHB-complications rarely identified as a specific goal, neither are CHB-related behaviors (e.g., avoiding alcohol use or peanuts, hygiene, vaccination, etc.) - Prevention is rarely valued or prioritized – except vaccination

Recognizing and countering social norms		- Social norms discouraging from consulting in health facilities recognized and countered	- Defiance towards vaccination or blood sampling not always recognized or countered
(Perceived) Self-governance and self-management Control on one's life Handling one's workload Control of behaviors Seek out and obtain support	55	- Overall perception to be in control of one's own life - Resourceful individuals with strong abilities to manage personal, familial and extra-familial obligations - Frequent habit to reach out to family, and support networks (e.g., neighbors, 'tontine') to seek out, and obtain help and monetary resources	- Limited availability of help or monetary resources is a major obstacle for self-governance and self-management - Separation of duties (household duties versus economic activities or farming), as well as shared meals can be obstacles to controlling behaviors and obtaining help
Effective health decision-making Using knowledge and resources Weighting the short- and long-term costs and benefits Identifying CHB symptoms and pursue management Making healthy choices	40	- Strong profiles employ knowledge and resources in health facilities and staff to make informed decisions - Symptoms related to stomach aches well-identified, and acted upon (i.e., changes in diet) - Healthcare professionals advice or guidelines sometimes prompt healthy choices	- Individuals generally receive information rather than seek it out, and often don't act on it - Long-term costs of foregoing CHB management (i.e., liver cirrhosis or cancer) rarely assessed or underestimated when compared to immediate costs (exams, blood sampling) - Many choices motivated by others' behaviors rather than evidence-based health considerations
Intrinsic motivation to achieve desirable health outcomes Quantifying motivation, and whether internally or externally motivated	54	- Widespread internal motivation to remain healthy - Internal motivation reinforced and/or fueled with advice from healthcare professionals or supportive relatives	- Hierarchical family influences and religious beliefs can be at odds with internal motivation to achieve health outcomes - Internal CHB-specific motivation is low in most individuals
Positive expectations about achieving health outcomes Optimistic or pessimistic viewpoint on personal life and CHB-related health prospects	48	- Perception of the severity of CHB-related complications (worse than HIV/AIDS or malaria) - Some awareness that prevention and monitoring are efficient in preventing complications - Positive expectations when treatment has been prescribed	- Belief that neither traditional medicine, nor standard healthcare facilities can treat advanced liver disease - Belief that health prospects are decided upon by God or fate, in particular when it comes to serious conditions

Social norms Associated with CHB Favorable or unfavorable views Characterization of people (Anti-)Discrimination Norms on decisional latitude in relation to health Changes/resistance to CHB-related social norms	42	- Standard care perceived as a (preferred) complement to traditional medicine, especially for the educated youth or non-Sereer people - Health dispensary, health center and hospitals are efficient in treating some disease - Confined ability to make autonomous health decisions - Perception that studies on health helped reduce mortality - Changes in social norms with more favorable view towards vaccination and prevention	- Swollen bellies believed to be caused by cursed food or malignant wife, to be treated with shamanism or prayers - Strong defiance towards blood sampling (sold to richer people, "guinea pig") - Unfavorable views on alcohol use (Muslim religion) - Hierarchical decision-making penalizing women and the youth - Sereer people self-defined as defiant, wait to be really sick to seek care - Stigma attached to swollen bellies, to be kept hidden
Social network and social capital Ability to ask for instrumental and emotional help Existence of groups/networks Detrimental social networks	46	- Resilient networks of solidarity in the extended family for instrumental help and monetary resources - Resource persons (e.g., teacher or nurse among relatives) identified and frequently drawn upon for reliable information and support in maneuvering the healthcare system	- Instrumental help *ad hoc* often limited to emergencies – - Seasonal migrations move people away from social networks - Shame or social exclusion isolate vulnerable individuals - Absence of CHB/health specific groups/networks for information sharing
Group membership influences that may provide instrumental or emotional support, counterbalance or augment CHB-relevant norms	39	- Close relationship with AMBASS study or Sen-B cohort staff facilitates linkage to care - Religion (Catholicism) discourages traditional medicine - No negative influences from neighbors/village association - Teachers and army fellows raise awareness on CHB testing	- Direct family in shamanism, prayers (protestants), or in the charismatic movement is a barrier to blood sampling and CHB management - Absence of social groups and isolation (e.g., non-Sereer) can impede linkage to care - No group dedicated to CHB and/or health promotion - Rumors about deadly vaccination, and blood selling circulating on social networks (What'sApp audios)
Material circumstances Economic resources Neighborhood Water quality Housing status and quality Food availability & quality Other CHB patients and other sources of pollution	50	- Perceived ability to obtain monetary resources when facing emergency expenses - Semi-urban housing facilitates linkage to care - Running water available in most compounds for cooking, farming and livestock farming - Carts and basic amenities (housing) - Basic foods (i.e., millet, peanuts) widely available - Some households with no CHB patients	- Limited monetary resources in relation to amounts required for CHB management (up to 200,000 CFA/year) - Rural areas impede access to health facilities - Water of poor quality (non-drinkable) - Precarious housing (no electricity, low heat protection) - Frequent food insecurity or limited quality (oil, fried foods)

			- CHB patients often living in households with other CHB patients (vertical and horizontal transmissions)
Economic, political, and social security Economic security Political security Social security	29	- Existence of stable jobs in the private and public sectors - Political stability and democratic elections - Social services can cover *ad hoc* hospital invoices (*indigents certificates*), cash transfer program (PNBSF) - Free care for children and the elderly and reduced fees with CBHI schemes	- Low job security (farming, informal work, absence of sickness or pregnancy leaves, etc.) - Absence of health insurance schemes covering all CHB-related expenses (e.g., treatment and DNA viral load) - Cronyism and limited efficiency of public services
Utilization and access to health services CHB-related symptoms Other symptoms Perceived need to see a healthcare provider Existence of services Barriers to access	44	- Symptoms such as headaches, stomach aches, dizziness or fatigue are well-identified - Some of these symptoms indicate a need to consult hospital - CHB management partially available in health centers and regional hospital, fully available in Dakar - Health posts (dispensaries) geographically and financially accessible – ambulances can be called for emergencies	- CHB infection is often asymptomatic, which participates to a low perception of a need for healthcare utilization - Prayers or shamanism more appropriate to address some symptoms - Pharmacy closed at Toucar, long waiting times, out-of-pocket expenses and distance are frequent obstacles - CHB management in Dakar can be problematic without a chaperone who knows the city
Enabling public health and healthcare systems Giving information and developing agency Protecting people Efficient and accountable	48	- Agency promotion from community healthcare workers, local nurses and physicians that build a bridge between populations and the healthcare system - Faith in doctors' advice (legitimate, God's envoy) - CHB testing offered to all pregnancy women and systematic vaccination as part of the Immunization Program - Close monitoring and reminders for visits in the Sen-B cohort study - Perception of good quality of care provided at the local health facilities as well as in the hospitals	- Shyness and embarrassment deter patients from asking questions, especially to non-familiar doctors - Limited acceptability of repeated blood sampling in the absence of treatment and in-depth counseling - Paternalistic approach to CHB management: increased frequency of visits and very close monitoring of treatment - Hygiene and diets are presented as a form of CHB treatment - Limited ability to treat advanced liver disease (viral load outsourced, FibroScan only in Dakar, transplant unavailable in Senegal, etc.); turn-over and shortages in trained staff - Limited accountability following errors in diagnostic - Insufficient support from the Hepatitis Program (PNLH)

4. Discussion

Using a social justice mixed methods sequential design, this study adapts the health capability profile to empirically study the CHB-related morbidity and mortality in rural Senegal. To our knowledge, this is the first study to collect and compile data on both internal health capabilities such as knowledge, perceived competency, and motivation as well as external health capabilities such as social norms, type of neighborhood, social networks or living conditions, all linked to health status and health outcomes in relation to CHB.

4.1. Promoting CHB-related health capabilities in rural Senegal

In line with recent calls for a more interactive and multidimensional approaches to social conditions and factors that influence people's health(14), the health capability profile captures a broader, multidimensional and more accurate array of interrelated factors that puts individuals at risk or to be resilient for CHB and successful CHB prevention and/or management in rural Senegal.

The profile highlights elements that had been separately identified in previous studies, such as the health provider's paternalistic approach to linkage to care ("*triage*"), and a focus on dietary changes as a form of CHB management (173), or the limited availability of reliable CHB-related information, centered around the Hepatitis Awareness Day, often of ominous nature and characterized with low evidence, and misinformation, including among self-help networks (174).

From the detailed analysis of individual experiences, the HCP also documents a wide range, and complex inter-relations of elements that can enhance, or impede, people's abilities to avoid CHB-related morbidity and mortality, such as personal experience of a relative dying from CHB-related complications, or denial of own CHB status, respectively. Furthermore, unlike perspectives that focus solely on individual abilities and characteristics, the profile brings out collective capabilities from a sociological and ethnographic point of view. For instance, the profile highlights the interplay between gender-specific decision-making latitude, financial agency, healthcare seeking expectations and behaviors, and geographic mobility associated with seasonal migrations relevant to women or illiterate youth living in the Niakhar area.

Most importantly, this application of the profile revealed obstacles to CHB linkage to care previously undocumented, specifically beliefs on traditional medicine and appropriate care for CHB infection at odds with standard care, as well as the absence of

comprehensive health insurance and social protection schemes, and poor job quality. These elements were attached to shared and serious shortfalls in the health capabilities of knowledge and social norms on the one hand, and on economic and social security on the other hand. These results are consistent with Samb and Ridde's study of free healthcare on women's capability in Burkina Faso, where the authors highlighted the persistence of cultural barriers, and urged for broader social and economic policies to promote overall capability(175). Their results, together with ours, illustrate the value added of applying health capability to investigate empirical issues in rural sSA.

As a whole, the health capability profile can thus better illuminate the most important factors interactions of factors in the system of health production or disease creation in relation to CHB for actionable recommendations in rural Senegal, and other relevant settings, while accounting for complex, unique, and multiple individual experiences.

Flow diagrams constitute a sophisticated tool, whose reach could extend beyond research and into case management approaches(176). Indeed, flow diagrams provide an overview of the overall vulnerability (when capabilities are placed on the left-hand side) or strength (capabilities placed towards the optimal coordinate on the right-hand side). Additionally, they offer more precise information on the level, type, and mutual influences of shortfalls and optima – thus providing a comprehensive picture of people's experiences and abilities in relation to CHB. They present an individualized appraisal of strength and vulnerabilities; help identify virtuous or vicious cycles among health capabilities. With this mixed methods study of vulnerability as a multidimensional and dynamic concept, we meet Addison's criteria for innovative research on poverty(177)[22]. Our characterization of health capability vulnerability as a complex, inter-related, multidimensional and multi-faceted reality for individuals relates to Cissé's work on the poor in Senegal, where she presented poverty inheritance as the result of a complex combination of cumulative negative shocks(178). Similarly to Cissé's identification of positive examples of ways out of poverty (e.g. young people's initiatives), we also illuminate strengths in each capability, as well as positive examples of highly developed health capability profiles. These can offer a way forward in prioritizing action and changes that work in the context. Our results also help guide policy intervention by addressing the largest shortfalls and most detrimental interactions first and moving forward until optimal health capability is attained. Indeed, this principle of 'shortfall inequality', which gives priority to elements and individuals further away from optimality, is at the core of health capability(23). Additionally, by accounting for, and valuing people's unique, and heterogeneous experiences and perceptions, the HCP participates in promoting patients' and engagement in the public health and healthcare systems and their involvement in the design of health policy (179,180).

The above-mentioned principle of shortfall inequality also, and foremost applies to societal and policy changes. Applications of the HCP have, therefore, a transformative orientation and fall within what Creswell and Plano (2018) have defined as a *social justice*

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[22] According to Addison and colleagues, research that is dynamic, multidimensional, and that combines qualitative and quantitative data meets these criteria.

mixed methods study[23]. The empirical findings prompt programmatic, interventional and policy changes up until all health capabilities for all individuals have attained an optimal level of development – starting with those further away —and until all negative influences have disappeared or been replaced with positive ones. The quantification of shortfalls through progressive levels of health capability development, explicitly defined and measured, help prioritize public policies, programs and interventions. In addition, the identification of effective or positive examples in all domains that constitute a person's health capability inform on the content or strategies that can be developed to attain optimal health capability for all – a normative, but realistic objective.

4.2. An empirical application of the health capability profile

A major contribution of our study is to provide a detailed methodology, and an example on how to apply the HCP for empirical investigations. Indeed, while the health capability profile has been applied in other settings and populations (27,28), this is the first empirical mixed-methods study to adapt the entire health capability profile to the specific context of CHB in Senegal.

In particular, our study presents a clear strategy for mixed methods data integration, with the use of individual flow diagrams and of a 0-100 score for each of the fifteen health capabilities derived from a detailed indicative scoring table. The provision of eight distinct levels of health capability development with corresponding descriptions for internal and external health capabilities produces a refined model which enables overcoming many challenges associated with data integration in mixed methods studies (181,182).

Applications to different research questions, settings or populations, can draw from the study design, data collection tools and data integration strategy using capability scores and flow diagrams in this study (see Figure 18).

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[23] Following Ponterotto and colleagues (2013) (159), they characterize social justices study based on an intent of promoting human development, here through health capability, and explicitly aiming to address challenges at the individual and societal level through the integration of both quantitative and qualitative data.
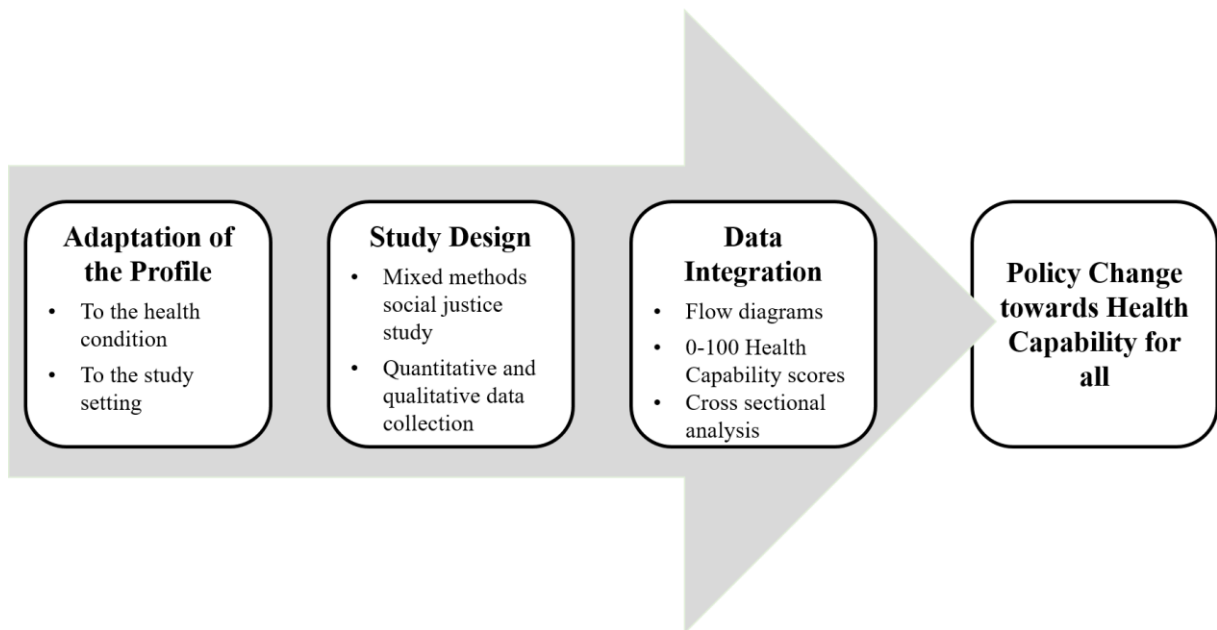
Figure 18. An empirical application of the HCP

This study has limitations. First, the empirical results only apply to the specific health issue and context that the study was designed to address, specifically premature mortality and avoidable morbidity in people living with CHB infection in rural Senegal. In addition, an even more comprehensive application of the HCP would have documented all fifteen dimensions in the general population survey – instead of the eight presented here (pilot module and analysis). Finally, we recognize that the empirical application of the HCP is labor-intensive. It requires a prior understanding of concepts of agency, and capability, followed by an in-depth review, and adaptation of the whole profile to the specific empirical setting to design an appropriate data collection strategy and tools. Data analysis is also two-fold, with both the development of individual health capability profiles employing flow diagrams and health capability scores, and cross-sectional analysis of strengths and vulnerabilities at the health capability level. However, this is a minor drawback in light of the HCP's contribution in understanding and addressing complex health issues.

In addition, the reproducibility of applications of the HCP to other health issues or empirical settings would be facilitated by the methods and tools developed in this study, as well as the ability to avoid some of its design flows. First, the elaboration of the data collection tools, and subsequent tools for data integration analysis can be done expeditiously. First, the whole profile needs to be reviewed and adapted to the health issue and empirical setting building on the scientific literature with inputs from community stakeholders and expert patients, whenever possible and relevant. The interview guide(s) and survey module are then derived from the initial adaptation (presented in Table 7 in the present study) to ensure that all elements of the profile (at the minimum all fifteen health capabilities) are documented in quantitative and qualitative data for all participants. An initial scoring table for all capabilities and stages of development in relation to the research question and context (table B3.2 in this study)

should also be elaborated at this early stage, and later updated during the data collection process if/when new elements relevant to this specific HCP emerge. Second, the study need not be sequential: the identification of participants to be interviewed (sampling for qualitative data collection) could be embedded within the *complete* survey module, which would allow for IDI to be conducted in parallel to quantitative data collection. Third, the scoring of each participant's profile is done simultaneously with the development of the flow diagrams, while those elements are integrated in real-time in the health capability-level cross analysis (Table 11). There are also software that can be coded using the profile's categories to facilitate qualitative and mixed data analysis. For all these reasons, future empirical applications of the profile are likely to be much less time-consuming than this initial study.

5. Conclusion

The HCP addresses most of the criticism of conventional models, including the health capital and social determinants of health models. In particular, it moves away from the segmented quantification of the contribution of resources to health outcomes and accounts for uncertainly, multiple causes, and heterogeneous effects of similar resources or individual traits on overall health capability. The HCP is a more accurate framework, both to describe individual complex lived experiences, and to comprehensively document and quantify cross-cutting strengths and vulnerabilities at the health capability level.

The HCP also significantly contributes to implementation sciences: guided by the profile, and a principle of shortfall inequality, it provides a clear roadmap on the content, and steps to follow in order to move from vulnerability to resilience, for individuals (flow diagrams), and societies (cross-cutting analysis). Last, the HCP is conceptually grounded in normative principles to foster human flourishing and is intrinsically concerned with equity. It, therefore, offers a way forward in reconciling ethics, policy, and health economics.

In a nutshell, the HCP enables an accurate and comprehensive understanding of people's complex lived experiences, and society's strengths and vulnerabilities, and provides detailed empirical guidance (both in the content, and the prioritization) on how to develop programmatic, intervention and policy changes so that to reach a normative, but realistic horizon of healthy lives – for all people living with CHB in rural Senegal.

Chapter 3: Predicting health services utilization with a score of perceived ability to access healthcare[24]

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[24] This chapter is a joint work with Marwan-al-Qays Bousmah, and has been published at *BMC Health Services Research*.

Abstract

Ensuring access to healthcare services is a key element to achieving the Sustainable Development Goal 3 of "promoting healthy lives and well-being for all" through Universal Health Coverage (UHC). However, in the context of low- and middle-income countries, most studies focused on financial protection measured through catastrophic health expenditures (CHE), or on health services utilization among specific populations exhibiting health needs (such as pregnancy or recent sickness).

This study aims at building an individual score of perceived barriers to medical care (PBMC) in the context of rural Senegal, as an explicit measure of the capability of access and utilization of health services. The proposed PBMC score is built using data available from the CMUtuelleS survey on six items: (1) knowing where to go, (2) getting permission, (3) having money, (4) distance to the facility, (5) finding transport, and (6) not wanting to go alone, using individual-level data from 1787 adult participants living in rural Senegal. We build the PBMC score using a stepwise descendent explanatory factor analysis (EFA), and assess its internal consistency through the Cronbach's alpha coefficient. Finally, we assess the validity of the factor-based score by testing its association (univariate regressions) with a wide range of variables on determinants of healthcare-seeking (content validity) and healthcare services utilization (predictive validity).

EFA yields a one-dimensional score combining items 3-6 with a 0.7 Cronbach's alpha indicating good internal consistency. The score is strongly associated – p-values significant at the 5% level – with determinants of healthcare-seeking (including, but not limited to, sex, education, marital status, poverty, and distance to the health facility). Most importantly, the score can predict non-utilization of health services within the household, utilization and non-utilization of health services following an individual's episode of illness, and utilization of health services during pregnancy and birth. Confirmatory factor analysis was conducted on the AmBASS dataset for external validity.

Keywords: Health services utilization; perceived barriers to medical care; universal health coverage (UHC); rural Senegal; sub-Saharan Africa.

1. Background

Achieving universal access to healthcare services is a key element in the Sustainable Development Goal (SDG) n°3 of "ensur[*ing*] healthy lives and promot[*ing*] well-being for all at all ages" (49). Specifically, target 3.8 sets to "achieve universal health coverage [UHC], including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all" (*ibid*). Two conventional metrics for measuring progress towards the financial risk protection aspect of UHC are typically used. The first one is the catastrophic health expenditures (CHE) approach, which identifies whether out-of-pocket (OOP) health expenditures represent a "catastrophic" share of the overall household expenditures, usually set at 40% (183–185). The second measure is impoverishing health expenditures, which document whether the household's falling below the poverty line is attributable to health expenditures (186). These metrics can be easily computed from widely available household surveys.

A recent comprehensive assessment of UHC progress combined CHE prevalence with a measure of service coverage capturing both prevention and treatment indicators at the country level (187). Service coverage is meant to document the aspects of access which are part of UHC and might be at odds with CHE, especially in the context of low- and middle-income countries (LMICs), where lower OOP might reflect the lower quality of health services (188,189), unmet health needs (190), or even a younger, healthier population (191). Indeed, Wagstaff and colleagues found an association between low incidence of CHE and low service coverage in LMICs.

At the population level, access to health services is usually measured through observed health services utilization (192), often within specific populations exhibiting health needs, e.g., children's immunization records, women with a recent pregnancy, or individuals having experienced a recent or chronic illness. It involves heavy data collection processes and long interviews focusing on specific events in a given timeframe (e.g., two years for recent pregnancy and birth, 12 months for inpatient visits, etc.).

In LMICs, the literature has specifically investigated women's self-reported barriers to seeking medical care (193,194), which are collected as part of the Demographic and Health Surveys (DHS) (83). These questions record perceptions on both the financial (possession of, or perceived ability to obtain monetary resources) and the geographic accessibility (distance and transportation means) as well as barriers pertaining to cultural and social norms (i.e., concerns about obtaining permission and going alone) – thereby covering a wide range of elements which have been identified as determinants to healthcare seeking and health services utilization (195–199).

Existing studies have documented an association between reporting at least one significant barrier and lower maternal and prenatal health services utilization (200–202). A 2012 study combined socioeconomic, geographical, and psychosocial barriers from the

2003 DHS in Burkina Faso to create a tri-dimensional score of women's perceived ability to overcome barriers to healthcare seeking (108). The score is validated in relation to a selected number of socio-demographic variables (specifically age, education level, poverty status and rural versus urban living) without investigating associations with the utilization of maternal or child services.

Conceptually, as advanced by Nikiema and colleagues (108), perceived obstacles to healthcare seeking fall in line with a capability-based understanding of access to health services. More precisely, they measures two elements defined by Prah (2010) as part of the health capability of utilization and access to health services, specifically people's ability to obtain health services when they perceive a need to do so, and people's agency with respect to barriers to access and utilization (26).

These two elements also enter the conceptual model of patient-centered access to health care developed by Lévesque and colleagues (2013), where access is defined as "the opportunity to have health care needs fulfilled" (p.4)(203). Access is a six-step process (represented in the successive squares on Figure 19), created by the interactions among five dimensions on the *approachability of health care services*, (to the left of the figure) and five dimensions of individual abilities (to the right of the figure). More precisely, people's ability to obtain health services considering their agency with respect to barriers to access and utilization corresponds to the abilities to seek, reach, and pay defined on the patient's side of the model (also called demand side determinants). This overlap is represented in dotted lines and italic on Figure 19.
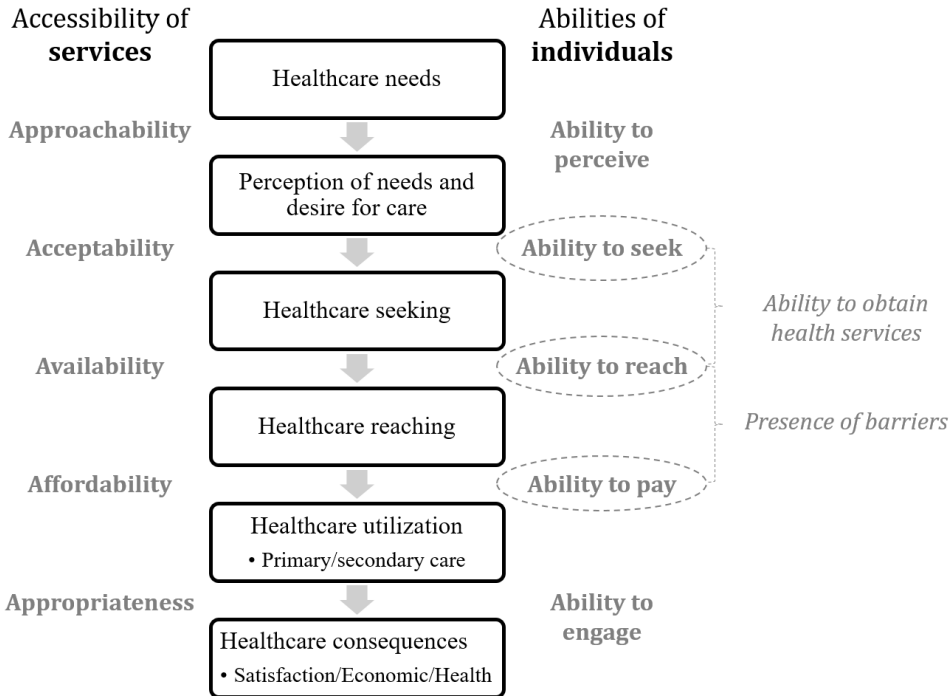
Figure 19. Overlap between the patient-centered access to healthcare and the capability on utilization and access to health services of the Health Capability Profile

In this chapter, we seek to compute a combined score of perceived obstacles to health services seeking, in the context of LMICs, as a complementary, individual-level measure of UHC attainment, in relation to the health capability of access and utilization of health services. Our score will contribute to the literature in at least two different ways: first, the score is estimated on both men and women, and second, its validity is assessed with respect to both socio-demographic variables (construct validity), and health services utilization (predictive validity). Additionally, the score captures people's *ex-ante* ability to access health services, and not simply *ex-post* utilization (attainment).

2. Methods

2.1. Design and setting of the study

We employed individual data from the CMUtuelleS survey, a cross-sectional survey conducted in 2019-2020 among 1787 residents of the Niakhar Health and Demographic Surveillance System (HDSS) in rural Senegal (36). The CMUtuelleS survey aimed at characterizing the implementation of community-based health insurance (CBHI) schemes. Yearly subscription to a CBHI scheme is partially subsidized by the government: it covers 50% of premiums for regular, voluntary subscribers. Members of households which are beneficiaries of the PNBSF are supposed to be eligible to a fully-subsidized subscription to their local CBHI office (204). In the CMUtuelleS survey, both the subscriber/head of household and their partner were interviewed among three groups: voluntary subscribers (n=285), PNBSF recipients (n=176), and non-enrolled in a CHBI scheme (n=1326).

2.2. Data

The CMUtuelleS dataset contained rich self-reported micro-level data on the individuals and their households. All its variables are defined in Appendix C1.

2.2.1. DHS-based items on barriers to medical care

In an adaptation from the 2008 Demographic and Health Survey (DHS)'s woman's questionnaire[25], both male and female participants were asked "*When you are sick, or you want to get medical advice or treatment is any of the following (i) not a problem, (ii) a small problem, or (iii) a big problem:*

(1) Knowing where to go?
(2) Getting permission to go?
(3) Getting the money to pay?
(4) The distance to the health facility?
(5) Having to take transport?
(6) Not wanting to go alone?".

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[25] Specifically, the 2008 DHS model woman's questionnaire read "Many different factors can prevent women from getting medical advice or treatment for themselves. When you are sick and want to get medical advice or treatment, is each of the following a big problem or not a big problem?" and offered "not a big problem" versus "a big problem" as options. The 2012 and 2020 questionnaires used a similar phrasing but only document the items "permission to go", "getting money", "distance" and "go alone".

2.2.2.   Determinants to healthcare seeking

In addition to standard socio-demographic variables, including, age, education level, sex and marital status, data reported GPS coordinates, which were used to compute distances between the household and the nearest health facility and CBHI office, respectively. The survey recorded the participants' health insurance status and self-reported health (12-Item Short Form Survey questionnaire (82), chronic illness, and handicap). Participants reported perceived quality of care at the local healthcare facility, knowledge of community-based health insurance, willingness to pay for health insurance, risk aversion (205), and generalized trust (206). The survey also extensively quantified the household's expenditures (including monthly consumption expenditures per adult equivalent, and out-of-pocket health expenditures) and included several measures of poverty (specifically, monetary, food, and subjective poverty). Catastrophic health expenditures were computed following Xu et al. (183).

2.2.3.   Health services utilization

Finally, the survey documented individual-level health services utilization following health needs (consultation, self-medication, exams, or hospitalization among participants with an episode of illness in the past two months; prenatal consultations and health facility delivery among women who had a live birth in the past two years), as well as unmet health needs at the household level (having forgone healthcare expenses in the past 12 months).

2.3. Building the score

We first ran the Bartlett test of sphericity in order to reject the null hypothesis that inter-correlations are driven by the non-collinearity of sample variables or to sampling error (207). We also computed the Kaiser-Meyer-Olkin measure of sampling adequacy, which measures the proportion of shared variance among variables considered for factor analysis (208). The score was built on DHS-based barriers to medical care using stepwise descendant explanatory factor analysis (EFA). Starting with the full set of items, each was removed one at a time to test whether any of the reduced form factor analyses provided a better fit to the data(69). Accordingly, we dropped variables if the reduced set of items did provide a better fit.

We then selected the number of factor dimensions to retain following scree plot analysis with a conservative Kaiser criterion of eigenvalues >1.1 (209). Factors were rotated to provide a clearer pattern of which items loaded on each factor, and only items that contributed to the factors' dimension (i.e., with factor loadings sufficiently high) were retained to create the final score. The internal consistency of the final set of items was assessed using Cronbach's alpha coefficients, with values over 0.7 indicating good internal

consistency(70). Finally, a factor-based score was computed as the average of items, as it has the advantage of being expressed in the same scale than the original items.

2.4. Validating the score

2.4.1. Construct validity

Following Nikiema and colleagues(108), we assessed the construct validity of the factor-based score by testing its association with a series of variables, which were grouped into three main categories: (i) determinants of healthcare-seeking, (ii) other potentially associated variables, and (iii) catastrophic health expenditures. More specifically, we ran univariate regressions of the factor-based score on each variable (logistic, multinomial logistic, and linear regressions for binary, polytomous, and continuous, variables, respectively).

2.4.2. Predictive validity

We assessed the predictive validity of the factor-based score by testing its association with variables on primary care utilization at the household level (foregone consultation or treatment in the past 12 months), among participants with a recent episode of illness (consultation, auto-medication) and among women with a recent history of live birth (birth in a health facility, pre-natal consultations). We ran univariate regressions of the factor-based score on each variable (logistic, linear, and Poisson regressions for binary, continuous, and count variables, respectively). After each univariate regression, we calculated predictions for the dependent variable at three representative values of the factor-based score: 0 ("not a problem"), 1 ("a small problem"), and 2 ("a big problem"). Predictions are in the form of predicted probabilities for logistic and multinomial logistic regressions, linear predictions for linear regressions, and predicted number of events for Poisson regressions.

In all regressions, standard errors were clustered at the household level to account for intra-household correlation. Regressions were weighted using sampling weights to account for choice-based stratified samples. All estimations were performed using Stata (210).

2.4.3. Confirmatory factor analysis and external validity

The score was computed with confirmatory factor analysis (CFA) in the dataset of the ANRS12356 AmBASS survey using the same set of items selected by EFA in the CMUtuelleS dataset. The AmBASS survey was also conducted in the Niakhar HDSS and features a sample representative of the general adult (age > 15) population living in the

area in 2018-2019 (46,47). Indeed, CFA can be used to validate the structure of scores built with data-driven methods – such as EFA (69). For sensitivity analyses purposes, the score was also re-built using stepwise descendant EFA to investigate potential differences in the structure of the score (i.e. on the set of items selected by EFA). External validity of the score was also assessed with respect to the same two groups of variables, specifically determinants of healthcare seeking (construct validity), and utilization of health services (predictive validity).

3. Results

3.1. Perceived barriers to medical care

Figure 20 presents descriptive results on perceived barriers to medical care. For almost all participants, knowing where to go and getting permission was "not a problem" (98.3% and 98.6% respectively). Having to go alone was "not a problem" either for most participants (88.1%), "a small problem" for about 10% (162 participants), and "a big problem" for only a small share (2.8%). In contrast, over half of the participants (55.1%) reported that having the money to pay was "a big problem", with an extra 531 participants (29.7%) declaring it as "a small problem". Distance to the health facility and finding transport was "not a problem" for a majority of participants (57.2% and 61.1%, respectively), "a small problem" for about a third (32.5% and 28.5%), and "a big problem" for 264 (14.8%) and 187 (10.5%) participants, respectively.
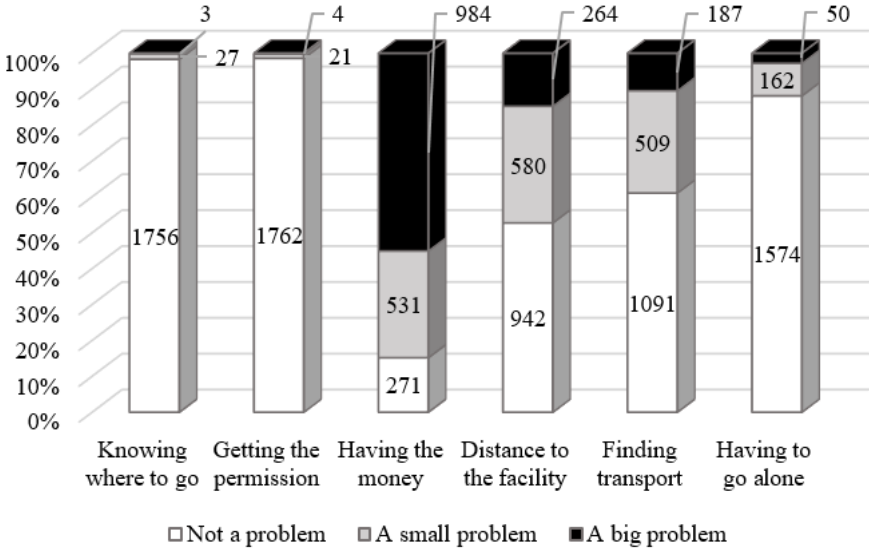
Figure 20. Perceived barriers to medical care (items considered for the score)

3.2. Score building

Our sample passed the Bartlett test of sphericity, rejecting the null hypothesis that variables were not inter-correlated (γ^2=2080.857(15), p<0.001), and gave a value for the Kaiser-Meyer-Olkin measure sufficiently large (0.645) to justify running a factor analysis. Stepwise descendant factor analysis suggested that removing the item "knowing where to go" did not significantly reduce the quality of the factor analysis. Subsequent analyses of the score were, therefore, performed on items (2)-(6). Following EFA and scree plot analysis, only one dimension was retained (2.13 eigenvalue, explaining 42.6% of

variations; detailed results were provided in Appendix C2 in the Supplementary Material). Rotations with weights revealed that only items (3)-(6) significantly contributed to dimension one (loadings > 0.4). The 0.7 Cronbach's alpha of this reduced set indicated good internal consistency[26]. We, therefore, built a factor-based score with the average of items (3)-(6). This score of perceived barriers to medical care (hereafter, PBMC score) was comprised between zero and two, with a mean (standard deviation) value of 0.67 (0.47) – and a 0.5 (0.25-1) median (interquartile range) value.

3.3. Validity

Summary statistics for all variables used are provided in Appendix C3. Univariate regression results are presented in Table 12 (construct validity) and Table 13 (predictive validity). Coefficient estimates (CE) are provided for linear regressions, odds ratios (OR) for logistic regressions, incidence-rate ratios (IRR) for Poisson regressions, and relative-risk ratios (RRR) for multinomial logistic regressions. We also provide graphical representations of the univariate regression results for each of the groups of variables; they are displayed in Appendix C4.

3.3.1. Construct validity

A higher PBMC score was significantly associated (p-value>0.05) with being a woman, being less formally educated, being unmarried, being poor (whether in terms of monetary, food or subjective poverty, or lower monthly consumption expenditures), being in a smaller household, living further away from the nearest healthcare structure or CBHI office. When it comes to distance, a one-point increase in the PBMC score was associated with living 1.32 km further away from the nearest healthcare structure. More specifically, perceiving barriers to healthcare seeking as "not a problem" was associated with living 2.24 km away from the nearest health structure, while perceiving barriers as "a big problem" was associated with living 4.89 km away from the nearest health structure. Age was the only variable not significantly associated with the PBMC score.

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[26] The reduced set was of higher internal consistency than both the original set (0.6295) and the 5-items retained after stepwise descendant EFA (0.6577).

Table 12. Construct validity of the score using univariate regressions

Variable group	Dependent variable	Model	Type of estimate	Estimate	P-value
Determinants of healthcare-seeking	Primary education or higher	Logistic	OR	0.62** (0.10)	0.002
	Female gender	Logistic	OR	1.53*** (0.12)	<0.001
	Marriage	Logistic	OR	0.68* (0.13)	0.042
	Age	Linear	CE	-0.81 (0.92)	0.376
	Monetary poverty (HH level)	Logistic	OR	1.37* (0.19)	0.023
	Food poverty (HH level)	Logistic	OR	1.45** (0.20)	0.007
	Subjective poverty (HH level)	Logistic	OR	1.77*** (0.26)	<0.001
	Monthly consumption expenditures per adult equivalent (in CFA)	Linear	CE	-1611.87* (672.56)	0.017
	Number of adult equivalents in the household (HH level)	Linear	CE	-1.12** (0.39)	0.004
	Distance to the nearest healthcare structure (in km)	Linear	CE	1.32*** (0.13)	<0.001
	Distance to the nearest CBHI (in km)	Linear	CE	0.52** (0.19)	0.006
Other potentially-associated variables	At least fair knowledge of CBHI	Logistic	OR	0.64** (0.09)	0.001
	Health insurance status	Multinomial logistic	RRR (Voluntary)	0.52*** (0.09)	<0.001
			RRR (Subsidized)	1.82** (0.34)	0.001
	Willingness to pay for CBHI (in CFA francs)	Linear	CE	-1019.09*** (216.71)	<0.001
	Chronic illness	Logistic	OR	1.69* (0.37)	0.017
	Handicap	Logistic	OR	1.75* (0.46)	0.031
	Poorer health	Logistic	OR	1.86*** (0.25)	<0.001
	SF-12 Mental Component Summary	Linear	CE	0.35 (0.49)	0.475
	SF-12 Physical Component Summary	Linear	CE	-1.63* (0.65)	0.012
	Perception of healthcare quality	Linear	CE	0.16*** (0.03)	<0.001
	Risk tolerance	Linear	CE	-0.61*** (0.15)	<0.001
	Generalized trust	Linear	CE	-0.41** (0.13)	0.002
Catastrophic health expenditures	Catastrophic health expenditures, 40% threshold (HH level)	Logistic	OR	1.45 (0.43)	0.203
	Catastrophic health expenditures, 30% threshold (HH level)	Logistic	OR	1.05 (0.24)	0.844
	Catastrophic health expenditures, 20% threshold (HH level)	Logistic	OR	1.17 (0.21)	0.370

Notes: * p < 0.05, ** p < 0.01, *** p < 0.001. All variables measured at the individual level, unless when HH-level specified. Robust standard errors (clustered at the household level to account for intra-household correlation) in parenthesis. Regressions were weighted using sampling weights to account for choice-based stratified samples. For linear models, predictions are linear predictions of the dependent variable. For logistic and multinomial logistic models, predictions are predicted probabilities of the dependent variable. Abbreviations: n=number of observations, HH=household, OR=odds ratio, CE=coefficient estimate, CBHI=community-based health insurance, RRR=relative-risk ratio.

A higher PBMC score was associated with lower odds of knowing about the CBHI scheme, lower odds of having voluntarily enrolled in a CHBI scheme, and higher odds of benefiting from a subsidized CBHI enrollment through the PNBSF program. The PBMC score was also negatively associated with the willingness to pay for CBHI schemes. Facing higher barriers to medical care was associated with having a chronic illness, a handicap or disability, and poorer self-assessed health. Interestingly, the PBMC score was tied to physical health (negative association with the SF-12 Physical Component Summary score), but independent of mental health (no association with the SF-12 Mental Component Summary score). Finally, reporting higher barriers to medical care was associated with a lower perception of the quality of local healthcare services, lower risk tolerance, and lower generalized trust.

In contrast, catastrophic health expenditures were not significantly associated with the PBMC score. Note that this result was robust to the use of alternative thresholds of catastrophic health expenditures (namely, out-of-pocket health expenditures ≥ 40%, 30%, and 20% of non-food expenditures, respectively – as displayed in Figure C5.3).

3.3.2.   Predictive validity

Along with the univariate regression results provided in Table 13, Figure 21 displayed graphical representations of the predictions of health services utilization and non-utilization across the distribution of the PBMC score.

Table 13. Predictive validity of the score using univariate regressions

	Population	Dependent variable	Model	Estimate	Predictions		
					At Score=0 ("not a problem")	At Score=1 ("a small problem")	At Score=2 ("a big problem")
Primary care utilization	All adults (n=1,787)	Forgone medical consultation (HH level)	Logistic	3.10*** (0.45)	0.20 (0.02)	0.43 (0.02)	0.70 (0.04)
		Forgone medical treatment (HH level)	Logistic	1.30 (0.18)	0.21 (0.02)	0.26 (0.02)	0.31 (0.04)
	Participants with a recent episode of illness (n=418)	Consulted in a health facility	Logistic	0.63* (0.15)	0.41 (0.05)	0.30 (0.03)	0.22 (0.05)
		Self-medicated	Logistic	2.09** (0.47)	0.20 (0.04)	0.34 (0.03)	0.52 (0.07)
	Women with a recent birth (n=197)	Gave birth in a health facility	Logistic	0.46* (0.16)	0.68 (0.07)	0.49 (0.05)	0.31 (0.10)
		Number of prenatal consultations	Poisson	0.87* (0.06)	3.69 (0.20)	3.20 (0.12)	2.78 (0.25)

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All variables measured at the individual level, unless when HH-level specified. Robust standard errors (clustered at the household level to account for intra-household correlation) in parenthesis. Regressions were weighted using sampling weights to account for choice-based stratified samples. For logistic models, predictions are predicted probabilities of the dependent variable. For Poisson models, predictions are the predicted number of events.

Abbreviations: n=number of observations, HH=household.

The PBMC score was positively associated with the households' probability of forgoing medical consultation, whose probabilities increased along the distribution of the score. For instance, perceiving all four barriers to healthcare seeking as "not a problem" (0 value of the score) was associated with a 20% predicted probability of foregoing medical consultation, while perceiving all barriers as "a big problem" (score value of 2) was associated with a 50 percentage-point higher probability (i.e., 70%). This was true to a lesser extent – p-value only significant at the 10% level – for the probability of foregoing medical treatment, with a 10 percentage-point increase in probability from 21% ("not a problem" for all items with a 0 PBMC score) to 31% ("a big problem", PBMC score of 2).

Among people with a recent episode of illness, perceiving no barriers in seeking medical care (0 PBMC score) predicted a 41% probability of having consulted, versus a 22% probability when perceiving barriers as "a big problem" (value 2 for the PMBC score); conversely, the probability of self-medicating increased from 20% to 52% (for an increase from 0 to 2 of the PBMC score).

Among women with a recent pregnancy, the probability of giving birth in a health facility decreased by 37 percentage points (i.e., from 68% to 31%) when all barriers to medical care were perceived as "not a problem" versus "a big problem" (PBMC score of 0 versus 2). Similarly, the predicted number of prenatal consultations was 3.69 in women with no perceived barriers, versus 2.79 for those who perceived all barriers as "a big problem".

All participants (n=1787)

Forgone medical consultation (HH level)

Forgone medical treatment (HH level)

Participants with a recent episode of illness (n=498)

Consultated in a health facility

Self-medicated

Women with a recent birth (n=197)

Gave birth in a health facility

Number of prenatal consultations
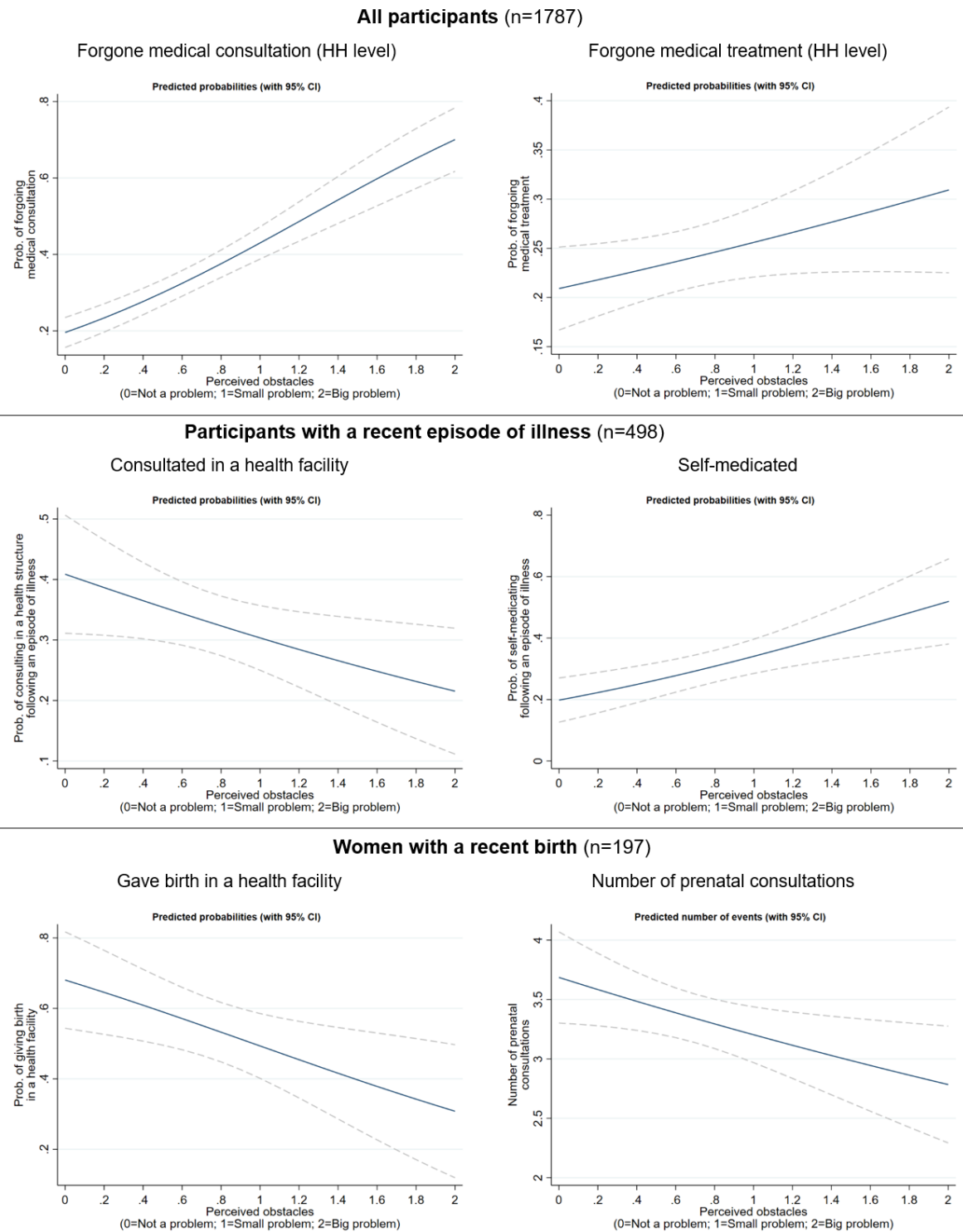
Figure 21. Predicted utilization and non-utilization of health services across the distribution of the PBMC score[27]

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[27] Predicted probabilities (for logistic regressions), and predicted number of events (for Poisson models).

3.3.3. Confirmatory factor analysis and external validity

Details on the CFA and analysis on the AmBASS dataset were reported in Appendix C5. These results provided strong evidence to support the external validity of the PBMC score in the rural area of Niakhar. First, they validated the structure of the score – the choice of the set of items, and its consistency. In the AmBASS dataset, items (3)-(6) (hereafter 'reduced PBMC score') yielded a 0.71 Cronbach's alpha indicating good internal consistency. Stepwise descendant EFA conducted in the AmBASS dataset yielded a one-factor score with the full set of item (hereafter, 'full PBMC score'). The CFA model estimated on items of the reduced PBMC score fitted the data well – as indicated by goodness-of-fit measures, which got worse when computed on the full set of items. Second, they provided additional evidence for construct validity. Both the reduced and full PBMC scores were significantly associated with determinants of health-care seeking, such as education, gender, age, neighborhood or measures of wealth. In addition, the score could be used to predict health services utilization (and non-utilization), measured with self-reported data (i.e. consultation of a shaman during a recent episode of illness or place of birth for the most recent delivery). The score was also valid to predict linkage to care for chronic hepatitis B directly observed in the health facilities[28]. In sum, this analysis confirmed the construct and predictive validity of the four-item PBMC score in the general population of the Niakhar HDSS, but suggested that the structure of the score (i.e. items to be selected for the factor-based score among the 6 perceived barriers to medical care) may be sample-dependent.

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[28] The score was significantly associated with having done at least one visit for CHB management among CHB patients. This was documented using health facilities registries for over 24 months after initial CHB testing – this was also the time at which the questionnaire used to build the score was administered.

4. Discussion

As in the 2012 study on women from Burkina Faso (108), we found that obstacles were higher in under-educated, poorer individuals and those living in rural areas (i.e., in our sample, participants living further away from semi-urban – health – facilities). In contrast, the EFA yielded a one-dimensional factor score, whereas Nikiema and colleagues built a second-stage score combining all six items over three dimensions (specifically, psychosocial, socioeconomic, and geographic barriers). However, the Burkina Faso data was from 2005, only among women, a sizeable share of whom was living in urban areas. This suggests that the structure of the score might need to be validated when computed in very different settings or samples. In line with the literature, we also found that perceived barriers were strongly associated with the utilization of prenatal and maternal health services (201,211). Specifically, we show that our score can be employed to predict the probability of foregoing medical consultation or expenses at the household level, of medical consultation and non-utilization (self-medication) in individuals with a recent episode of illness or suffering from chronic illness (CHB linkage to care), and of maternal health services utilization in women who had a live birth the past two years (documented through delivery in a health facility and the number of prenatal consultations).

4.1. Value-added of the PBMC score

The main contribution of our study is to provide evidence that the PBMC score is valid to predict health services utilization, and non-utilization across a wide variety of health services, health needs, and populations. Conceptually, measures of access focusing on individuals that experienced an event prompting health services utilization (e.g., recent episode of illness or recent pregnancy or birth) merely document *attainments* in health services utilization. In contrast, the PBMC score measures the more broader concepts of people's *ability* to access health services, as well as their *ability* to overcome existing barriers. As such, it provides a more accurate measure of UHC attainment (or lack thereof) at the individual level for the aspects that relate to access to health services[29].

In contrast to studies documenting 'any' perceived barrier (193,201) or focusing on a specific barrier such as distance (200), the PBMC score provides a much more precise and sensitive measure of both the intensity and the width of barriers to medical care. The factor-based score also has the advantage of being expressed in the same scale as the original items, with values that can be easily interpreted: a 0 score corresponds to having declared "not a problem" to all items, a 2 score indicates that all items were reported as "a big problem", and values in between reflect increasing levels in barriers. In addition,

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[29] As illustrated by the absence of association with CHE, the PBMC score captures something besides the financial risk protection aspect, which is also instrumental to UHC attainment.

with a factor-based score, only the structure of the score (i.e. the selection of the set of items used to build the score) may be sample-dependent. Another attractive feature of the PBMC factor-based score is that it can be documented through simple, and relatively light data collection and data analysis processes. As illustrated by the absence of association with CHE, the PBMC score captures something other than the financial risk protection dimension of UHC. This result aligns with Wagstaff and Neelson's finding of diverging patterns between CHE incidence (relating to the financial risk protection's element of CHE) and service coverage (as a measure of the UHC's dimension on access to health services). Indeed, it is likely that people who perceive high financial barriers in accessing healthcare (leading to a higher PBMC score) are less able to afford, and therefore incur, significant healthcare expenses. This highlights once again why the score is valuable in providing information on additional deficits in, and progress towards, UHC attainment.

There is a wide range of possible uses for the score. For instance, the identification of individual and structural characteristics associated with the intensity of the score can help characterize populations and areas that should be targeted by specific interventions or policies aiming at improving UHC. In particular the score can be seen as a measure of shortfall in the health capability of access and utilization of health services, which indicates greater needs in UHC attainments. The score can also be used to evaluate such interventions through the comparison of changes in individual score levels over time (intervention evaluation or longitudinal studies) – to name a few potential applications.

4.2. Limitations

Our study has limitations. One concern is that it relies on self-reported measures, which can be subject to heterogeneity in reporting associated with psycho-social and socio-economic variables – such biases have been extensively documented in the literature on self-assessed health (212–217). In addition, our results reveal an association between the PBMC score and psychosocial variables (specifically risk aversion, generalized trust, and perceived quality of the healthcare system), which ought to be accounted and controlled for in potentially future multivariate regressions. However, we provide ample evidence that our score is significantly associated with objective measures and determinants of healthcare-seeking (distance to the health facility, sex, formal education, several measures of wealth and poverty, etc.).

A second limitation relates to the uni-dimensionality of the score, which is agnostically derived from EFA and validated with a high enough value of the Cronbach's alpha demonstrating good internal consistency, but may overlook differences in the importance or contribution of barriers (whether geographic, economic or socio-cultural). Future studies should investigate potential heterogeneity in the association among perceived barriers and effective utilization.

A third limitation is that, though multidimensional, the PBMC score only provides a partial view of access to healthcare. Items used to build the PBMC score encompasses the "ability to seek", "ability to reach" and "ability to pay" of populations defined in this

framework, but its scope falls short of abilities to perceive and engage that are to Levesque's comprehensive framework of patient-centered access to healthcare (203). In addition, the score does not include supply-side determinants on the availability or quality of healthcare services, professionals, equipment, or medications in the area of interest. This information was not collected during the CMUtuelleS survey, which only included participants' questionnaires. However, these elements undoubtedly affect access to health care. For example, the health facility survey conducted in decentralized facility on resources for chronic hepatitis B (CHB) management described in chapter 2 recorded the absence of equipment for viral load measurement and limited staff for abdominal ultrasound, reflecting a deficit in the element of 'availability'. The survey also highlighted significant out-of-pocket payments associated with biological exams (e.g., 80 USD for viral load), falling short of a criterion of 'affordability'.

The literature has documented low CHB-related knowledge among local healthcare workers(137) as well as practices to advise nutritional diets and 'triage' on patients instead of standard CHB management (173) – illustrating suboptimal supply-side 'appropriateness'. As for the two missing elements on the demand-side, qualitative interviews conducted with CHB patients recorded beliefs that standard healthcare facilities were inferior to traditional medicine for healing CHB (a sign of limited 'ability to perceive a need' to consult a healthcare professional for CHB) and many instances in which patients were unwilling or unable to question healthcare professionals on the content, or implications of CHB management guidelines, in particular with respect to their reluctance to undergo repeated blood sampling in the absence of treatment (reflecting both suboptimal supply-side 'approachability' and 'acceptability', and demand-side 'ability to engage'). All these elements entered the exhaustive CHB-related health capability profile of people living with CHB in rural element, and were important in identifying obstacles and levels for avoiding CHB-related morbidity and mortality – in addition to the quantitative survey responses on perceived barriers to medical care documented in the AmBASS survey. The PBMC score is therefore by no means an exhaustive measure for access to healthcare, but the present study does demonstrates that it is nonetheless valid to (i) measure some important aspects of the ability of health services access and utilization, and to (ii) predict health services utilization in the general population living in the Niakhar HDSS.

A final, and related, limitation is that, by using pre-defined DHS-based items, the PBMC score may overlook context-specific barriers that are relevant to accessing healthcare goods and services in rural Senegal. Bottom-up approaches tailoring items to the specific context gain in internal validity though potentially at the expense of external validity[30]. Indeed, the PBMC score has the ambition of being used in other settings, e.g., through DHS surveys, though data availability is limiting – especially in men[31].

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[30] See for instance the process of building a bottom-up index of well-being for women living in rural Malawi from focus groups and ordered preferences (104,218).

[31] To a lesser extent, data availability is also a concern for women: in the most recent waves of the DHS surveys, women's questionnaires have been reduced to binary responses ("a big problem" versus "not a big problem") for four items (permission, money, distance, and going alone).

5. Conclusion

We used DHS-based items on perceived barriers to medical care to build a one-dimensional score in both men and women living in rural Senegal. This PMBC score is internally consistent and significantly associated with a wide range of determinants of healthcare-seeking (including, but not limited to, sex, education, marital status, poverty, and distance to the health facility). Additionally, the score can predict non-utilization of health services at the household level, utilization and non-utilization of health services following an individual's episode of illness or a diagnostic of chronic illness, and utilization of health services during pregnancy and birth. The score was confirmed using CFA in the general adult population living in the Niakhar HDSS, though further investigation is warranted to confirm its validity in other settings.

As a valid, sensitive, and easily documented individual-level indicator, the PBMC score can be a complement to regional or national level health services coverage to measure health services access and utilization. At the individual or household level, the PBMC score can also be combined with conventional metrics of financial risk protection such as CHE to comprehensively document deficits in, and progress towards UHC.

Discussion

This final section presents a general discussion of the thesis, reflecting on its contributions with respect to both research and policy implications. This chapter also discusses some limitations of this work. It highlights perspectives for future research and concludes by advancing policy recommendations.

1. Contributions

The main contribution of the present work is that it presents an in-depth empirical application of health capability as conceptualized in Prah's health capability model (2010), and operationalized into the health capability profile (26). The three empirical health capability studies presented here in the context of rural Senegal can, therefore, serve as a model for future applications.

The first chapter extends the application of SEM strategies to estimate basic capabilities to the health field. In moving away from the isolated contribution of determinants to health outcomes, it offers a new perspective on health promotion in LMICs. Indeed, the health capability model produces a simultaneous characterization of health status, empowerment within the intermediate social context, and access to health services. The structural part of the model documents heterogeneous individual characteristics associated with shortfalls in these three dimensions. These results provide empirical guidance, in informing where, and how to target policies for health lives. The application of a SEM to empirically estimate health capability is suitable with cross-sectional data. The resulting health capability model accounts for the complex, cumulative, and sometimes opposing influences of individual and social elements – much in the way that a "polysocial risk score" would(14). It is therefore a viable strategy to identify, and prioritize health policy in LMICs.

In terms of policy implications, the health capability model highlights a need to differentiate among policies targeting people with lower immediate health outcomes (e.g., older individuals, living in less agricultural, and bigger households) and interventions aiming at promoting participation in decision-making processes (younger, childless, unmarried, household members). Empirical results also stress different profiles between the latter, and individuals reporting higher barriers to accessing health services, specifically people living in rural areas, without a field of their own, and from households with lower living standards. Finally, these results, together with a principle of shortfall inequality suggest prioritizing interventions for women and permanent residents that accumulate shortfalls in both health status and empowerment.

Chapter 2 presents a detailed protocol for the empirical application of the health capability *profile*. It illustrates how the entirety of the profile is to be reviewed and thoroughly adapted to both the empirical context (including social norms or key stakeholders) and the natural history, risk factors, and epidemiology of the health issue under consideration. This chapter provides rationale for documenting subjective, and objective data, and for integrating qualitative and quantitative research methods. To do so, it introduces tools to document, measure, and address shortfalls and optima in all elements of the profile, specifically the flow diagrams and health capability scores. Chapter 2 contributes to several strands of the literature. First, it provides a sophisticated example of a social justice mixed methods study, as defined by Plano and Creswell (2017)

(160). Second, it introduces novel tools and a clear strategy for the integration of qualitative and quantitative data into mixed results, a main challenge in mixed methods studies(181,182,219). In addition, the flow diagrams constitute a promising tool for health promotion in at least two different ways: it can help structure case management practices(176,220), and it promotes patients' involvement and engagement with, and within the healthcare system(179,180,221).

Another major contribution of chapter 2 is to illustrate how empirical applications of the health capability profile can provide a roadmap for policy makers in tackling complex public health issues. First, the profile is exhaustive in documenting both individual and societal, strengths and weaknesses, in all dimensions and elements that may contribute to people's health. In addition, the profile is practical, and rooted in implementation science (155). Authors such as Ridde (2016) have argued for the development of more and better implementation science to turn evidence-based policy and recommendations into practice in the field of global health (222). In Sub-Saharan Africa, previous studies have analyzed factors of success or failure of health interventions using policy-level framework for analysis (223)– for example investigating community-based interventions for controlling dengue fever, or performance-based financing interventions in Burkina Faso (224,225).

This chapter contributes to this field in providing an individual-level framework to identify gaps (and optima) between observed and optimal capabilities, as well as intermediate stages of development, and positive examples for effectively promoting people's ability to experience optimal health. Results at the health capability level can also serve as a prospective tool for policy design and implementation. More precisely, the quantification of shortfalls employing the levels of health capability development, help identify what is most lacking or essential, as well as what is most immediately achievable – and how so. The profile's preventative orientation and holistic feature can ensure individual and collective resilience – this would be attained with all optimally developed health capabilities. The profile therefore also pictures a counterfactual, a normative horizon. Finally, the profile, rooted in equity, provides a workable principle of shortfall inequality to incorporate this concern in policy and action. This is particularly relevant since the failure to define equity and to provide criteria for inequity and policy response has been identified as a major shortfall of UHC policy document in Senegal (226).

Finally, chapter 3 builds and validates a simple yet sensitive measure of people's ability to access health services in both men and women living in the Niakhar HDSS. The PMBC score is externally valid and can predict health services utilization. This score can be combined with indicators of financial protection, quality of health services or availability of essential drugs and vaccines to provide a comprehensive assessment of progress in UHC attainment. This work supports the documentation of perceived obstacles to healthcare seeking in both men *and* women, with a wide array of potential barriers, and answers measuring their intensity. These policy implications are at odds with the most recent versions of the DHS surveys, which have reduced the set of items and offer only binary options (a big problem versus not a big problem).

Overall, the contributions of this dissertation are two-fold: empirical and theoretical. First, this dissertation provides uniquely comprehensive and discerning empirical results on elements associated with people's ability – or limited ability—to experience optimal health in the rural area of Niakhar. One such example is seasonal migration, a major socio-economic and cultural phenomenon for Sereer *sining* farmers (42). Chapter 1 highlights the positive association between seasonal migrations and optimal levels in both empowerment and health status, which had been previously presented as a causal relationship of migration on health outcomes (92). We are more cautious in allowing for reverse causality: it is possible that our results reflect that better health status and higher ability to participate to decisions creates more opportunities for seasonal migration – especially given that those are in majority work-related. Chapter 2 provides further insights on the complex relationship between migrations and health capability. In the profile, seasonal migration is identified as a lever for access to socio-economic resources which may facilitate access to CHB management (both in terms of seeking and paying for care, and in terms of engaging with the healthcare system), but, at the same time, as an obstacle for continuous follow-up – a prerequisite for the effective prevention of CHB-related morbidity and mortality.

The second main contribution of this overall dissertation relates to applications of capability theory. In sub-Saharan Africa, the concept of 'capability' has been alluded to in both qualitative and quantitative studies of women's health – see for instance dissertations on free healthcare initiatives in Burkina Faso or on utilization of maternal health services in Mali (227,228), and estimations of capability indices in Ethiopia and Burkina Faso (88,108). This is illustrative of a broad interest for the conceptual advances that capability allows in redefining human development through flourishing and effective freedom(21,229).

However, as pointed out in a broader review in the health field, applications of capability have been characterized by a general lack of coherence and consistency (101). This dissertation offers a way forward in presenting empirical studies rigorously derived from capability theory, through the health capability paradigm, first conceptualized into a model that can be appealed to in order to unpack complex relationships (chapter 1), and then operationalized into a profile which constitutes a comprehensive tool for empirical applications (chapter two) and can serve as a guide for the elaboration of quantitative measures of elements particularly relevant to policy targets – such as Universal Health Coverage (chapter 3).

2. Limitations

A few limitations of this work ought to be acknowledged. Firstly, applications of the model presented in chapter 1 is incomplete. The first chapter estimates three of the four dimensions of the health capability model developed by Prah (2010). This is because the local feature of the data set does not allow for estimating heterogeneity in the overall institutional, political and economic environment. Similarly, in chapter 2, the quantitative survey data assesses eight of the fifteen health capabilities of the profile although all fifteen health capabilities are documented in the qualitative interviews. Whenever possible, future applications should aim at applying the whole health capability model or profile.

The PBMC score built and validated in the third chapter, tough multidimensional, measures parts of one's ability to access and utilize health services. This score should, therefore, be complemented with other measurements or indicators. For instance, additional information could document the patients' ability to perceive and to engage as well as supply side dimensions of the patient-centered conceptual framework developed by Levesque and colleagues (203)[32]. Supplementing the PBMC score in reference to the health capability of access and utilization of health services advanced by Prah (2010), would require collecting data on severe or serious symptoms, on perceptions of a need to seek health services, and on the existence of health services to meet these needs (26).

A second limitation of this work is one of external validity. The health capability model, profile, and of the health capability of access and utilization of health services were empirically applied using data collected among individuals living in the Niakhar HDSS in rural Senegal. The adaptation of the health capability profile presented in the second chapter is even more specific as it focuses on capabilities in relation to preventing morbidity and mortality associated with chronic hepatitis B virus infection. The validity of the empirical results presented in this thesis are therefore limited to the specific context of the studies. It has however been argued that the Niakhar HDSS may be representative of rural areas in sub-Saharan Africa (SSA) (46). For instance, some of the key empirical results of chapter 1 are in line with the literature on women's empowerment (67,108,230). In addition, many of results presented in chapter 2, on health-capability strengths and weaknesses relevant to avoiding CHB-related morbidity and mortality are likely to transfer to other endemic areas in rural SSA. Finally, our results in chapter 3, on the validity of PBMC score in are in line with other studies conducted in sub-Saharan Africa, either in terms of building a score of perceived obstacles (108), or in being associated with higher odds of maternal or child health services utilization (201,202). Factor analysis conducted on the AmBASS survey to check for external validity

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[32] On the supply side (i.e. health services), five dimensions of accessibility include approachability, acceptability, availability and accommodation, affordability, and appropriateness. These are mirrored on the patients' side with ability to perceive, ability to seek, ability to reach, ability to pay, and ability to engage, respectively.

suggests that the structure of the score (i.e. the selection of items employed for the final factor-based score) may be sample or context dependent. However, this does not affect the score's validity in predicting health services utilization –and, therefore, in measuring the ability to access health services.

An additional limitation is that most of this work relies on the analysis of self-reported data. There is a wide literature on the existence of significant biases in utilizing measures of self-assessed health, especially in the context of LMICs. For instance, Van Doorslaer and O'Donnell (2010) have provided evidence income-dependent peer effects in the probability of reporting good health, which may overestimate the health status of individuals in lower income groups (231). Back in 2002, Sen also raised concerns about basing analyses on self-reported morbidity, citing "severe limitations" (111).

However, some of the drawbacks associated with the use of self-reported measures, in particular where it comes to self-assessed health, may not be of concern in the present work. First, self-assessed health in neither the only, nor the main outcome of interest. In the first chapter, it is one of three dimensions, all equally important for the creation of health capability. In the second chapter, self-assessed health is complemented with objective measures of health conditions (CHB status, biological markers, and medical examination). Other dimensions of the profile combine subjective and objective measures, for instance in assessing the level of development of material conditions or the enablement of the healthcare systems. The third chapter analyzed self-reported data of perceived obstacles, but these were validated with objective indicators and determinants of healthcare seeking. Indeed, the PMBC score's content validity is confirmed by assessing its association with objectively measured obstacles to access, such as poverty, household expenses and distance to the health facility computed from GPS coordinates. Conceptually, capability places an emphasis on people's ability to choose a life they value. It is therefore necessary to account for people's perceptions, while controlling for "adaptive preferences" or other biases that could play against their own interest. The integration of both objective and subjective data to assess health capability, as presented in this work, offers a way forward.

3. Perspectives for future research

The current work could be extended in many different ways. An obvious perspective for future research is to apply the health capability model, profile or the PBMC score to different settings or health issues. For instance, with Prah and collaborators, we are in the process of drafting a quantitative survey documenting all fifteen dimensions health capability profile in relation to avoiding COVID-19-related morbidity and mortality. The questionnaire is to be administered to a representative sample of individuals living in Germany, the United States, Taiwan and South Korea. Quantitative scores for the fifteen health capabilities will be computed to identify and quantify shortfalls and optima at the health capability level, as well as strong or vulnerable individual profiles. The content of the survey, and methodology employed to derive these scores builds on the quantitative analysis developed in chapter 2. This is just one example of the many other settings and health issues for future applications of the health capability model and profile.

An additional perspective includes extending the present work to the field of economic evaluation and health services research. For instance, a burgeoning research project aims at building on the findings of chapter 2 to design several hypothetical models of CHB management in the empirical context of rural Senegal, and compare their costs, and effectiveness in preventing CHB-related and morbidity. This project relies on a micro-costing methodology for the measurement of resources required for each competing model of CHB management (232,233). Benefits will be assessed with respect to premature mortality and avoidable morbidity associated with CHB. The principle of shortfall inequality might be incorporated following extended cost-effectiveness analysis (ECEA) developed by Verguet and colleagues (2016). Cost measurement adopts a societal perspective, and accounts both for expenses of the healthcare system, as well as for direct and indirect costs incurred by patients. Further, ECEA assigns costs and benefits according to income levels, rural versus urban living or any other relevant categorization relevant for stratification (234). This distributional analysis allows to identify populations that might disproportionally contribute to, and/or benefit from, competing models of CHB management. As a result, one will be able to critically asses which model is more in line with a principle of shortfall inequality – and not simply evaluating the maximization of overall benefits with respect to costs.

Another avenue worth exploring is the development of valid measures for all the agencies and functionings that the fifteen health capabilities of the profile encompass. Chapter 3 is one such example: the PBMC score explicitly documents two agencies of the external health capability n°14. The need for developing and validating additional indicators and measurement scales is particularly stringent in the context of LMICs, and extends beyond the scope of health capability studies. For example, Lemoine and colleagues (2019) have warned against using the APRI biological score to determine treatment eligibility among CHB patients living in SSA, despite it being recommended by

the WHO (235). They provide evidence that the APRI score underestimates liver inflammation in this context. Similarly, the EQ5-D, a widely used measure of health status, and a gold standard for computing utilities in economic evaluation (236), is still not available in Senegal or any of the neighboring countries (237). A wider research perspective is therefore to develop, and validate a set of clinical, biological, and other tools, indicators and scores, that are valid in the context of SSA to measure shortfalls in health capabilities.

4. Conclusion

Coast and colleagues (2008) have argued that applying capability may contribute to health economics in reconciling theoretical, empirical and normative considerations and create a more coherent field (238). This work provides strong evidence that it is, indeed, both possible and desirable to apply health capability as conceptualized and operationalized by Prah (2010) in investigating empirical topics in health and development economics.

The three chapters apply a wide range of methods to measure, compute, and analyze the complexity and multidimensionality of health capability (structural equation models, exploratory and confirmatory factor analysis, qualitative deductive content analysis, flow diagrams, quantitative and integrated health capability scores, etc.). All these methods are clearly described, valid, and conceptually compliant with the concept of health capability. It is, therefore, feasible, to empirically apply health capability.

Additionally, the empirical studies in health capability presented in these chapters address most of the criticisms raised against conventional approaches. First, health capability, as modelled and operationalized by Prah (2010), and applied here in the empirical concept of rural Senegal, provides an accurate, and comprehensive *description* of what contributes to healthy lives, avoiding CHB-related morbidity, and access to health services. In particular, health capability accounts for heterogeneous, complex individual experiences, as well as opposing and cumulative influences. Health capability is intrinsically concerned with *equity*: vulnerable features, areas or individuals are identified and prioritized following a principle of shortfall inequality. Finally, its transformative orientation is based on *pragmatism*. Strengths at the individual and societal levels are highlighted as realistic and normative examples of what can be achieved by individuals and societies working together towards health capability for all.

A few policy recommendations can be advanced from this work. First, results from the health capability model recommend investigating heterogeneous and/or cumulative individual needs in health status, access to health services, and empowerment simultaneously. This cautions about measuring the separate contribution of any element in relation to health outcomes. This work supports the adoption of shortfall inequality as a guiding principle to identify, and prioritize (i) population with cumulative shortfalls (chapter 1) as well as (ii) areas of greater vulnerabilities that need to be addressed in order to prevent premature mortality and avoidable morbidity (chapter 2).

Our results highlight the importance to assess deficits and progress in *ability* to accessing health services as part of the appraisal of UHC attainment, using the PBMC score, or variations of the score in combination with other indicators. Following this work, we advocate for a broadened use of individual health capability profiles developed into flow diagrams as a tool for clinical practice and health promotion, for professionals and individual themselves. Finally, we suggest employing the health capability profile as a comprehensive framework for covering all aspects that contribute to individual and society's ability in promoting healthy lives.

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APPENDICES

A.   Appendices to Chapter 1

Appendix A1. Measures of poverty

The 12356 ANRS AmBASS survey included questions on household and individual earnings, but expenditures, the preferred method to estimate monetary wealth, was not documented. This appendix describes the construction of two standardized indices (the standardized living conditions index and the standardized agricultural resources index), and provides details on overlap among these, and other monetary measures of poverty.

A1.1 Non-monetary (asset) indices

Asset indices, have been developed as non-monetary proxies of household wealth(239). Multiple correspondence analysis (MCA) was preferred to Principal components analysis (PCA) and factor analysis (FA) because this method that makes fewer assumptions about the underlying distributions of indicator variables, and can cater to non-linear and categorical variables (85). Following the literature, variables were selected after a descriptive analysis according to a criterion of homogeneity, i.e. only retained variables that reflected some dimension of wealth were retained (e.g., no demographic variable). Variables were recorded in two, three or four categories, with rare modalities (<5%) merged in order to avoid imbalances caused by variables with too many categories, or modalities with too small a headcount, respectively. The number of dimensions was selected using the Burth method of adjusted inertia, and weights are computed across these dimensions. Indices were standardized following formula (1).

$$(1)\ Standardized\ value = \frac{(value - mean\ value)}{standard\ deviation}$$

27 variables coded in 66 modalities were initially selected for the MCA (see *Table A1.1*). The MCA revealed that the first two dimensions explained 58% and 18% of total inertia respectively (see Table *A1.2*). The analysis of two-dimensional MCA coordinate plot showed that dimension 1 was more heavily weighted by agricultural resources (or lack of), whereas dimension 2 illustrated living conditions (see *Figure A1*). From these dimensions, two indices, labelled "agricultural resources index" (dimension 1), and "living conditions index" (dimension 2), were derived. The latter was inverted so that higher values indicate higher living standards. Following the literature, no adjustment on household size was made – since housing characteristics and durable goods are identical at the household level (240). Descriptive statistics for the indices are presented in *Table A1.3*.
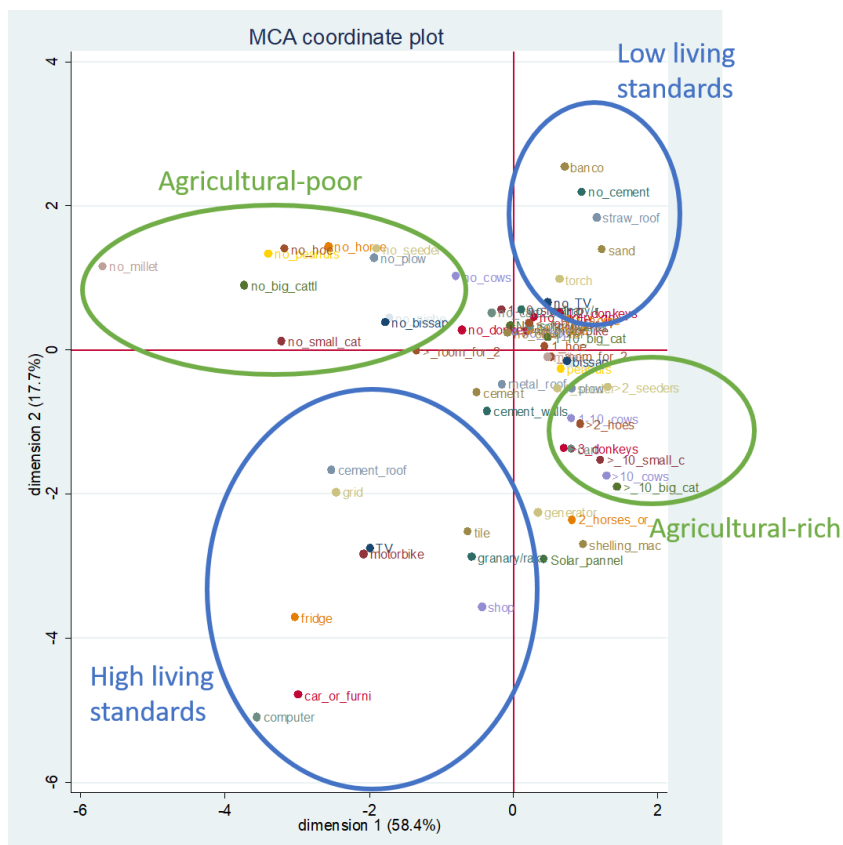
Figure A1. MCA coordinate plot

A1.2 Contrasting measures of poverty

Binary variables of poverty (coded 1 for poor, 0 for non-poor), were derived for several dimensions of poverty, specifically individual earnings, household monetary means, living conditions and agricultural resources (see *Table A1.4*). In a setting where over two-thirds of participants reported no individual earnings (0 XOF) over the past 12 months, a conservative level of annual individual earnings was set at 50,000 XOF (about 75 USD) or under. 532 participants (73.5%) were classified as poor in this dimension. Relative poverty in terms of household monetary resources was defined with respect to the median value in the study population – 420,000 XOF (630 USD) or under – this concerned 359 participants (49.6%).

Relative poverty in the dimensions of the asset indices was defined for participants in the first or the second quartiles at the household level and in the whole sample of the AmBASS survey (n=300 households). In the study population, 275 (38.0%) and 266 individuals (36.7%) were identified as living in households with relatively poor living conditions and agricultural resources, respectively. A variable of poverty in both dimensions of the asset indices classified 104 participants (14.4%) as living in relatively asset poor households. Finally, a variable on multidimensional poverty at the household level was defined for individuals who were classified as poor on the following three dimensions: agricultural resources, living conditions and household monetary resources. There were 45 individuals who met these criteria of multidimensional poverty (6.2% of

the study sample). The limited overlap among measures of poverty (see *Table A1.5*) justified including all of them separately – rather than combined – in the structural part of the model.

Table A1.1 Variables used in the multiple correspondence analysis

Asset	Modalities	Count	%	Agricultural resources index	Living conditions index
TV	no TV	243	80.73%	0.475	-0.657
	TV	58	19.27%	-1.989	2.754
Motorbike	no motorbike	275	91.36%	0.196	-0.267
	motorbike	26	8.64%	-2.076	2.828
Solar panels	no solar panels	270	89.70%	-0.049	-0.334
	solar panels	31	10.30%	0.424	2.908
Fridge	fridge	21	6.98%	-3.027	3.712
	no fridge	280	93.02%	0.227	0.278
Computer or tablet	Computer or tablet	18	5.98%	-3.551	5.090
	none	283	94.02%	0.226	0.324
Luxury goods	car or furniture	26	8.64%	-2.990	4.786
	no car or furniture	275	91.36%	0.283	0.452
Shop	shop	19	6.31%	-0.441	3.561
	no shop	282	93.69%	0.030	0.240
Light	torch	205	68.11%	0.634	-0.976
	grid	58	19.27%	-2.462	1.975
	generator	38	12.62%	0.340	2.249
Number of rooms	< room for 4	47	15.61%	0.213	-0.374
	room for ~3	178	59.14%	0.519	0.093
	> room for 2	76	25.25%	-1.348	0.014
Roof	straw	72	23.92%	1.150	-1.838
	metal	209	69.44%	-0.154	0.474
	cement	20	6.64%	-2.525	1.661
Walls	no cement walls	84	27.91%	0.948	-2.191
	cement walls	217	72.09%	-0.367	0.848
Floor	sand	66	21.93%	1.226	-1.388
	banco	35	11.63%	0.705	-2.534
	cement	168	55.81%	-0.508	0.592
	tile	32	10.63%	-0.631	2.525
Millet	no millet	23	7.64%	-5.692	-1.154
	millet	278	92.36%	0.471	0.096
Peanuts	peanuts	252	83.72%	0.660	0.259
	no peanuts	49	16.28%	-3.396	-1.330
Niebe	niebe	207	68.77%	0.782	0.199
	no niebe	94	31.23%	-1.721	-0.439
Bissap	bissap	213	70.76%	0.735	0.158
	no bissap	88	29.24%	-1.779	-0.382

Small cattle	no small cattle	18	5.98%	-3.215	-0.117
	1-10 small cattle	207	68.77%	-0.163	-0.552
	> 10 small cattle	76	25.25%	1.207	1.530
Big cattle	no big cattle	43	14.29%	-3.733	-0.894
	1-10 big cattle	218	72.43%	0.473	-0.172
	> 10 big cattle	40	13.29%	1.434	1.900
Horse	no horse	70	23.26%	-2.570	-1.434
	1 horse	160	53.16%	0.763	-0.418
	2 horses or more	71	23.59%	0.814	2.355
Cart	no cart	219	72.76%	-0.299	-0.515
	cart	82	27.24%	0.798	1.376
Donkey	no donkey	145	48.17%	-0.713	-0.279
	1-2 donkeys	92	30.56%	0.636	-0.513
	>3 donkeys	64	21.26%	0.700	1.370
Cows	no cows	164	54.49%	-0.801	-1.017
	1-10 cows	92	30.56%	0.801	0.958
	>10 cows	45	14.95%	1.282	1.749
Seeder	no seeder	83	27.57%	-1.905	-1.398
	1 seeder	180	59.80%	0.601	0.535
	>2 seeders	38	12.62%	1.313	0.519
Hoe	no hoe	46	15.28%	-3.173	-1.397
	1 hoe	183	60.80%	0.435	-0.052
	>2 hoes	72	23.92%	0.922	1.025
Plow	plow	212	70.43%	0.813	0.536
	no plow	89	29.57%	-1.936	-1.276
Granary or rake	no granary/rake	252	83.72%	0.113	-0.559
	granary/rake	49	16.28%	-0.582	2.876
Shelling machine, mil or baler	no equipment	277	92.03%	-0.083	-0.234
	At least one	24	7.97%	0.962	2.702

Table A1.2 Results of the MCA

Method: Burt/adjusted inertias   Number of axes = 2

Dimension	Principal inertia	%	cumul %
dim 1	.0399961	**58.43**	58.43
dim 2	.0121297	**17.72**	**76.15**
dim 3	.0017144	2.50	78.66
dim 4	.0014766	2.16	80.81
dim 5	.0013251	1.94	82.75
dim 6	.0012096	1.77	84.52
dim 7	.0005328	0.78	85.30
dim 8	.0000851	0.12	85.42
dim 9	.0000789	0.12	85.53
dim 10	.0000361	0.05	85.59
dim 11	.0000106	0.02	85.60
dim 12	4.15e-06	0.01	85.61
dim 13	5.10e-07	0.00	85.61
Total	.0684498	100.00	100.00

Table A1.3 Descriptive statistics of the standardized indices

Index	Mean	Std	Min; Max	Median	IQR
Agricultural resources index	0.68	1	-3.99; 1.28	0.28	[-0.26;0.63]
Living condition index	-0.375	1	-1.92; 3.43	-0.14	[-0.67;0.57]

Table A1.4 Descriptive statistics for the different measures of poverty (n=724)

Binary variables of poverty	N (%)
No individual earnings (0 CFA)	521 (72.0)
Poor in terms of individual earnings	532 (73.5)
Poor living conditions (1st or 2nd quartiles)	275 (38.0)
Poor in terms of agricultural resources (1st or 2nd quartiles)	*266 (36.7)*
Poor on both asset indices (1st or 2nd quartiles)	104 (14.4)
Poor in terms of household monetary resources	*359 (49.6)*
Multidimensional poverty (household level)	*45 (6.2)*

Table A1.5 Limited overlap among measures of poverty (n=724)

a. Overlap between asset indices		Living conditions	
		Poor	*Non-poor*
Agricultural resources	*Poor*	**104** (14.4)	162 (22.4)
	Non-poor	171 (23.6)	287 9.6)

b. Overlap between monetary measures		Individual income	
		Poor	*Non-poor*
Monetary resources	*Poor*	**302** *(41.7)*	57 *(7.9)*
	Non-poor	1. *(30.2)*	146*(20.2)*

c. Overlap among household-level indicators		Monetary resources	
		Poor	*Non-poor*
Both asset indices	*Poor*	**64** *(8.8)*	59 *(8.1)*
	Non-poor	266 *(36.7)*	354 *(48.9)*

Appendix A2. Selection of items to estimate health capability dimensions

A2.1 Health status

The correlation matrix containing the full set of nine candidate items to estimate health status revealed redundancies (correlation > 0.85) between role-emotional (RE) and role-physical (RP) on the one hand, and mental health (MH) and vitality (VT) on the other (see *Table A2.1a*). Role-physical and role-emotional were combined into a new variable, as were mental health and vitality. These two combined variables were coded 0 to reflect a shortfall in any of the items and 1 otherwise. In addition, a correlation of 1 showed that general health and physical functioning were identical, which prompted deletion of the latter. The reduced set included six items: combined role-physical and role-emotional, combined mental health and vitality, bodily pain, general health, social functioning and fatigue. Examination of the correlation matrix showed values ranging from 0.0964 to 0.6749, suggesting perfectible consistency (see *Table A2.1b*). Indeed, the reduced set yielded a Cronbach alpha coefficient of 0.7358.

Internal consistency was progressively improved with the step-by-step deletion of the combined mental health and vitality item (to 0.7621), general health (0.7873), and finally fatigue to reach a Cronbach's alpha coefficient of 0.8110, which indicated good internal consistency. The correlation matrix of the three remaining items (combined role-physical and role-emotional, bodily pain and social functioning) had values between 0.5171 and 0.6749 (see *Table A2.1c*).

A2.2 Empowerment

The four-item set for the 'Empowerment' dimension exhibited very good internal consistency with a Cronbach's alpha coefficient of 0.8724. It could not be improved by deleting one of the items: coefficients in reduced sets ranged between 0.8159 without the variable on major purchases and 0.8650 without the variable on visiting relatives and friends. With values between 0.5223 and 0.7765, the correlation matrix did not indicate a need to combine or eliminate any of the items (see Table A2.2).

A2.3 Healthcare Access

Six items reflected participant-perceived barriers to accessing healthcare services: knowing where to go, distance, transportation, going alone, getting the money to pay, and getting the permission to go (see Table A2.3a). Cronbach's alpha coefficient for the full set was 0.8283, indicating good internal consistency. With the deletion of the item "Getting the money to pay", it improved to 0.8659 demonstrating very good internal consistency.

The correlation matrix did not identify redundancies or outliers among the five remaining items (values ranging from 0.4918 to 0.7440, see Table A2.3b). A more restricted set of items did not lead to an increase in the Cronbach's alpha coefficient (smallest drop observed deleting 'knowing where to go' at 0.8418; biggest drop observed deleting 'transportation' to 0.8270).

Table A2.1 Correlation matrices for 'Health status' dimension

A2.1a. Full matrix

	RP	RE	PF	BP	VT	GH	SF	MH	FT
RP	1.0000								
RE	*0.8589*	1.0000							
PF	0.3151	0.3028	1.0000						
BP	0.5276	0.5270	0.2433	1.0000					
VT	0.1037	0.0835	0.1802	0.0439	1.0000				
GH	0.3151	0.3028	*1.0000*	0.2433	0.1802	1.0000			
SF	0.7056	0.6872	0.2466	0.5713	0.1117	0.2466	1.0000		
MH	0.1112	0.0982	0.1870	0.0490	*0.8919*	0.1870	0.1168	1.0000	
FT	0.3780	0.3592	0.1813	0.3329	0.0858	0.1813	0.4223	0.1022	1.0000

A2.1b. Reduced set (six items)

	RP & RE	BP	VT & MH	GH	SF	FT
RE & RP	1.0000					
BP	0.5171	1.0000				
VT & MH	0.0964	0.0502	1.0000			
GH	0.3035	0.2453	0.1866	1.0000		
SF	0.6749	0.5780	0.1171	0.2485	1.0000	
FT	0.3386	0.3413	0.1033	0.1853	0.4278	1.0000

Table A2.1c. Final set

	RP & RE	BP	SF
RP & RE	1.000		
BP	0.5171	1.000	
SF	0.6749	0.5780	1.000

RP: Role-Physical, RE: Role-Emotional, PF: Physical Functioning, BP: Bodily Pain, VT: Vitality, GH: General Health, SF: Social Functioning, MH: Mental Health, FT: Fatigue

Table A2.2 Four-item correlation matrix for 'Empowerment' dimension

	Daily life	Own health	Purchase	Visit
Daily life	1.000			
Own health	0.6120	1.000		
Purchase	0.6517	0.7765	1.000	
Visit	0.6735	0.5223	0.5528	1.000

Table A2.3 Correlation matrices for 'Healthcare access' dimension

A2.3a. Full matrix

	Knowing where to go	Permission	Money	Distance	Transport	Going alone
Knowing where to go	1.000					
Permission	0.6785	1.000				
Money	0.2841	0.2744	1.000			
Distance	0.4938	0.4930	0.3315	1.000		
Transport	0.4961	0.5232	0.3075	0.7428	1.000	
Going alone	0.5931	0.5753	0.2244	0.5269	0.5847	1.000

A2.3a. Final set (five items)

	Knowing where to go	Permission	Distance	Transport	Going alone
Knowing where to go	1.000				
Permission	0.6786	1.000			
Distance	0.4918	0.4910	1.000		
Transport	0.4935	0.5207	0.7440	1.000	
Going alone	0.5932	0.5754	0.5248	0.5819	1.000

Appendix A3. Intermediate steps in building the structural part of the model

Table A3.1 Indirect effects (unstandardized estimates) for the intermediate steps of the structural part of the model

	Health status			Empowerment			Healthcare access		
	(1)	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
Health status	–	–	–	–	–	–	–	–	–
Empowerment	–	–	0.109*	–	–	–	–	–	–
Healthcare access	–	–	-0.089*	–	–	–	–	–	–
Age	-0.027***	-0.027***	-0.029***	0.017***	0.018***	0.018***	0.001	–	–
Being a women	-0.304***	-0.308***	-0.229*	-0.758***	-0.760***	-0.760***	-0.033	–	–
Being married	0.146	–	–	0.447***	0.451***	0.459***	0.003	–	–
Being a parent	0.021	–	–	0.618***	0.604***	0.600***	-0.279	–	–
Household size	-0.020**	-0.020**	-0.020**	-0.005	–	–	-0.005	–	–
Attended primary school	0.108	–	–	-0.352***	-0.329**	-0.320**	0.157	–	–
Attended secondary school	-0.172	–	–	0.177	–	–	-0.157	–	–
Semi-urban residency	0.072	–	–	-0.056	–	–	0.665***	0.605***	0.599***
Temporary migration	0.331**	0.325**	0.277**	0.459***	0.479***	0.479***	0.065	–	–
Own field for farming	-0.253*	-0.244*	-0.178	0.156	–	–	0.749***	0.761***	0.761***
Individual earnings	0.021**	0.021**	0.019*	0.024**	0.025**	0.025**	0.005	–	–
Monetary means per head	-0.033	–	–	-0.049**	-0.050**	-0.052**	-0.031	–	–
Agricultural resources	0.147***	0.167***	0.193***	-0.312***	-0.318***	-0.318***	-0.133*	-0.115*	-0.115*
Living conditions	0.039	–	–	-0.007	–	–	0.236***	0.214***	0.210**
PNBSF recipient	0.121	–	–	0.023	–	–	0.222	–	–

Table A3.2 Goodness-of-fit measures for the intermediate steps of the structural part of the model

Model	Direct effects	Interactions among latent variables (dimensions)	N obs.	Chi² (df)	RMSEA [90% CI]	CFI	TLI
(1)	All	No	708	377.124 (192)	0.037 [0.031-0.042]	0.981	0.975
(2)	10 % level	No	713	298.824 (194)	0.028 [0.021-0.034]	0.989	0.987
(3)	10% level	Towards health	713	298.097 (194)	0.027 [0.021-0.033]	0.989	0.987

Appendix A4. Confirmatory factor analysis (CFA)

Table A4.1 presents are estimates for both CFA and EFA measurement models (there are no structural set of equations between latent factors or with exogenous variables). In the three-factor EFA, two CFA indicators of **healthcare access** - distance and transportation – loaded on **health status**. Conceptually, it is not surprising that the latent dimension of health can be estimated using indicators of geographical accessibility (for example, the distance to the healthcare facility will be more problematic for someone in poor health). However, these loadings were both under 0.3, a much lower weighting than indicators for health status, which were all above 0.85.

With regard to the '**empowerment'** dimension, only the pre-specified indicators for its measurement had a significant loading. The pre-specified indicator "having the final say in major purchases" used to measure '**empowerment'** also had a significant, albeit low load coefficient (0.15) on another dimension ('access'). The ability to participate in decision-making regarding major purchases could facilitate access to healthcare, whose costs can be considered major household expenses.

The goodness of fit measures suggest a slightly better fit of the EFA. However, there were no major differences in how the dimensions were estimated, and how they fit the data (see *Table A4.2*).

Table A4.1 Unstandardized estimates of the EFA and CFA measurement models

	Health status		Empowerment		Healthcare access	
	CFA	*EFA*	*CFA*	*EFA*	*CFA*	*EFA*
Role-physical and role-emotional	**0.945***	**0.945***	–	0.015	–	-0.016
Bodily Pain	**0.843***	**0.856***	–	-0.006	–	0.050
Social functioning	**0.975***	**0.963***	–	-0.058	–	-0.011
Final say on own health	–	-0.001	**0.960***	**0.959***	–	-0.009
Final say on daily life	–	-0.046	**0.956***	**0.949***	–	0.018
Final say on major purchases	–	0.027	**0.977***	**1.002***	–	**0.150***
Final say on visits to relatives	–	-0.100	**0.913***	**0.894***	–	-0.107
Going alone	–	0.009	–	0.056	**0.888***	**0.913***
Transportation	–	**0.277***	–	-0.012	**0.962***	**0.990***
Distance	–	**0.299***	–	0.024	**0.944***	**0.986***
Getting permission	–	-0.024	–	-0.051	**0.919***	**0.909***
Knowing where to go	–	-0.072	–	-0.099	**0.923***	**0.901***

*p-value significant at the 5% level.

Table A4.2 Goodness of fit of CFA vs. EFA models

Model	N obs.	Chi^2 (df)	RMSEA [90% CI]	CFI	TLI
CFA	724	143.790 (51)	0.050 [0.041-0.060]	0.994	0.992
EFA, 3 factors	724	89.159 (33)	0.048 [0.037-0.061]	0.996	0.993

Appendix A5. Indirect effects of the structural model

Table A5.1 Estimates for the indirect effects of the structural part of the model

	Health status		Empowerment		Healthcare access	
	Raw	*Std.*	*Raw*	*Std.*	*Raw*	*Std.*
Health status	–	–	–	–	–	–
Empowerment	**0.131*****	**0.158*****	–	–	–	–
Healthcare access	-0.091*	-0.091*	–	–	–	–
Age	**-0.030*****	**-0.026*****	**0.018*****	**0.013*****	–	–
Being a women	–	–	**-0.785*****	**-0.565*****	–	–
Being married	–	–	**0.460*****	**0.331*****	–	–
Being a parent	–	–	**0.598*****	**0.430*****	–	–
Household size	**-0.020****	**-0.018****	–	–	–	–
Attended primary school	–	–	**-0.318****	**-0.229****	–	–
Semi-urban residency	–	–	–	–	**0.600*****	**0.520*****
Temporary migration	**0.268*****	**0.232*****	**0.479*****	**0.344*****	–	–
Own field for farming	–	–	–	–	**0.778*****	**0.675*****
Individual earnings	–	–	**0.027****	**0.019****	–	–
Per head monetary means	–	–	**-0.052****	**-0.037****	–	–
Agricultural resources	**0.211*****	**0.182*****	**-0.318*****	**-0.229*****	–	–
Living conditions	–	–	–	–	**0.210****	**0.182****

P-value significant at the 1%***, 5%** or 10%* level.

Appendix A6. Robustness checks: measurement part of the model

Table A6.1 Goodness-of-fit measures for alternative indicators

Model	Indicators	N obs.	Chi² (df)	RMSEA [90% CI]	CFI	TLI
(1)	Autonomous decision	713	345.322 (198)	0.032 [0.027-0.038]	0.983	0.980
(2)	Categorical indicators	713	363.094 (198)	0.034 [0.029-0.040]	0.980	0.976
(3)	Larger sets for decision & health	713	767.152 (276)	0.046 [0.042-0.050]	0.957	0.951

Table A6.2 Total effects (unstandardized estimates) of the structural part of the model for alternative indicators

	Health status			Empowerment			Healthcare access		
	(1)	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
Health status	–	–	–	–	–	–	–	–	–
Empowerment	**0.175*****	**0.196*****	0.095*	–	–	–	–	–	–
Healthcare access	**-0.135*****	-0.012	0.050	–	–	–	–	–	–
Age	**-0.028*****	**-0.032*****	**-0.029*****	**0.033*****	**0.027*****	**0.018*****	–	–	–
Being a women	**-0.248*****	**-0.222*****	-0.075*	**-1.417*****	**-1.138*****	**-0.785*****	–	–	–
Being married	0.017	**0.082*****	0.043	0.100	**0.417*****	**0.455*****	–	–	–
Being a parent	0.026	**0.091*****	0.057	0.147	**0.467*****	**0.600*****	–	–	–
Household size	**-0.021****	**-0.021****	**-0.021****	–	–	–	–	–	–
Attended primary school	0.003	-0.031	-0.030	0.016	-0.157	**-0.314****	–	–	–
Semi-urban residency	**-0.081****	-0.008	0.029	–	–	–	**0.600*****	**0.652*****	**0.570*****
Temporary migration	**0.334****	**0.407*****	**0.269****	0.084	**0.369*****	**0.479*****	–	–	–
Own field for farming	**-0.104****	-0.008	0.035	–	–	–	**0.771*****	**0.698*****	**0.705*****
Individual earnings	**0.009*****	**0.008*****	0.003	**0.051*****	**0.042*****	**0.026****	–	–	–
Monetary means per head	-0.009	**-0.012*****	-0.005	-0.051*	**-0.060*****	**-0.052****	–	–	–
Agricultural resources	**0.171*****	**0.199*****	**0.227*****	**-0.268*****	**-0.315*****	**-0.318*****	–	–	–
Living conditions	-0.028*	-0.002	0.014	–	–	–	**0.207****	**0.215****	**0.272****

P-value significant at the 1%***, 5%** or 10%* level.

Appendix A7. Robustness checks: interactions among latent variables

Table A7.1 Goodness-of-fit measures for models with alternative interactions among dimensions of health capability

Model	Interactions among dimensions	N obs.	Chi² (df)	RMSEA [90% CI]	CFI	TLI
(1)	Among all dimensions	713	326.339 (191)	0.031 [0.025-0.036]	0.987	0.984
(2)	From empowerment	713	329.921 (198)	0.031 [0.025-0.036]	0.987	0.984
(3)	Towards empowerment	713	339.235 (199)	0.031 [0.026-0.037]	0.986	0.983
(4)	Towards healthcare access	713	337.847 (198)	0.031 [0.026-0.037]	0.986	0.983

Table A7.2 Total effects for models with alternative interactions among dimensions of health capability

	Health status				Empowerment				Healthcare access			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Health status	–	–	–	–	-0.140	–	–	–	0.005	–	–	**-0.233*****
Empowerment	**0.257*****	**0.149*****	–	–	–	–	**0.117*****	–	-0.054	**-0.208*****	–	-0.101*
Healthcare access	-0.115	**-0.098*****	–	–	**-0.166****	–	**-0.213***	–	–	–	–	–
Age	**-0.027*****	**-0.028*****	**-0.027*****	**-0.027*****	**0.017*****	**0.017*****	**0.018*****	**0.017*****	-0.001	**-0.003*****	–	-0.001
Being a women	**-0.206*****	**-0.111****	–	–	**-0.777*****	**-0.743*****	**-0.784*****	**-0.720*****	0.044	**0.154*****	–	**0.144*****
Being married	0.120*	0.065*	–	–	**0.453*****	**0.437*****	**0.465*****	**0.430*****	-0.025	**-0.091****	–	**-0.086****
Being a parent	**0.155*****	**0.093****	–	–	**0.586*****	**0.622*****	**0.623*****	**0.629*****	-0.033	**-0.129****	–	**-0.126****
Household size	**-0.018****	**-0.020****	**-0.021****	**-0.020****	0.003	–	-0.002	–	0.000	–	–	0.002
Attended primary school	-0.081*	-0.049*	–	–	**-0.305****	**-0.330****	**-0.339*****	**-0.342****	0.017	**0.068****	–	**0.068****
Semi-urban residency	-0.068	-0.060*	–	–	**-0.098****	–	**-0.126*****	–	**0.595*****	**0.612*****	**0.591*****	**0.623*****
Temporary migration	**0.326****	**0.331****	**0.326****	**0.308****	**0.473*****	**0.454*****	**0.494*****	**0.451*****	-0.027	**-0.094****	–	**-0.122*****
Own field for farming	-0.084	-0.078*	–	–	**-0.120****	–	**-0.146****	–	**0.734*****	**0.794*****	**0.687*****	**0.780*****
Individual earnings	0.007*	0.004*	–	–	**0.028****	**0.025****	**0.026****	**0.023****	-0.002	**-0.005****	–	-0.005*
Monetary means per head	-0.014*	-0.007	–	–	**-0.052****	**-0.048****	**-0.051****	**-0.046****	0.003	0.010*	–	0.010*
Agricultural resources	**0.167*****	**0.169*****	**0.167*****	**0.179*****	**-0.311*****	**-0.289*****	**-0.328*****	**-0.294*****	0.017	**0.060****	–	0.040*
Living conditions	-0.023	-0.021	–	–	-0.033	–	**-0.042*****	–	**0.200****	**0.214****	**0.197****	**0.220****

P-value significant at the 1%***, 5%** or 10%* level.

Appendix A8. Robustness checks: subpopulations

Table A8.1 Goodness-of-fit measures for subpopulations

Model	Subpopulations	N obs.	Chi² (df)	RMSEA [90% CI]	CFI	TLI
(1)	Adults (>18 years old)	586	292.718 (198)	0.029 [0.021-0.035]	0.986	0.983
(2)	Women	410	260.964 (187)	0.031 [0.021-0.040]	0.987	0.984
(3)	Men	303	215.925 (187)	0.023 [0.991-0.989]	0.991	0.989

Table A8.2 Total effects for subpopulations

	Health status			Empowerment			Healthcare access		
	Adults	*Women*	*Men*	*Adults*	*Women*	*Men*	*Adults*	*Women*	*Men*
Health status	–	–	–	–	–	–	–	–	–
Empowerment	0.115*	**0.161****	-0.50	–	–	–	–	–	–
Healthcare access	-0.062	**-0.206*****	0.076	–	–	–	–	–	–
Age	**-0.026*****	**-0.028*****	**-0.028*****	**0.012*****	**0.013*****	**0.023*****	–	–	–
Being a women	-0.106*	*N/A*	*N/A*	**-0.926*****	*N/A*	*N/A*	–	*N/A*	*N/A*
Being married	0.050	0.073	-0.002	**0.431****	**0.455****	0.032	–	–	–
Being a parent	0.067	0.072	-0.049	**0.579*****	0.448*	**0.974*****	–	–	–
Household size	-0.018*	-0.016	-0.029*	–	–	–	–	–	–
Attended primary school	-0.039	-0.072	0.010	**-0.337****	**-0.446****	-0.208	–	–	–
Semi-urban residency	-0.033	**-0.136*****	0.033	–	–	–	**0.538*****	**0.659*****	**0.432****
Temporary migration	**0.374****	**0.475****	0.179	0.245	0.276	**0.659*****	–	–	–
Own field for farming	-0.051	**-0.164*****	0.045	–	–	–	**0.826*****	**0.799*****	**0.595****
Individual earnings	0.004	0.004	-0.001	**0.031****	0.023	0.029	–	–	–
Monetary means per head	-0.007	-0.012	-0.001	**-0.057****	**-0.073****	0.025	–	–	–
Agricultural resources	**0.217*****	**0.152***	0.089	**-0.336*****	**-0.315*****	**-0.268*****	–	–	–
Living conditions	-0.014	-0.044	0.016	–	–	–	**0.228****	**0.214****	0.217

P-value significant at the 1%***, 5%** or 10%* level

Appendix A9. Robustness checks: poverty

Table A9.1 Goodness-of-fit measures for alternative measures of poverty

Model	Measures of poverty	N obs.	Chi² (df)	RMSEA [90% CI]	CFI	TLI
(1)	Binary variables for agricultural resources and living conditions	713	294.652 (198)	0.026 [0.020-0.032]	0.990	0.988
(2)	Binary variables for income and monetary means (binary)	713	324.716 (198)	0.030 [0.024-0.036]	0.987	0.984
(3)	Sum of household monetary resources	713	308.289 (198)	0.028 [0.022-0.034]	0.989	0.987

Table A9.2 Total effects (unstandardized estimates) for alternative measures of poverty

A9.2a- Model (1)	Health status	Empowerment	Healthcare access
Health status	–	–	–
Empowerment	**0.112****	–	–
Healthcare access	-0.087*	–	–
Age	**-0.028*****	**0.019*****	–
Being a women	-0.090*	**-0.799*****	–
Being married	0.056*	**0.499****	–
Being a parent	0.070*	**0.626*****	–
Household size	-0.018*	–	–
Attended primary school	-0.029	-0.261*	–
Semi-urban residency	-0.057*	–	**0.656*****
Temporary migration	**0.286****	**0.513*****	–
Own field for farming	-0.064	–	**0.735*****
Individual earnings	0.003	**0.029*****	–
Monetary means per head	-0.004	-0.035	–
Agricultural poverty	-0.158	**0.419*****	–
Living conditions poverty	0.042	–	**-0.484*****

A9.2b- Model (2)	Health status	Empowerment	Healthcare access
Health status	–	–	–
Empowerment	**0.137****	–	–
Healthcare access	-0.072	–	–
Age	**-0.028*****	**0.018*****	–
Being a women	**-0.106****	**-0.776*****	–
Being married	0.063*	**0.462*****	–
Being a parent	0.079*	**0.579*****	–
Household size	-0.018*	–	–
Attended primary school	-0.046*	**-0.332****	–
Semi-urban residency	-0.041	–	**0.570*****
Temporary migration	**0.302****	**0.448*****	–
Own field for farming	-0.053	–	**0.737*****
Income poverty	-0.061*	**-0.447*****	–
Monetary poverty	0.030	**0.219****	–
Agricultural resources	**0.165*****	**-0.312*****	–
Living conditions	-0.012	–	**0.169****

A9.2c- Model (3)	Health status	Empowerment	Healthcare access
Health status	–	–	–
Empowerment	**0.132****	–	–
Healthcare access	-0.092*	–	–
Age	**-0.028*****	**0.018*****	–
Being a women	**-0.103****	**-0.786*****	–
Being married	0.061*	**0.460*****	–
Being a parent	0.079*	**0.600*****	–
Household size	**-0.019****	–	–
Attended primary school	-0.042	**-0.317****	–
Semi-urban residency	-0.056*	–	**0.605*****
Temporary migration	**0.331****	**0.478*****	–
Own field for farming	-0.072*	–	**0.781*****
Individual earnings	-0.003*	**0.026****	–
Household monetary means	-0.006	**-0.045****	–
Agricultural resources	**0.174*****	**-0.315*****	–
Living conditions	-0.020	–	**0.213****

Alternative measures of poverty in each of the model are identified in grey. P-value significant at the 1%***, 5%** or 10%* level.

B. Appendices to Chapter 2

Appendix B1. Health capability scores

Table B1.1 Details on scoring of the quantitative data

ELEMENTS OF THE PROFILE/Survey Item	Item options	Score
HEALTH STATUS AND HEALTH FUNCTIONING		
Self-reported physical health	0-100 SF12 score	0-25
Self-reported mental health	0-100 SF12 score	0-25
Chronic Hepatitis B (CHB) virus infection status	Negative	25
Chronic illness or disability	No	25
CHB-RELATED KNOWLEDGE		
Liver disease: *"Do you know of liver diseases that are also known as swollen bellies, yellow eyes, etc.?"*	Yes	10
Hepatitis B: *"Have you ever heard of hepatitis B?"*	Yes	10
Hepatitis B and liver disease: *"Do you believe there exists a link between hepatitis B and liver disease"*	Yes	10
Testing: *"Have you even been tested for CHB?"*	Yes	10
Hepatitis B vaccine: *"Do you know if there exists a vaccine that protects from hepatitis B?"*	Yes	10
	No/Don't know	0
Vaccine efficient in protecting children's health	Yes	10
Vaccine dangerous for children's health	No	10
Transmission routes: *"Do you believe that someone who has hepatitis B can transmit the disease…?"*		
During sexual intercourse	Yes	5
Talking with someone	No	5
Blood contact	Yes	5
With saliva	No	5
During pregnancy and birth	Yes	5
Through mosquito bites	No	5
HEALTH SEEKING SKILLS AND BELIEFS, AND SELF-EFFICACY		
I feel confident in my ability to remain healthy	Fully agree	25
I now feel capable of managing my health.	Agree	20
I am able to adopt behaviors that enable me to stay healthy.	Neutral	10
I am able to meet the challenge of remaining healthy.	Disagree	5
INTRINSIC MOTIVATION TO ACHIEVE POSITIVE HEALTH OUTCOMES		
"When you go to a health facility for a health issue or a question about your health, you do it…		
… because it is your responsibility or your duty"	Agree	15
… because corresponds to your preferences"	Agree	15
… because it is what you want to do"	Agree	15
… because you believe it is the right thing to do"	Agree	15
… because otherwise you might get in trouble"	Disagree	10
… because this is what your relatives tell you to do"	Disagree	10
… so that your family doesn't get upset"	Disagree	10
… because you want your family to love you"	Disagree	10
SOCIAL NORMS		
Last say in decisions on:	Alone	25
• **A major purchase**	Alongside someone else	15
• **Daily life**	Someone else decides	0
• **One's own health**		
• **Visits to friends and relatives**		

MATERIAL CIRCUMSTANCES		
	Training or studies	5
	Agricultural activity	10
	Nonagricultural activity	15
Household monetary resources per head	None	0
	< 20,000* CFA	5
	20,000-140,000* CFA	10
	> 140,000* CFA	15
Neighborhood	Semi-urban (versus rural)	10
Water source in the compound	Yes	10
Housing and living conditions index	1st quartile (poorest)	0
	2nd quartile	5
	3rd quartile	10
	4th quartile	15
Food security	No food insecurity	10
	Early harvest or food aid	0
Environment (CHB+ living in the compound)	None	15
	One or two CHB+	5
	More than two	0

POLITICAL, ECONOMIC & SOCIAL SECURITY		
Job seasonality	< 3 months or inactive	0
	Studies/training/harvest	5
	3-6 months	10
	6-9 months	15
	9-12 months	20
	12 months	25
Job security	Farm work or studies	5
	Oral agreement	10
	Self-employed	15
	Written contract	20
	Civil servant	25
Government Family Security Grant	Recipient	10
	Non-identified insurance	5
	Community-based	10
	Compulsory/job-based	20
Indigent status/certificate	Ever heard	10
	Heard and ever received	20

ACCESS & UTILIZATION TO HEALTH SERVICES		
History of HBV testing	Yes	10
	No	0
Consultation during recent episode of sickness	Yes (or not applicable)	10
	No	0
Behavior when gets sick or has questions about health	Consultation	10
	Traditional practitioner	5
	Self-medication/nothing	0
Obstacles (7 items): knowing where to go, getting the permission, having the money to pay, distance to the facility, finding transportation, going alone, fear of discrimination	Not a problem	10
	A small problem	5
	A big problem	0

*20,000CFA covers a minimum follow-up (bi-annual consultation and biological checkup including full blood count, AST and ALT). 140,000 CFA covers the follow-up recommended by the Ministry of Health and Social Affairs (minimum follow-up + bi-annual viral load and ultrasound) and the treatment (subsidized at 60,000 CFA annually).

Table B1.2 Integrating qualitative and quantitative data into a health capability score

Score	Level of development	Health Status and Health Functioning	Health Knowledge
0	Nil	Death	No knowledge of hepatitis B
10	Basic 1	Terminal stage or extremely incapacitated	Very little knowledge (heard about it, vague idea)
25	Basic 2	Very poor health (cannot do anything normally)	At least one right piece of information (swollen bellies, virus, existence of a vaccine, etc.)
40	Intermediate 1	Poor health status (very tired, ongoing illness, CHB patient with complications)	Some knowledge, for example about symptoms, transmission or potential complications
55	Intermediate 2	Good health, but some issues (fatigue, or illness, CHB patient with some symptoms)	Acceptable knowledge: knows the name, the main modes of transmission and the natural history
70	Advanced 1	Very healthy (e.g. asymptomatic CHB patient), some risk factors	Good knowledge: knows of hepatitis B, its prevention, the existence of treatment – some minor errors or inaccuracies
85	Advanced 2	Excellent health (rarely sick and only in the past), a few mild risk factors	Very good knowledge without inaccuracies or errors
100	Optimal	Perfect health: no subjective or objective issues, past or present, no risk factor	Expert patient: knows hepatitis B as well as a doctor (e.g. prominent figure of the Saafara Hepatitis patient association)

Score	Level of development	Health-Seeking Skills and Beliefs, Self-Efficacy	Health Values and Goals
0	Nil	Reports being completely incompetent, unable to learn or remember anything	Health completely absent from the individual's priorities and goals
10	Basic 1	Feels generally incompetent, devalues self (e.g. mentions illiteracy as a major limitation)	Very low concern for health with no specific objectives
25	Basic 2	Feels minimally competent: can learn a little, but from others or forgets quickly	Concern for health in general, but pre-empted by other priorities (food, work, family, etc.)
40	Intermediate 1	Feels fairly competent: thinks he can learn and manage his health in general, but cannot give an example	Some health objectives, in relation to disease and healthy habits, but not always a priority
55	Intermediate 2	Feels fairly competent: knows how to learn and manage his or her health and can provide an example	A number of health goals, in relation to disease and healthy habits, most of which are priorities
70	Advanced 1	Feels competent: knows how to learn, how to manage one's behaviors and health with several real-life examples	Health in general is a priority, with several specific objectives, without necessarily having CHB objectives
85	Advanced 2	Feels very competent: continuous learning and adaptation of behaviors including for CHB	Health in general is a priority, with several specific objectives, including CHB (prevention of infection or complications)
100	Optimal	Fully capable of learning and managing their health and CHB risk with many specific examples	Health is the top priority with a large number of specific objectives, including about CHB, and prioritized over else

Score	Level of development	Self-Governance and Self-Management and Perceived Self-Governance and Management to Achieve Health Outcomes	Effective Health Decision-Making
0	Nil	Complete inability to organize one's life or control one's behavior	No individual decision making (passivity, inaction)
10	Basic 1	Very great difficulty in reconciling obligations with health, no possibility of receiving help	Decisions only dictated by others (carrying out orders, following advice blindly)
25	Basic 2	Manages to organize their personal life and daily routine but often at the expense of health	Externally motivated decisions because the order/advice comes from someone in authority or legitimate (doctor)
40	Intermediate 1	Overall manages to organize their daily life and fulfill obligations, has some control over their behavior s	Decisions mainly motivated by an order/advice with a hint of personal reflection e.g. some questions
55	Intermediate 2	Organizes well to manage daily life and personal constraints, frequently controls their behaviors	Decisions motivated by personal reflection and findings following information seeking
70	Advanced 1	Good organization of daily life, control of behavior, ability to ask for help when needed	Information seeking and decision making involving health behavior changes
85	Advanced 2	Excellent organization of daily life, control of behaviors including CHB relevant ones, seeks and receives help	Information seeking and rational decision making on health behaviors including in relation to CHB
100	Optimal	Optimal organization, ability to manage daily life, personal and professional life and health, including CHB concerns	Expert in CHB decision making: excellent information seeking, rational and systematic process, etc.
Score	Level of development	Intrinsic Motivation	Positive expectations
0	Nil	Complete lack of intrinsic motivation for health concerns	Absolute pessimism
10	Basic 1	Externally constrained health behaviors and concerns (laws, obligations, religion, etc.)	Very pessimistic (optimistic) despite excellent (very poor) health and prognosis
25	Basic 2	Externally motivated health behaviors and concerns only (family, health professionals)	High pessimism (optimism), at odds with good (bad) health/prognosis
40	Intermediate 1	External motivation with a vague idea that health is important in itself	Optimism (pessimism), at odds with a worrying (encouraging) health status/prognosis
55	Intermediate 2	Sources of external motivation that coexist with an internal motivation that values health as an end in itself	Small discrepancy between health status/prognosis and state of mind regarding health prospects
70	Advanced 1	Strong internal motivation with some external motivation (family, health professionals)	Rather optimistic expectations, slightly disconnected from health status or prognosis
85	Advanced 2	Very strong internal motivation, health is valued as an end in itself, without external motivation	Optimistic expectations consistent with health status or prognosis
100	Optimal	Optimal intrinsic motivation to be healthy and avoid CHB-related morbidity as an end in itself	Expectations as optimistic and realistic as health status and prognosis permit

Score	Level of development	Social norms	Social Networks and Social Capital for Achieving Positive Health Outcomes
0	Nil	Social norms in complete opposition to the recommendations, very strong discrimination, no decision-making	Complete lack of instrumental or emotional support, no reliable information
10	Basic 1	Social norms very much at odds with recommendations, strong discrimination, poor decision-making	Very little reliable information and instrumental and emotional support available for health in general
25	Basic 2	Social norms at odds with recommendations, hierarchical decision-making, some discrimination	Some information available, rare instrumental **or** emotional help from relatives
40	Intermediate 1	Few social norms at odds with recommendations, decision making possible	Rare instrumental **and** emotional support, emerging information sharing networks
55	Intermediate 2	Fairly supportive social norms for CHB prevention and management, including autonomous decision making	Occasional instrumental and emotional support, information sharing networks - not always reliable
70	Advanced 1	Decision-making consistent with CHB management, social norms supportive of prevention	Frequent instrumental and emotional support, established information sharing networks
85	Advanced 2	Highly supportive social norms for CHB prevention and care: well-regarded and widespread practices	Continuous instrumental and emotional support, established and reliable information sharing networks
100	Optimal	Social norms fully enabling with respect to decision making and CHB management	Optimal instrumental and emotional support, excellent information sharing networks
Score	Level of development	Group Membership Influences	Material circumstances
0	Nil	Groups in complete opposition to CHB prevention and management recommendations	Absolute poverty, living conditions that threaten survival
10	Basic 1	Groups at odds with CHB management and prevention	Extreme poverty, living conditions that barely allow for survival (unsanitary housing, food insecurity, etc.)
25	Basic 2	Groups not particularly compatible with HBV management and prevention	Poor living conditions (housing, food), monetary poverty, several CHB patients in the household
40	Intermediate 1	No influence of membership groups on HBV management or prevention	Very limited monetary resources, precarious living conditions (housing, food), one CHB patient in the household
55	Intermediate 2	Groups compatible with CHB prevention and/or management	Limited monetary resources, modest living conditions (acceptable housing, food available)
70	Advanced 1	Groups that facilitate CHB prevention and/or management	Good living conditions, sufficient monetary resources, decent housing and sanitation, diversified food
85	Advanced 2	Groups that strongly encourage CHB prevention and/or management	Excellent living conditions and monetary resources, no CHB patients in the household
100	Optimal	Groups that are fully involved in CHB prevention and/or management	Optimal living conditions: ample monetary resources, comfort, food, sanitation, and no CHB patients

Score	Level of development	Economic, political and social security	Utilization and Access to health services
0	Nil	Absolute insecurity: war or natural disaster, absence of economic activity and of social protection	No utilization or access to health services at all
10	Basic 1	High level of insecurity: significant political unrest, economic instability and lack of social protection	No perceived need and/or almost insurmountable barriers to access or utilize health services
25	Basic 2	High insecurity in at least 2 of the 3 dimensions mentioned above	Low perception of need + very significant barriers to accessing health services (distance, money, unavailability)
40	Intermediate 1	Significant insecurity in at least 1 dimension, residual insecurity in the other 2	Perceived need for utilization but significant barriers that restrict access to health services
55	Intermediate 2	Residual insecurity in all 3 dimensions e.g., inadequately protected economic activity, imperfect political system	Intermittent utilization of health services due to multiple barriers to access
70	Advanced 1	Security in 1 of the 3 dimensions, residual insecurity in the other 2	Regular utilization of health services despite some residual barriers (e.g., only in case of serious symptoms)
85	Advanced 2	Security in 2 of the 3 dimensions, residual insecurity in the 3rd	No specific barriers to access and frequent utilization of health services
100	Optimal	Optimal security: stable and efficient political system, favorable economic situation and very strong social protection	Optimal access to and utilization of health services for any symptom or health issue

Score	Level of development	Enabling public health and Health Care systems
0	Nil	Public health system and health services are non-existent and/or completely abusive
10	Basic 1	Jeopardizing, paternalistic and unaccountable public health system and health care services
25	Basic 2	Public health system somewhat protective, rather paternalistic and rarely accountable
40	Intermediate 1	Fairly protective public health systems; occasional dialogue with patients and procedures for accountability
55	Intermediate 2	Fairly protective public health systems; intermittent dialogue with patients and procedures for accountability
70	Advanced 1	Protective public health systems; frequent dialogue with patients and procedures for accountability
85	Advanced 2	Protective public health systems; routine dialogue with patients and procedures for accountability
100	Optimal	Fully protective, efficient, and accountable patient-centered public health system and health services

Appendix B2. Characteristics of participants to the qualitative data collection

Table B2.1 IDI of AmBASS participants (n=40)

ID	Age	Sex	Education	Occupation	CHB patient	CHB-related healthcare utilization
12	49	F	Literacy	Street vendor	Yes	3 visits to Niakhar's center
31	22	F	Literacy	Tailor	No	N/A – Good CHB knowledge
109	40	M	None	Hairdresser	Yes	Absent for follow-up exams
115	48	F	Literacy	Farmer/healer	Yes	Refused follow-up exams
120	35	F	Religious	Farmer/home sell	Yes	Refused follow-up exams
164	17	M	High school	Student	Yes	Several visits to Dakar
182	19	M	High school	Student	Yes	Refused follow-up exams
196	28	M	University	Teacher	Yes	1 visit to Niakhar's center
296	24	F	None	Inactive	No	History of CHB testing
381	29	F	None	Farmer	Yes	1 visit to Fatick's center
387	29	M	Primary	Farmer	Yes	Absent for follow-up exams
406	18	M	Primary	Builder	Yes	Absent for follow-up exams
626	33	M	University	Training/Teacher	No	History of CHB testing
762	44	M	None	Former builder	No	N/A – Good CHB knowledge
839	58	F	None	Street vendor	Yes	Absent for follow-up exams
909	19	F	High school	Student	Yes	No visit following referral
925	18	M	High school	Student/farmer	Yes	No visit following referral
937	69	M	Middle school	Retired fireman	Yes	No visit following referral
1108	63	M	None	Farmer	Yes	Absent for follow-up exams
1141	57	M	None	Livestock farmer	Yes	Several visits to Dakar
1160	39	F	None	Farmer	Yes	No visit following referral
1161	18	F	Middle school	Farmer	Yes	No visit following referral
1212	51	M	None	Farmer; craftsman	No	N/A – Good CHB knowledge
1235	44	F	*missing*	Farmer	Yes	Refused follow-up exams
1522	23	F	High school	Student	Yes	(delayed) visit to Dakar
1566	27	M	Primary	Farmer	Yes	Refused follow-up exams
1619	19	M	Professional	Farmer/student	Yes	Refused follow-up exams
1670	35	M	Primary	Retired builder	Yes	No follow-up exams (error)
1747	58	F	None	Farmer	Yes	No visit following referral
1833	18	M	None	Farmer	Yes	No visit following referral
1840	20	M	High school	Farmer/student	Yes	Treated at Fatick's hospital
1843	48	F	None	Shopkeeper	Yes	No visit following referral
1877	66	F	None	Farmer	Yes	No visit following referral
1920	35	M	Literacy	Farmer/brick maker	Yes	Refused follow-up exams
1929	60	M	None	Shaman	Yes	No visit following referral
2100	60	M	University	Retired clerk	Yes	Several visits to Dakar
2533	46	F	None	Breeder/vendor	Yes	1 visit to Niakhar's center
2666	36	M	None	Farmer; builder	Yes	Several visits to Dakar
2795	32	F	None	Farmer	Yes	1 visit to Fatick's center
2909	49	F	None	Farmer/vendor	Yes	Several visits to Dakar

Table B2.2 Characteristic of participants to in-depth key informant interviews (n=5)

Health facility	Town	Status	Sex
Regional hospital	Fatick	Physician	M
Health center	Fatick	Physician	M
Health center	Niakhar	Physician	F
Health dispensary	Toucar	Head nurse	M
Health dispensary	Ngayokheme	Head nurse	F

Table B2.3 Characteristics of focus group's participants (n=6) and interviewers (n=3, in grey)

Town	Status	Sex
Toucar	Relay	F
Ngayokheme	*Badjenu Gox*	F
Ngayokheme	Relay	M
Diohine	Relay	F
Diohine	*Badjenu Gox*	F
Toucar	*Badjenu Gox*	F
Bambilor (Dakar area)	Anthropologist	F
Niakhar	Interviewer	F
Toucar	Facilitator	M

Appendix B3. Individual health capability profiles

Figure B3.1 Diagrams 1-12: CHB patients with at least one visit (n=12)

196 (M, 28)

NIL — OPTIMAL

- Health "priceless" — HEALTH-RELATED VALUES & GOALS
- Worked in the AmBASS project — GROUP MEMBERSHIP
- 80% of people go to shamans ; intelectuals don't — SOCIAL NORMS
- Good care, straightforward process — ENABLING HEALTHCARE SYSTEMS
- Very good knowledge of CHB — KNOWLEDGE
- Salaried work, no health-insurance, CHB follow-up cost 10 USD — ECONOMIC, SOCIAL & POLITICAL SECURITY
- Followed-up in local health facility, missed the latest appoinment — HEALTHCARE ACCESS & UTILIZATION
- « I really want it » — INTRINSIC MOTIVATION
- Invested money in business (vs. health) — GOVERNANCE
- CHB+, digestive hemorragiae — FUNCTIONING
- Seeks advice /info and acts accordingly — DECISION-MAKING
- Optimistic: treatment controls viral load — POSITIVE EXPECTATIONS
- Sick mother, can't be left alone — SOCIAL CAPITAL & NETWORKS
- Salaried job; relatively wealthy household — MATERIAL CIRCUMSTANCES
- Optimal perceived competency — BELIEFS, SELF-EFFICACY

381 (F, 29)

NIL — OPTIMAL

- GROUP MEMBERSHIP — No specific group membership
- BELIEFS, SELF-EFFICACY — Believes in ability to seek and obtain medical care
- HEALTH-RELATED VALUES & GOALS — Health takes precedence
- SOCIAL NORMS — Stomach aches caused by worms, traditional medicine
- POSITIVE EXPECTATIONS — Hepatitis worse than malaria
- INTRINSIC MOTIVATION — Always accepts healing / her own decision
- MATERIAL CIRCUMSTANCES — Poor agricultural household
- HEALTHCARE ACCESS & UTILIZATION — CHB follow-up in local facility, might be discontinuated
- ECONOMIC, SOCIAL & POLITICAL SECURITY — No insurance, no pregnancy leave
- GOVERNANCE — Ability to organize and put health first
- FUNCTIONING — CHB+, good self-reported health, on-going hemorragiae + pregnancy,
- ENABLING HEALTHCARE SYSTEMS — Hospital is a 1st choice, feels better after visiting doctors
- KNOWLEDGE — Low knowledge, remembered "hepativis"
- SOCIAL CAPITAL & NETWORKS — Supportive family, but unemployed husband
- DECISION-MAKING — Seeks and follows professional advice

166

1141 (M, 57)

NIL

ECONOMIC, SOCIAL & POLITICAL SECURITY

Farmer, no insurance

GROUP MEMBERSHIP

No specific group membership

FUNCTIONING

CHB+ past hemorragiae, ok self-reported health

KNOWLEDGE

Low knowledge, but knows status and disease eating from the inside

MATERIAL CIRCUMSTANCES

Agricultural household with some monetary resources

BELIEFS, SELF-EFFICACY

Confident in ability to manage own health

SOCIAL CAPITAL & NETWORKS

Children can take care of fields

INTRINSIC MOTIVATION

Own preference and motivation

POSITIVE EXPECTATIONS

Disease might last a while, but can be cured

SOCIAL NORMS

Distance from traditional beliefs, makes decision on his own

HEALTH-RELATED VALUES & GOALS

Own health is most important

DECISION-MAKING

Straightforward, based on doctors advice

HEALTHCARE ACCESS & UTILIZATION

Goes to Dakar

GOVERNANCE

Ability to control, organize seek and obtain resources

ENABLING HEALTHCARE SYSTEMS

Doctors know what they see

OPTIMAL

1522 (F, 23)

NIL

ECONOMIC, SOCIAL & POLITICAL SECURITY

No job, no insurance

BELIEFS, SELF-EFFICACY

Low self-perceived competency, low beliefs

SOCIAL NORMS

Traditional CHB beliefs, decision making, not shared (nun)

DECISION-MAKING

Tends to wait to be told to do things

INTRINSIC MOTIVATION

KNOWLEDGE

Low knowledge

FUNCTIONING

Good self-reported health, CHB+, stomach aches

MATERIAL CIRCUMSTANCES

Good housing; limited monetary resources

SOCIAL CAPITAL & NETWORKS

Father shaman, family supportive of her different views

HEALTH-RELATED VALUES & GOALS

Health is valued, no other conflicting value

GOVERNANCE

Ability to organize, seek and obtain help

ENABLING HEALTHCARE SYSTEMS

Optimistic provided she seeks and obtains care from catholic dispensaries

POSITIVE EXPECTATIONS

HEALTHCARE ACCESS & UTILIZATION

Absent for follow-up exams, joined cohort following interview

GROUP MEMBERSHIP

Nun in training, goes to catholic dispensaries

OPTIMAL

167

1840 (M, 20)

NIL — OPTIMAL

- No adverse group membership documented — GROUP MEMBERSHIP
- Avoiding CHB complications is a main concern — HEALTH-RELATED VALUES & GOALS
- Optimistic outlook — POSITIVE EXPECTATIONS
- No autonomous decision-making, relatives favor traditional medicine — SOCIAL NORMS
- Helpful household, emotional support from mother — SOCIAL CAPITAL & NETWORKS
- High internal & external motivation — INTRINSIC MOTIVATION
- Counseling + encouragement — ENABLING HEALTHCARE SYSTEMS
- Student in a very poor rural, CHB+ household — MATERIAL CIRCUMSTANCES
- CHB+ with complications, good self-reported health — FUNCTIONING
- AmBASS survey pays for treatment + collaboration with SEN-B study cohort — ECONOMIC, SOCIAL & POLITICAL SECURITY
- CHB+ treatment in local dispensary (horse ride away) — HEALTHCARE ACCESS & UTILIZATION
- Low knowledge,e.g., CHB caused by contaminated water — KNOWLEDGE
- Perceived freedom; smokes + drinks occasionally — GOVERNANCE
- Listens to doctor's advice — DECISION-MAKING
- Good perceived self-competency — BELIEFS, SELF-EFFICACY

2100 (M, 60)

NIL — OPTIMAL

- GROUP MEMBERSHIP
- Serer ethnicity and beliefs (tradi-praticioners)
- Not too worried — POSITIVE EXPECTATIONS
- Optimal (no external influences) — INTRINSIC MOTIVATION
- Good counseling and care since testing — ENABLING HEALTHCARE SYSTEMS
- Fully autonomous decision-making — SOCIAL NORMS
- Pension, no insurance — ECONOMIC, SOCIAL & POLITICAL SECURITY
- Salaried work, relatively wealthy semi-urban household — MATERIAL CIRCUMSTANCES
- Excellent knowledge — KNOWLEDGE
- CHB+ ongoing hemorragiae, good self-reported health — FUNCTIONING
- Systematic decision-making, learns from experience — DECISION-MAKING
- CHB follow-up in Dakar, no obstacles — HEALTHCARE ACCESS & UTILIZATION
- Everyone helps in the household — SOCIAL CAPITAL & NETWORKS
- Low perceived freedom; ability to organize trips; changed diet (peanuts, palm oil) — GOVERNANCE
- Good perceived self-competency, able to change behaviors — BELIEFS, SELF-EFFICACY
- Health is a priority — HEALTH-RELATED VALUES & GOALS

168

Participant 2533 (F, 46) — diagram spanning NIL to OPTIMAL:

- ECONOMIC, SOCIAL & POLITICAL SECURITY — Self-employed, no insurance
- MATERIAL CIRCUMSTANCES — Relatively wealthy semi-urban household, poor housing, no farming land, spent most savings in HC
- ENABLING HEALTHCARE SYSTEMS — Hospitals are competent but not efficient for all disease
- GROUP MEMBERSHIP — Started traditional medicine in her home village (Casamance)
- POSITIVE EXPECTATIONS — Fears CHB-related death, "in the hands of God"
- KNOWLEDGE — No knowledge
- FUNCTIONING — CHB+ hemorragiae, ok self-reported health, frequently sick
- SOCIAL NORMS — Shared decisions, shamans can help when traditional care fails
- HEALTHCARE ACCESS & UTILIZATION — CHB follow-up in local HC facility, money is an obstacle
- INTRINSIC MOTIVATION — High internal and external motivation
- DECISION-MAKING — Systematic decision making based on medical advice & experience
- SOCIAL CAPITAL & NETWORKS — Supportive husband and daughter
- HEALTH-RELATED VALUES & GOALS — Health is a priority
- GOVERNANCE — High perceived freedom ability to multi-task
- BELIEFS, SELF-EFFICACY — Optimal perceived competency

NIL — OPTIMAL

Participant 2666 (M, 36) — diagram spanning NIL to OPTIMAL:

- ECONOMIC, SOCIAL & POLITICAL SECURITY — Self-employed, no insurance
- MATERIAL CIRCUMSTANCES — Breadwinner, poor semi-urban household
- FUNCTIONING — CHB+, important fatigue
- ENABLING HEALTHCARE SYSTEMS — Good relationship with Sen-B's team
- POSITIVE EXPECTATIONS — Lucky to be part of project, worried about treatment running out
- SOCIAL NORMS — Shared decision-making; health autonomous
- GROUP MEMBERSHIP — Son died of CHB
- KNOWLEDGE — Very low during AmBASS, learned a lot since
- SOCIAL CAPITAL & NETWORKS — Family support, high responsibility
- HEALTH-RELATED VALUES & GOALS
- INTRINSIC MOTIVATION — Avoiding cirrhosis, top priority
- DECISION-MAKING
- GOVERNANCE — High perceived freedom, ability to learn and make decisions accordingly
- BELIEFS, SELF-EFFICACY — Optimal self-reported self-efficacy
- HEALTHCARE ACCESS & UTILIZATION — CHB follow-up in Dakar, no utilization in 1st intention, no obstacles

NIL — OPTIMAL

2795 (F, 33)

No notable group membership
GROUP MEMBERSHIP

Autonomous health decisions, trusts blood sampling
SOCIAL NORMS

Good quality of care, and agency building
ENABLING HEALTHCARE SYSTEMS

No job, no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Low, "benign" CHB requires follow-up but no treatmnt
KNOWLEDGE

Farmer in middle-class semi-urban household
MATERIAL CIRCUMSTANCES

High internal motivation, some external
INTRINSIC MOTIVATION

Family members supportive, went to visit with one other
SOCIAL CAPITAL & NETWORKS

No self-efficacy/perceived competency, forgot visit
BELIEFS, SELF-EFFICACY

Follow up in local HC but "forgot" 2nd visit
HEALTHCARE ACCESS & UTILIZATION

Asked questions, followed most instructions
DECISION-MAKING

Own CHB "benign", but swollen bellies deadly
POSITIVE EXPECTATIONS

Getting better is important
HEALTH-RELATED VALUES & GOALS

CHB+, on-going hemorragiae, average self-reported health, fatigue
FUNCTIONING

High perceived freedom, ability to organize and seek help despite duties
GOVERNANCE & SELF-MANAGEMENT

NIL **OPTIMAL**

2909 (F, 49)

Worried about the future
POSITIVE EXPECTATIONS

Not proactive, decision-making externally motivated
DECISION-MAKING

Farmer and vendor in middle-class semi-urban household
MATERIAL CIRCUMSTANCES

Health is a priority, so is getting better
HEALTH-RELATED VALUES & GOALS

No job or insurance "everything costs money"
ECONOMIC, SOCIAL & POLITICAL SECURITY

Trusts HC staff in the past but staggered at blood sampling and no treatment
ENABLING HEALTHCARE SYSTEMS

CHB follow up in Dakar,, no obstacles, but might discontinue
HEALTHCARE ACCESS & UTILIZATION

Mrs S from Ngayokheme helps for visits to Dakar
GROUP MEMBERSHIP

Low perceived freedom, good ability to organize/multitask
GOVERNANCE

Shared decision-making, dislikes blood sampling
SOCIAL NORMS

No knowledge
KNOWLEDGE

Both internal and external motivation
INTRINSIC MOTIVATION

CHB+, on-going hemorragiae, good self-reported health
FUNCTIONING

Optimal perceived competency, but "not educated"
BELIEFS, SELF-EFFICACY

Family supportive
SOCIAL CAPITAL & NETWORKS

NIL **OPTIMAL**

170

Figure B3.2 Diagrams 13-35: CHB patients lost to follow-up (n=23)

109 (M, 40)

No CHB counseling/ information/ hospital can't do anything
ENABLING HEALTHCARE SYSTEMS

Cirrhosis is "very serious", hospital can't do anything, but can heal through exercise
POSITIVE EXPECTATIONS

Shamans and exercise can heal his conditions
SOCIAL NORMS

No detrimental group membership, stays at home
GROUP MEMBERSHIP

Didn't retrieve CHB results, rarely goes to hospital, visits shamans
HEALTHCARE ACCESS & UTILIZATION

No CHB knowledge, ignores own status
KNOWLEDGE

Sticks with habits, systematic decision making
DECISION-MAKING

Part-time hairdresser in Mbour; comfortable housing
MATERIAL CIRCUMSTANCES

CHB+, low self-reported health, recent sickness
FUNCTIONING

Stable job, pays taxes, no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Internally motivated
INTRINSIC MOTIVATION

Helpful family
SOCIAL CAPITAL & NETWORKS

Confident in achieving positive health outcomes
BELIEFS, SELF-EFFICACY

Very organized, controls meals, behaviors and sports for health purposes
GOVERNANCE

Health is a priority "worth investing in"
HEALTH-RELATED VALUES & GOALS

NIL   OPTIMAL

115 (F, 48)

If disease too advanced nothing can be done
POSITIVE EXPECTATIONS

Beliefs that CHB is caused by wind/salamanders, shaman but believes in hospital
SOCIAL NORMS

Getting better is a priority even if expensive
HEALTH-RELATED VALUES & GOALS

Felt compelled to become a healer (djinns)
INTRINSIC MOTIVATION

Didn't find time to come for CHB check-up
DECISION-MAKING

Organized, ability to control behaviors ; very busy with shamanism
GOVERNANCE

Other women in her household cooking for her
SOCIAL CAPITAL & NETWORKS

CHB knowledge not evidence-based
KNOWLEDGE

CHB prevention through spells and roots, no CHB check-up (no time)
HEALTHCARE ACCESS & UTILIZATION

CHB+, ok physical health; lower mental health
FUNCTIONING

Comfortable semi-rural housing, own earnings
MATERIAL CIRCUMSTANCES

Shaman and the elderly
GROUP MEMBERSHIP

No insurance, independent work as a shaman
ECONOMIC, SOCIAL & POLITICAL SECURITY

Doctors do their best to stop disease
ENABLING HEALTHCARE SYSTEMS

Feels competent, knows her body, regulates eating
BELIEFS, SELF-EFFICACY

NIL   OPTIMAL

171

Diagram 1 — 120 (F, 35)

NIL ... OPTIMAL

- **GROUP MEMBERSHIP** — Aunt is traditional healer
- **SOCIAL NORMS** — Needs permission; family in traditional healing but also consults
- **POSITIVE EXPECTATIONS** — Little can be done against CHB "act of God"
- **KNOWLEDGE** — No knowledge (0/10), not even of own status
- **HEALTHCARE ACCESS & UTILIZATION** — No CHB-related follow-up, goes to aunt for incantations or doctor
- **ECONOMIC, SOCIAL & POLITICAL SECURITY** — No insurance; independant part time job
- **BELIEFS, SELF-EFFICACY** — Ability to learn and change behaviors, but forgets information
- **ENABLING HEALTHCARE SYSTEMS** — Low CHB info (status, vaccine), but trust in the Diohine facility
- **DECISION-MAKING** — Acts when told, except for own children
- **INTRINSIC MOTIVATION** — Own preferences and motivation, husband has a say + God's will
- **GOVERNANCE** — Ability to organize life, make time for health
- **SOCIAL CAPITAL & NETWORKS** — Resources available in familiy
- **FUNCTIONING** — CHB+, good self-reported health
- **HEALTH-RELATED VALUES & GOALS** — Health important, prefers to go see doctors, but often consults aunt
- **MATERIAL CIRCUMSTANCES** — Help available within relatively wealthy household, own income

Diagram 2 — 182 (M, 19)

NIL ... OPTIMAL

- **INTRINSIC MOTIVATION** — External motivation (parents, peers)
- **DECISION-MAKING** — Passive decisions
- **GOVERNANCE** — Teenager with no responsibility/ control over behaviors
- **KNOWLEDGE** — No knowledge
- **ECONOMIC, SOCIAL & POLITICAL SECURITY** — No job, no insurance
- **SOCIAL NORMS** — Mistrust towards blood sampling
- **BELIEFS, SELF-EFFICACY** — Belief in achieving outcomes, not very self-competent
- **MATERIAL CIRCUMSTANCES** — Student, poor household, other CHB+
- **HEALTHCARE ACCESS & UTILIZATION** — Refused follow-up exams, rarely consults for sickness, no obstacles
- **GROUP MEMBERSHIP** — No (detrimental) group membership
- **FUNCTIONING** — CHB+, recent sickness
- **SOCIAL CAPITAL & NETWORKS** — Supportive parents and brothers, dad refused blood sampling
- **POSITIVE EXPECTATIONS** — Hopeful "it will pass"
- **HEALTH-RELATED VALUES & GOALS**
- **ENABLING HEALTHCARE SYSTEMS** — "They heal you well"

387 (M, 29)

NIL

- Difficulty in looking for info, getting help, delays decisions
  - DECISION-MAKING
- Difficulty in handling family responsibility, work, and health
  - GOVERNANCE
- Absent for CHB follow-up, rarely goes to hospital
  - HEALTHCARE ACCESS & UTILIZATION
- Low knowledge, except for "full stomachs"
  - KNOWLEDGE

- Part time temporary work, no insurance
  - ECONOMIC, SOCIAL & POLITICAL SECURITY
- Cirrhosis is really bad and worrying
  - POSITIVE EXPECTATIONS
- Serer people often wait to see if they get better
  - SOCIAL NORMS
- Famer, relatively poor household
  - MATERIAL CIRCUMSTANCES
- Supportive family but can't delegate farming duties (eldest son)
  - SOCIAL CAPITAL & NETWORKS

- Member of neighbors association, no CHB info
  - GROUP MEMBERSHIP

- Health **issue** prioritized over food or work
  - HEALTH-RELATED VALUES & GOALS
- CHB+, high self-reported health
  - FUNCTIONING
- Health intrinsically important with external motivation (mother)
  - INTRINSIC MOTIVATION
- Good care delivered in local facilities
  - ENABLING HEALTHCARE SYSTEMS

- Believes in achieving positive outcomes (medication efficient)
  - BELIEFS, SELF-EFFICACY

OPTIMAL

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406 (M, 18)

NIL

- BELIEFS, SELF-EFFICACY
  - Describes himself as "Immature" and forgetful
- SOCIAL NORMS
  - Traditional medicine efficient, collective decision-making (elders)
- INTRINSIC MOTIVATION
  - Does as told, and as others do
- DECISION-MAKING
- KNOWLEDGE
  - No CHB knowledge

- GROUP MEMBERSHIP
  - No group membership, never left village
- SOCIAL CAPITAL & NETWORKS
  - Supportive family. aunt does incantations, father gives talismans
- ECONOMIC, SOCIAL & POLITICAL SECURITY
  - Lost job after boss' death, found another
- HEALTHCARE ACCESS & UTILIZATION
  - Goes to hospital if more convenient. Did not do check-up (absent?)

- GOVERNANCE
  - Went to help his father for harvest and decided to stay
- MATERIAL CIRCUMSTANCES
  - Bread winner in relatively well-off semi-urban household

- POSITIVE EXPECTATIONS
  - Trusts God and both standard and traditional medicine ("it heals")
- FUNCTIONING
  - Good self-reported health, seldom sick, CHB+
- ENABLING HEALTHCARE SYSTEMS
  - Hospital can prevent death, gives good information

- HEALTH-RELATED VALUES & GOALS
  - Health is very important, more than food

OPTIMAL

173

839 (F, 58)

Nil

Widow, no help
SOCIAL CAPITAL & NETWORKS

CHB caused by dirty dishes
SOCIAL NORMS

No knowledge
KNOWLEDGE

Self-employed, no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Not possible to empty swollen stomaches
POSITIVE EXPECTATIONS

Difficulty in handling all chores, can't get help ("ashamed")
GOVERNANCE

Consulted for recent sickness, absent for follow-up
HEALTHCARE ACCESS & UTILIZATION

Street vendor, relatively poor household
MATERIAL CIRCUMSTANCES

No adverse group membership
GROUP MEMBERSHIP

Trusts ability to seek and obtain care from local facilities/vaccines
BELIEFS, SELF-EFFICACY

Hospital first, then other options if no result within 3 days
DECISION-MAKING

Good self-reported health, CHB+, recent sickness
FUNCTIONING

CHB testing for trust in OROSTROM
INTRINSIC MOTIVATION

Health and prevention (vaccines) are prioritized
HEALTH-RELATED VALUES & GOALS

Hospital knows best to diagnose/heal
ENABLING HEALTHCARE SYSTEMS

Optimal

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909 (F, 19)

Nil

Student, works to pay for school equipement
ECONOMIC, SOCIAL & POLITICAL SECURITY

Forgot everything that she was told about CHB
BELIEFS, SELF-EFFICACY

Uses work money to pay for school, CHB+ household
MATERIAL CIRCUMSTANCES

Was told to go to hospital, but absent when they came back
DECISION-MAKING

Doesn't know anything about hepatitis B, though aware of positivity
KNOWLEDGE

INTRINSIC MOTIVATION

Usually decides to seek care on her own
HEALTH-RELATED VALUES & GOALS

Local facility as 1st intention, complemented with incantations
SOCIAL NORMS

Frequent headaches, CHB patient
FUNCTIONING

Regularly goes to local facility but didn't go to Dakar's hospital
HEALTHCARE ACCESS & UTILIZATION

Student group that walks to the Toucar highschool, teacher talks of CHB
GROUP MEMBERSHIP

Usually gets well
POSITIVE EXPECTATIONS

Walks to school, works for equipment, seeks & obtains help
GOVERNANCE

Local facility heals well, doesn't know Fann's hospital
ENABLING HEALTHCARE SYSTEMS

Parents help for health expenses, sister in Dakar, uncle does incantations
SOCIAL CAPITAL & NETWORKS

Optimal

174

925 (M, 18)

NIL

No understanding of hepatitis B, didn't ask
BELIEFS, SELF-EFFICACY

Felt tricked after blood sampling, waited, distrustful
DECISION-MAKING

Blood sold to others. Trusts hospital & vaccination
SOCIAL NORMS

Knows the name hepatitis B, nothing more
KNOWLEDGE

School & youth association, pills for swollen feet
GROUP MEMBERSHIP

Check-up but no referral (justification for blood sampling), no obstacle
HEALTHCARE ACCESS & UTILIZATION

No insurance, farmer
ECONOMIC, SOCIAL & POLITICAL SECURITY

Hospital safer than alternatives. Duty to justify blood sampling
ENABLING HEALTHCARE SYSTEMS

Relatively poor, agricultural CHB+ household
MATERIAL CIRCUMSTANCES

Rarely sick, good self-reported health, CHB+
FUNCTIONING

POSITIVE EXPECTATIONS

Health valued for itself, mindful, relatively hopeful
INTRINSIC MOTIVATION

Health more important than work or money
HEALTH-RELATED VALUES & GOALS

Organizes, rests when needed, seeks and obtains help
GOVERNANCE

Supportive family
SOCIAL CAPITAL & NETWORKS

OPTIMAL

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937 (M, 69)

NIL

Didn't enquire, left results papers at home
DECISION-MAKING

Cirrhosis is deadly, incurable
POSITIVE EXPECTATIONS

Health facilities help getting better, doubt over CHB disgnosis
ENABLING HEALTHCARE SYSTEMS

Health facility 1st if symptoms (none for CHB), many obstacles
HEALTHCARE ACCESS & UTILIZATION

Retired marine & firefighter, no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Some instrumental help, little emotional help
SOCIAL CAPITAL & NETWORKS

CHB+, average self-reported health, frequent alcohol
FUNCTIONING

Breadwinner in a relatively wealthy semi-urban, CHB++ household
MATERIAL CIRCUMSTANCES

Educated and competent (though not a professional)
BELIEFS, SELF-EFFICACY

Health valued in itself, and a priority
INTRINSIC MOTIVATION

Excellent knowledge, but doubting own status
KNOWLEDGE

Always working, mutual assistance in household
GOVERNANCE

Prefers standard medicine, trusts blood sampling, decides for himself
SOCIAL NORMS

HEALTH-RELATED VALUES & GOALS

Health is priceless, consulting when sick is a priority

Former military, CHB, used to blood sampling (part of the duty)
GROUP MEMBERSHIP

OPTIMAL

175

Diagram 1 — 1108 (M, 63)

NIL — OPTIMAL

- POSITIVE EXPECTATIONS — Difficult to heal from swollen bellies
- KNOWLEDGE — No CHB knowledge, vague recollection of swollen bellies
- BELIEFS, SELF-EFFICACY — Illiterate people tend to forget
- ECONOMIC, SOCIAL & POLITICAL SECURITY — Farmer, no salary, no insurance
- MATERIAL CIRCUMSTANCES — Farmer in big, semi-urban, CHB+ household
- DECISION-MAKING — Goes to dispensary but doesn't actively look for information until sickness
- GROUP MEMBERSHIP — No specific group membership
- HEALTHCARE ACCESS & UTILIZATION — 1st intention when sick, money can be an obstacle, absent for follow-up
- FUNCTIONING — Average self-reported health, CHB+
- ENABLING HEALTHCARE SYSTEMS — Doctors know how to heal. Never heard back from CHB testing
- SOCIAL CAPITAL & NETWORKS — Household head pays for expenses, can get help from acquaintances
- SOCIAL NORMS — Decides on his own, growing trust in health facilities
- INTRINSIC MOTIVATION — Decides on his own, values health for itself
- GOVERNANCE — Prioritizes health over farming, multitasking, reaches out for money
- HEALTH-RELATED VALUES & GOALS — People protect their lifes, children's health is priceless

Diagram 2 — 1160 (F, 39)

NIL — OPTIMAL

- POSITIVE EXPECTATIONS — No CHB cure, Gods will
- INTRINSIC MOTIVATION
- DECISION-MAKING — Follows husband's decision
- ECONOMIC, SOCIAL & POLITICAL SECURITY — No job, no insurance, COVID in Dakar
- MATERIAL CIRCUMSTANCES — Farmer, poor rural household
- KNOWLEDGE — No knowledge, heard of CHB-related death but not linked to own "blood sickness"
- ENABLING HEALTHCARE SYSTEMS — Mistrust in some healthcare ; prefers specific staff/facilities
- SOCIAL NORMS — Blood sampling causes miscarriages, no autonomous decision-making
- HEALTHCARE ACCESS & UTILIZATION — Full check-up but no referral to Dakar; did not consult for recent sickness
- FUNCTIONING — CHB+ hemorragiae, recent sickness & oedema, ok self-reported health
- GROUP MEMBERSHIP — Catholic who trusts healthcare rather than traditional practitioners
- BELIEFS, SELF-EFFICACY — Perceived bility to follow doctor's advice and achieve health outcomes
- SOCIAL CAPITAL & NETWORKS — Gets help at home but doesn't know anyone in Dakar or that can go with her
- GOVERNANCE — Ability to multitask, seek and obtain help
- HEALTH-RELATED VALUES & GOALS — Health prioritized over other considerations (e.g., food)

1161 (F, 18)

NIL ... OPTIMAL

- MATERIAL CIRCUMSTANCES — Farming in a very poor CHB+ rural household
- FUNCTIONING — CHB+, tired, swollen feet, cannot eat, long periods
- ECONOMIC, SOCIAL & POLITICAL SECURITY — No income, no insurance
- BELIEFS, SELF-EFFICACY — Forgets and loses information
- KNOWLEDGE — No knowledge of hepatitis B, doesn't identity own illness
- DECISION-MAKING — Opportunistic, somewhat passive decision-making
- HEALTHCARE ACCESS & UTILIZATION — Check-up but no referral, needs money, permission, doesn't know Fann's hospital
- INTRINSIC MOTIVATION — Wants to heal but only if authorized by brother
- GOVERNANCE — Not tied by work, still didn't visit hospital in Dakar, gets help at times
- GROUP MEMBERSHIP — Left school after failed exam
- SOCIAL NORMS — Doesn't trust in shamans, ok with blood sampling, brother makes decisions
- SOCIAL CAPITAL & NETWORKS — Supportive relatives though living far and with limited resources
- POSITIVE EXPECTATIONS — Neither worried not optimistic
- ENABLING HEALTHCARE SYSTEMS — Good care at dispensary and « Fall » clinic, but fears not knowing people
- HEALTH-RELATED VALUES & GOALS — Healing is important and prompts behaviors

1235 (F, 44)

NIL ... OPTIMAL

- MATERIAL CIRCUMSTANCES — Poor, big household
- ECONOMIC, SOCIAL & POLITICAL SECURITY — No job, no insurance
- SOCIAL NORMS — Sun might have affected CHB testing, Serer people defiant
- HEALTHCARE ACCESS & UTILIZATION — Refused followed-up exams
- KNOWLEDGE — No knowledge, doesn't believe in CHB positivity
- BELIEFS, SELF-EFFICACY — Questions own choices looking back
- DECISION-MAKING — Did not believe the test was accurate, refused follow-up
- GOVERNANCE — Can't always find time for health
- SOCIAL CAPITAL & NETWORKS — In charge of meals, sick mother & sister in law
- GROUP MEMBERSHIP — Catholic
- HEALTH-RELATED VALUES & GOALS — Health important but can conflict with family duties (e.g., meal prep)
- FUNCTIONING — CHB+, very good self-reported health
- ENABLING HEALTHCARE SYSTEMS — Disease are identified and cured
- POSITIVE EXPECTATIONS — Hopeful for diagnostic and healing plan
- INTRINSIC MOTIVATION — Goes to dispensary at her own initiative

177

1566 (M, 27)

NIL / OPTIMAL

- External motivation (people who went to school) — INTRINSIC MOTIVATION
- Ability to achieve positive outcomes thanks to (smarter) others — BELIEFS, SELF-EFFICACY
- CHB worring, but not personally scared — POSITIVE EXPECTATIONS
- Not proactive, decisions based on beliefs or instructions — DECISION-MAKING
- Works in construction, no insurance — ECONOMIC, SOCIAL & POLITICAL SECURITY
- Ability to organize, control behavior and seek/obtain help — GOVERNANCE
- Health more important than work — HEALTH-RELATED VALUES & GOALS
- Diohine's "jeunes unis", no CHB related influence — GROUP MEMBERSHIP
- No knowledge — KNOWLEDGE
- Refused follow-up exams, rarely goes to hospital — HEALTHCARE ACCESS & UTILIZATION
- CHB+, good self-reported health, frequent stomach aches — FUNCTIONING
- Collective decisions, opposes blood sampling, goes to see shaman — SOCIAL NORMS
- Hospital efficient in healing his hand, but requires blood sampling — ENABLING HEALTHCARE SYSTEMS
- Builder, poor CHB+ agricultural household, money from relatives — MATERIAL CIRCUMSTANCES
- Support from family at home and away — SOCIAL CAPITAL & NETWORKS

1619 (M, 19)

NIL / OPTIMAL

- Fears blood sampling — SOCIAL NORMS
- Low knowledge, CHB through blood contact — KNOWLEDGE
- No adverse group membership — GROUP MEMBERSHIP
- No job, no insurance — ECONOMIC, SOCIAL & POLITICAL SECURITY
- Health not a priority (family duties) — HEALTH-RELATED VALUES & GOALS
- Able to multitask and find help, though "not very frequently" — GOVERNANCE
- Very supportive mother, father absent, eldest son — SOCIAL CAPITAL & NETWORKS
- External motivation only — INTRINSIC MOTIVATION
- Not particularly optimistic — POSITIVE EXPECTATIONS
- Farmer, very poor agricultural houshold — MATERIAL CIRCUMSTANCES
- Absent for follow-up exams, rarely consults, no specific obstacles — HEALTHCARE ACCESS & UTILIZATION
- CHB+, good self-reported health — FUNCTIONING
- Decisions based on others'/habits — DECISION-MAKING
- Believes he can learn if needed — BELIEFS, SELF-EFFICACY
- Local healthcare staff heals well — ENABLING HEALTHCARE SYSTEMS

178

1670 (M, 35)

No detrimental group membership
GROUP MEMBERSHIP

Hospital 1st, Shaman 2nd intention, CHB due to food and causes cancer
SOCIAL NORMS

No knowledge of hepatitis "Stroke?'
KNOWLEDGE

Late CHB+ result, no follow-up exams; usually goes to hospital(s)
HEALTHCARE ACCESS & UTILIZATION

Decides for himself
INTRINSIC MOTIVATION

Trusts to explore all options to avoid issues
BELIEFS, SELF-EFFICACY

CHB+, excellent self-reported health
FUNCTIONING

Supportive family, health goals align
SOCIAL CAPITAL & NETWORKS

Part-time job, no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Optimistic, but active CHB "always leads to death"
POSITIVE EXPECTATIONS

Retired driver, relatively wealthy household
MATERIAL CIRCUMSTANCES

Systematic decision making
DECISION-MAKING

Error in CHB+ result, good care in the past
ENABLING HEALTHCARE SYSTEMS

Organizes work and health
GOVERNANCE

Health is highly prioritized (over food)
HEALTH-RELATED VALUES & GOALS

NIL   OPTIMAL

CHB-related decisions posponed
DECISION-MAKING

Health considerations overwhelmed by other ones
HEALTH-RELATED VALUES & GOALS

High self-reported intrinsic motivation, strong influence of neighbors & children
INTRINSIC MOTIVATION

1747 (F, 58)

Widow taking care of children alone, who opposed her trip to Dakar
SOCIAL CAPITAL & NETWORKS

Neighbors suspicious of blood tests
GROUP MEMBERSHIP

No job, relatively wealthy household (recent past)
MATERIAL CIRCUMSTANCES

Good perceived self-competency
BELIEFS, SELF-EFFICACY

Hospital useless for CHB, might die regardless
POSITIVE EXPECTATIONS

Low self-reported governance, no help
GOVERNANCE

No job, no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Shared decision-making, usually doesn't use healthcare services
SOCIAL NORMS

OK self-reported health, CHB+ with hemorragiae & past oedema
FUNCTIONING

No knowledge, CHB caused by "parasites"
KNOWLEDGE

Not referred (yet), money seen as an obstacle
HEALTHCARE ACCESS & UTILIZATION

Suspicious towards hospitals, except for prenatal/infant care
ENABLING HEALTHCARE SYSTEMS

NIL   OPTIMAL

179

1833 (M, 18)

NIL — **OPTIMAL**

No job, no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

No motivation
INTRINSIC MOTIVATION

Shared decision-making
DECISION-MAKING

Believes in cure (in general)
POSITIVE EXPECTATIONS

High perceived freedom
GOVERNANCE

Poor, rural, CHB+, agricultural household
MATERIAL CIRCUMSTANCES

Uncle is a traditional healer and lives nearby
GROUP MEMBERSHIP

Involved mother and older brothers
SOCIAL CAPITAL & NETWORKS

Good perceived self-competency
BELIEFS, SELF-EFFICACY

Not referred (yet?), dispensary far, cart not always available
HEALTHCARE ACCESS & UTILIZATION

Acts only when symptoms become unbearable
HEALTH-RELATED VALUES & GOALS

Family goes to healthcare facilities
SOCIAL NORMS

Very low knowledge, CHB status reportedly unknown
KNOWLEDGE

Incomplete CHB-related information/counseling
ENABLING HEALTHCARE SYSTEMS

CHB+ hemoragiae, good self-reported health
FUNCTIONING

1843 (F, 48)

NIL — **OPTIMAL**

No adverse group membership documented
GROUP MEMBERSHIP

Severe disease, but deadly when ignored/delayed follow-up
POSITIVE EXPECTATIONS

No job or insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Low perceived competency ("neutral")
BELIEFS, SELF-EFFICACY

Both internal and external motivation
INTRINSIC MOTIVATION

Small vendor in relatively poor, rural, agricultural, CHB+ household
MATERIAL CIRCUMSTANCES

High perceived freedom, ability to multitask
GOVERNANCE

Good health and recovery from sickness are high priorities
HEALTH-RELATED VALUES & GOALS

Shared decision-making even for own health; trusts hospitals the most
SOCIAL NORMS

Not clearly informed of CHB status
ENABLING HEALTHCARE SYSTEMS

CHB+ hemorragiae, good self-reported health
FUNCTIONING

Supportive neighbors, husband prioritizes health
SOCIAL CAPITAL & NETWORKS

No knowledge, own status undisclosed
KNOWLEDGE

Usually seeks healthcare, not referred for CHB, obstacles: money, distance, etc.
HEALTHCARE ACCESS & UTILIZATION

Systematic decision making: dispensary firth, then other options
DECISION-MAKING

1877 (F, 66)

NIL

Does as told by HC workers

INTRINSIC MOTIVATION

Shared decisions "we" CHB seen as a disease unlike before (cursed food)

SOCIAL NORMS

One neighbor died of CHB

GROUP MEMBERSHIP

DECISION-MAKING

Health not a priority waiting for opportunities presenting themselves

HEALTH-RELATED VALUES & GOALS

No insurance

ECONOMIC, SOCIAL & POLITICAL SECURITY

Widow, grandson worked in HC facility

SOCIAL CAPITAL & NETWORKS

Ability to change behaviors, multitask and seek help

GOVERNANCE

Widow in rural household

MATERIAL CIRCUMSTANCES

Waiting for referral to Dakar hospital, money and distance are obstacles

HEALTHCARE ACCESS & UTILIZATION

CHB+, ok self-reported health, anemia, no recent symptoms

FUNCTIONING

Perceived competency and self-efficacy ('I did')

BELIEFS, SELF-EFFICACY

No knowledge

KNOWLEDGE

Her neighbor's sickness had her worried

POSITIVE EXPECTATIONS

Doctors don't harm

ENABLING HEALTHCARE SYSTEMS

OPTIMAL

1920 (M, 35)

NIL

Full perceived self-competency

BELIEFS, SELF-EFFICACY

No adverse group membership documented

GROUP MEMBERSHIP

Health is important

HEALTH-RELATED VALUES & GOALS

Hopeful

POSITIVE EXPECTATIONS

Relatively poor rural agricultural CHB+ household

MATERIAL CIRCUMSTANCES

Self-employed, no insurance

ECONOMIC, SOCIAL & POLITICAL SECURITY

HC facilities efficient in solving health problems

ENABLING HEALTHCARE SYSTEMS

No knowledge, own status undisclosed

KNOWLEDGE

CHB+, good self-reported health

FUNCTIONING

Full internal and external motivation

INTRINSIC MOTIVATION

High perceived freedom

GOVERNANCE

No CHB-follow-up, self-medication in Mbour; distance is an obstacle

HEALTHCARE ACCESS & UTILIZATION

Father is a traditional healer; shared decision-making

SOCIAL NORMS

Receives help from family members living in the area & in Dakar

SOCIAL CAPITAL & NETWORKS

Systematic decision making based on knowledge & experience

DECISION-MAKING

OPTIMAL

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Figure B3.3 Diagrams 36-40: positive examples in non-CHB patients (n=5)

Very low knowledge

KNOWLEDGE

Decision-making by
mother-in-low,
traditional beliefs

SOCIAL NORMS

Health behaviors
externally motivated

INTRINSIC
MOTIVATION

No (traditional)
remedy for CHB

POSITIVE
EXPECTATIONS
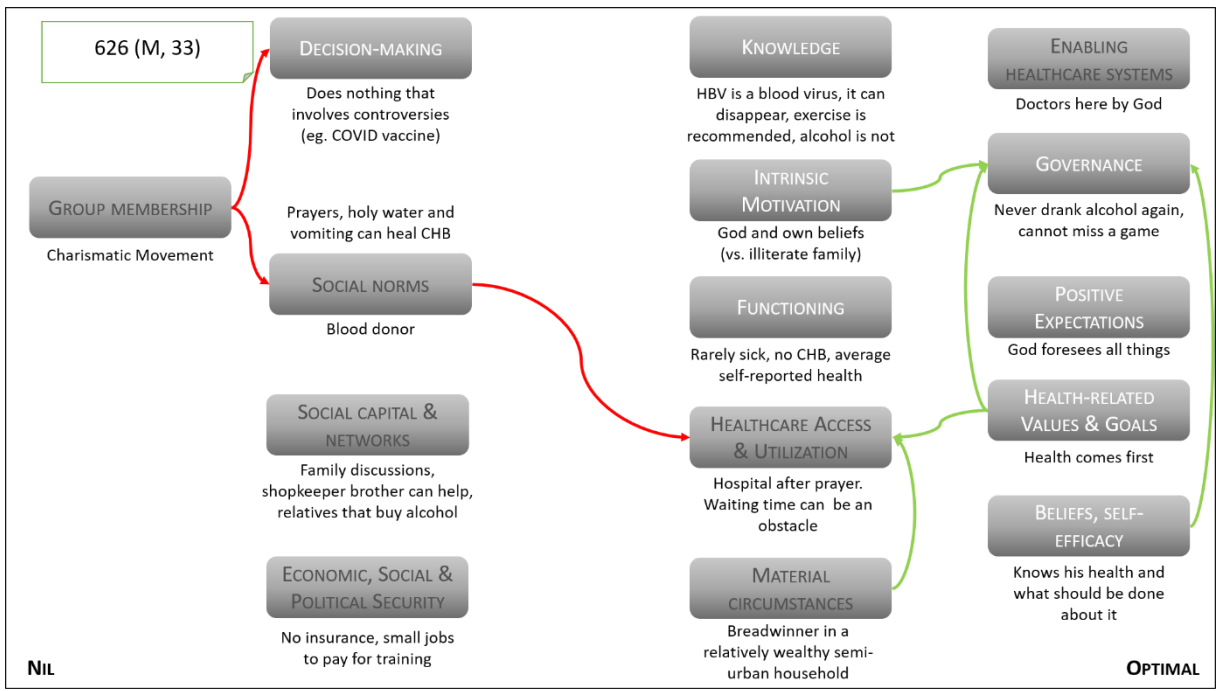
Easily believes what told

DECISION-MAKING

NIL

No job, no insurance,
universal care for
children under 5

ECONOMIC, SOCIAL &
POLITICAL SECURITY

Local HC has no pharmacy,
goes to Diohine instead,
money is an obstacle

HEALTHCARE ACCESS
& UTILIZATION

Some monetary
resources, poor housing

MATERIAL
CIRCUMSTANCES

"What I live is difficult"

GOVERNANCE

CHB-, low self-reported
health, current sickess

FUNCTIONING

Vaccinated but didn't
receive information on
CHB

ENABLING
HEALTHCARE SYSTEMS

Health of children a main
concern, hers not as
much

HEALTH-RELATED
VALUES & GOALS

Absent husband, twin
babies, help from
daughter and neighbors

SOCIAL CAPITAL &
NETWORKS

No group membership,
not of serer ethnicity

GROUP MEMBERSHIP

Ability to recognize
symptoms for hospital vs.
shaman

BELIEFS, SELF-
EFFICACY

296 (F, 24)

OPTIMAL

626 (M, 33)

GROUP MEMBERSHIP

Charismatic Movement

NIL

DECISION-MAKING

Does nothing that
involves controversies
(eg. COVID vaccine)

Prayers, holy water and
vomiting can heal CHB

SOCIAL NORMS

Blood donor

SOCIAL CAPITAL &
NETWORKS

Family discussions,
shopkeeper brother can help,
relatives that buy alcohol

ECONOMIC, SOCIAL &
POLITICAL SECURITY

No insurance, small jobs
to pay for training

KNOWLEDGE

HBV is a blood virus, it can
disappear, exercise is
recommended, alcohol is not

INTRINSIC
MOTIVATION

God and own beliefs
(vs. illiterate family)

FUNCTIONING

Rarely sick, no CHB, average
self-reported health

HEALTHCARE ACCESS
& UTILIZATION

Hospital after prayer.
Waiting time can be an
obstacle

MATERIAL
CIRCUMSTANCES

Breadwinner in a
relatively wealthy semi-
urban household

ENABLING
HEALTHCARE SYSTEMS

Doctors here by God

GOVERNANCE

Never drank alcohol again,
cannot miss a game

POSITIVE
EXPECTATIONS

God foresees all things

HEALTH-RELATED
VALUES & GOALS

Health comes first

BELIEFS, SELF-
EFFICACY

Knows his health and
what should be done
about it

OPTIMAL

762 (M, 44)

Not worried yet, "in the hands of God"
POSITIVE EXPECTATIONS

Doctor "semi-God"
ENABLING HEALTHCARE SYSTEMS

Never goes, money is an obstacle
HEALTHCARE ACCESS & UTILIZATION

Pastors/marabout can heal CHB
SOCIAL NORMS

Member of a religious choir since 2009
GROUP MEMBERSHIP

Good HBV-related knowledge
KNOWLEDGE

Unfit to work, no pension, no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Self-employed, relatively poor household
MATERIAL CIRCUMSTANCES

Decisions based on on experience & objectives, but limited by constraints
DECISION-MAKING

Internal hope & motivation
INTRINSIC MOTIVATION

Mother died, in charge of sick relatives, no one to talk to
SOCIAL CAPITAL & NETWORKS

Low self-reported health, CHB-, blind
FUNCTIONING

Very good perceived competency "God gave me a good brain"
BELIEFS, SELF-EFFICACY

Difficulty in organizing daily life, controlling behavior
GOVERNANCE

Health is important, prompts changes in life/travels to Touba town
HEALTH-RELATED VALUES & GOALS

NIL

OPTIMAL

1212 (M, 51)

Salaried work (oral contract), no insurance
ECONOMIC, SOCIAL & POLITICAL SECURITY

Part of the village's association
GROUP MEMBERSHIP

Good self-reported health, fatigue after farming
FUNCTIONING

Health is the top priority
HEALTH-RELATED VALUES & GOALS

Blood sampling gets taken away, Serer people used to wait, now more into prevention
SOCIAL NORMS

Efficient in providing care (except for CHB)
ENABLING HEALTHCARE SYSTEMS

Ability to multitask and control behaviors (e.g., diet)
GOVERNANCE

Optimal internal motivation
INTRINSIC MOTIVATION

Optimistic except for CHB "worrying disease"
POSITIVE EXPECTATIONS

Wife goes to Dakar, children too young to help
SOCIAL CAPITAL & NETWORKS

1st intention, money is an obstacle but prevention is worth it
HEALTHCARE ACCESS & UTILIZATION

Systematic, informed decision making
DECISION-MAKING

Breadwinner in relatively poor household
MATERIAL CIRCUMSTANCES

Good CHB knowledge, heard of vaccines
KNOWLEDGE

Self-perceived competency and skills
BELIEFS, SELF-EFFICACY

NIL

OPTIMAL

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Appendix B4. Individual health capability scores

Table B4.1 Health capability score for IDI participants (n=40)

ID	Overall Score	Health capabilities														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
12	**76**	55	85	85	70	85	85	70	85	70	85	70	70	55	85	85
31	**57**	70	55	40	70	70	70	85	70	55	40	25	55	25	70	55
109	**60**	40	40	85	85	85	85	70	70	40	70	25	85	40	25	55
115	**47**	70	25	70	70	85	40	10	25	40	70	10	70	40	25	55
120	**47**	70	10	55	70	70	40	55	10	40	55	10	70	40	55	55
164	**55**	40	55	10	85	70	40	70	70	70	70	70	25	25	55	70
182	**38**	55	25	25	10	40	10	70	70	10	55	40	55	10	70	25
196	**72**	55	85	85	85	70	85	85	85	40	70	85	70	55	70	55
296	**35**	40	25	40	55	25	55	55	40	25	10	25	40	10	40	40
381	**46**	55	25	10	70	70	40	70	55	40	55	25	25	25	55	70
387	**33**	70	25	25	70	10	40	25	25	40	10	40	40	25	25	25
406	**33**	70	0	10	70	70	10	25	25	25	40	25	40	25	25	40
626	**45**	85	40	70	70	40	10	70	10	25	55	10	70	40	25	55
762	**34**	40	70	70	25	25	0	10	55	40	25	55	25	10	10	55
839	**38**	40	25	25	55	25	40	40	40	40	10	25	55	40	70	40
909	**41**	55	10	10	40	40	25	85	55	40	40	70	40	25	40	40
925	**39**	70	25	10	70	70	0	70	25	25	40	55	55	25	25	25
937	**48**	70	40	40	70	55	0	85	40	70	40	70	55	55	10	25
1108	**44**	70	0	10	70	55	25	70	40	70	55	40	55	25	25	55
1141	**46**	55	40	25	55	55	0	70	70	55	40	25	55	25	55	70
1160	**38**	55	25	40	55	70	0	10	25	70	25	70	40	25	40	25
1161	**32**	40	25	25	55	55	10	25	25	25	25	55	25	25	25	40
1212	**54**	85	70	70	85	85	40	70	40	40	40	40	25	25	55	40
1235	**39**	55	25	25	55	40	25	70	25	40	55	25	25	25	40	55
1522	**36**	40	10	25	40	70	25	25	10	55	55	55	40	10	40	40
1566	**39**	40	10	55	70	70	25	25	55	25	40	40	40	25	25	40
1619	**44**	70	40	25	40	40	40	40	70	55	40	40	25	25	55	55
1670	**47**	55	40	40	70	25	70	55	40	55	40	25	85	40	40	25
1747	**30**	55	25	40	10	25	40	25	25	10	25	25	70	25	10	40
1833	**35**	70	0	40	25	40	55	55	25	40	55	10	40	25	25	25
1840	**46**	70	40	40	40	40	25	55	85	25	70	25	25	25	55	70
1843	**44**	40	55	25	55	55	40	70	55	40	55	25	25	25	55	40
1877	**39**	40	10	70	40	25	40	25	40	55	40	40	70	10	40	40
1920	**49**	55	40	55	55	70	85	85	70	25	55	10	40	25	10	55
1929	**39**	25	25	70	40	40	55	25	70	40	25	70	25	25	25	25
2100	**69**	70	85	70	85	85	85	70	70	55	40	40	85	55	85	55
2533	**48**	40	25	70	40	85	85	10	40	40	40	25	70	40	40	70
2666	**53**	40	25	70	55	25	85	70	85	55	40	25	40	40	85	55
2795	**47**	55	40	0	70	40	40	70	40	40	70	40	55	25	70	55
2909	**55**	40	10	25	85	85	25	70	40	40	70	70	85	25	85	70

C. Appendices to Chapter 3

Appendix C1. Definitions of all variables used

Table C1.1 Definition of all variables used

Variable group	Variable	Type	Definition	N	%
Determinants of healthcare-seeking	Had primary education or higher	Binary	None (=reference category); Primary school or higher	1787	83.77; 16.23
	Was a woman	Binary	Man (=reference category); Woman	1787	45.89; 54.11
	Was in a union	Binary	Not in a union (=reference category); In a union	1787	9.78; 90.22
	Age	Continu-ous	Age (in years)	1787	
	Was poor (monetary poverty, HH level)	Binary	Household not considered as poor based on a monetary poverty indicator (=reference category); Considered as poor	1787	49.09; 50.91
	Was poor (food poverty, HH level)	Binary	Household not considered as poor based on a food poverty indicator (=reference category); Considered as poor	1787	61.87; 38.13
	Was poor (subjective poverty, HH level)	Binary	Household not considered as poor based on a subjective poverty indicator (=reference category); Considered as poor	1787	70.84; 29.16
	Monthly consumption expenditures per adult equivalent (in CFA francs)	Continu-ous	Total monthly consumption expenditures per adult equivalent in the household	1787	
	Number of adult equivalents in the household (HH level)	Continu-ous	Number of adult equivalents in the household, calculated using the Food and Agriculture Organization (FAO)'s Adult Male Equivalent (AME) method	1787	
	Distance to the nearest healthcare structure (in km)	Continu-ous	Shortest geographical distance (in km) between the household and the nearest healthcare structure (based on GPS coordinates)	1787	
	Distance to the nearest CBHI (in km)	Continu-ous	Shortest geographical distance (in km) between the household and the nearest CBHI (based on GPS coordinates)	1787	
Other potentially-	Had an at least fair knowledge of CBHI	Binary	Never heard of CBHI schemes/No knowledge (=reference category); Fair/good knowledge	1787	73.88; 26.12

associated variables	Health insurance status	Polyto-mous	Not enrolled in a CBHI (=reference category); Enrolled (voluntarily); Enrolled (subsidized)	1787	87.38; 4.11; 8.51
	Willingness to pay for CBHI (in CFA francs)	Continu-ous	Maximum annual premium an individual would pay to enroll in a CBHI (in CFA francs)	1787	
	Had a chronic illness	Binary	No chronic illness (=reference category); Chronic illness	1787	91.16; 8.84
	Had a handicap	Binary	No handicap (=reference category); Handicap	1787	95.04; 4.96
	Had a poorer health	Binary	Excellent/Very good health (=reference category); Good/Fair/Poor health	1787	41.52; 58.48
	SF-12 Mental Component Summary (MCS-12)	Continu-ous	Mental health score calculated from the SF-12 questionnaire, ranging from 0 to 100 (higher values corresponding to better health-related quality of life)	1787	
	SF-12 Physical Component Summary (PCS-12)	Continu-ous	Physical health score calculated from the SF-12 questionnaire, ranging from 0 to 100 (higher values corresponding to better health-related quality of life)	1787	
	Perception of healthcare quality	Continu-ous	Factor-based score (higher values corresponding to a lower perception of healthcare quality), encompassing nine dimensions about the health facility the most frequently visited by the respondent (the premises, the medical material and equipment, the waiting time, the physician's listening skills, the physical examination, the medical care provided, the medical staff guidance, the reliability of the diagnosis, and the availability of drugs)	1787	
	Risk tolerance	Discrete	Qualitative scale ranging from 0 ("not at all willing to take risks") to 10 ("very willing to take risks")	1785	
	Generalized trust	Discrete	Qualitative scale ranging from 0 ("you can't be too careful in dealing with people") to 10 ("most people can be trusted")	1786	
Catastro-phic health expendi-tures	Had catastrophic health expenditures, 40% threshold (HH level)	Binary	The household's out-of-pocket health expenditure did not exceed 40% of its capacity to pay (=reference category); The household's out-of-pocket health expenditure exceeded 40% of its capacity to pay	1787	93.68; 6.32

	Had catastrophic health expenditures, 30% threshold (HH level)	Binary	The household's out-of-pocket health expenditure did not exceed 30% of its capacity to pay (=reference category); The household's out-of-pocket health expenditure exceeded 40% of its capacity to pay	1787	89.30; 10.70
	Had catastrophic health expenditures, 20% threshold (HH level)	Binary	The household's out-of-pocket health expenditure did not exceed 20% of its capacity to pay (=reference category); The household's out-of-pocket health expenditure exceeded 40% of its capacity to pay	1787	82.82; 17.18
Healthcare services utilization	Forgone medical consultation (HH level)	Binary	The household did not have to forgo medical consultation in the last 12 months due to financial hardship (=reference category); The household forgone medical consultation	1787	64.57; 35.43
	Forgone medical treatment (HH level)	Binary	The household did not have to forgo medical treatment in the last 12 months due to financial hardship (=reference category); The household forgone medical treatment	1787	75.85; 24.15
	Consulted in a health structure following an episode of illness	Binary	Did not consult in a health structure in case of health problem that occurred in the last 2 months (=reference category); Consulted	418	67.38; 32.62
	Self-medicated following an episode of illness	Binary	Did not self-medicate in case of health problem that occurred in the last 2 months (=reference category); Self-medicated	418	68.73; 31.27
	Gave birth in a health facility	Binary	Delivered at home, for a live birth that occurred in the last 2 years (=reference category); Delivered in a health facility	197	45.81; 54.19
	Number of prenatal consultations	Discrete	Number of prenatal consultations (for a live birth that occurred in the last 2 years)	197	

Notes: All variables measured at the individual level, unless when HH-level specified. Data were weighted using sampling weights to account for choice-based stratified samples.
Abbreviations: N=number of observations, %= percentage in the population or subpopulations, HH=household, CBHI=community-based health insurance.

Appendix C2. Results of the explanatory factor analysis

Factor analysis/correlation   Number of obs =   1,787
Method: principal-component factors   Retained factors =   2
Rotation: orthogonal varimax (Kaiser off)   Number of params =   9

Factor	Variance	Difference	Proportion	Cumulative
Factor1	**2.13304**	1.08438	**0.4266**	0.4266
Factor2	1.04866	.	0.2097	0.6363

LR test: independent vs. saturated: chi2(10) = 2035.55 Prob>chi2 = 0.0000

Rotated factor loadings (pattern matrix) and unique variances

Variable	Factor 1	Factor 2	Uniqueness
v2_A9_Q3_B	0.0775	0.8906	0.2008
v2_A9_Q3_C	**0.5390**	-0.3635	0.5773
v2_A9_Q3_D	**0.8768**	0.0606	0.2276
v2_A9_Q3_E	**0.8852**	0.0748	0.2108
v2_A9_Q3_F	**0.5331**	0.3376	0.6018
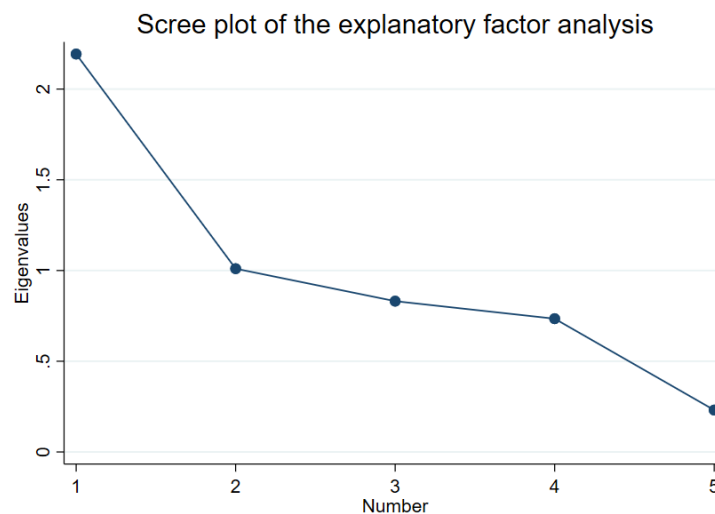
Figure C2.1 Scree plot and result of the EFA

We retained factor 1 (eigenvalue = 2.13 > 1.1), which was situated right before the "elbow" of the scree plot (see Figure C2.1).

Appendix C3. Summary statistics

Table C3.1 Summary statistics

Variable group	Variable	Type	Mean or propor-tion	Stan-dard devia-tion	Min	Max
Determi-nants of healthcare-seeking	Had primary education or higher	Binary	0.16	0.37	0.00	1.00
	Was a woman	Binary	0.54	0.50	0.00	1.00
	Was in a union	Binary	0.90	0.30	0.00	1.00
	Age	Continuous	52.85	13.85	15.00	94.00
	Was poor (monetary poverty, HH level)	Binary	0.51	0.50	0.00	1.00
	Was poor (food poverty, HH level)	Binary	0.38	0.49	0.00	1.00
	Was poor (subjective poverty, HH level)	Binary	0.29	0.45	0.00	1.00
	Monthly consumption expenditures per adult equivalent (in CFA francs)	Continuous	16,936.27	10,887.67	2,868.00	162887.59
	Number of adult equivalents in the household (HH level)	Continuous	11.53	5.94	0.79	41.90
	Distance to the nearest healthcare structure (in km)	Continuous	3.15	2.19	0.01	9.40
	Distance to the nearest CBHI (in km)	Continuous	5.46	2.84	0.05	12.82
Other potentially-associated variables	Had an at least fair knowledge of CBHI	Binary	0.26	0.44	0.00	1.00
	Willingness to pay for CBHI (in CFA francs)	Continuous	3,865.83	3,905.57	0.00	50,000.00
	Had a chronic illness	Binary	0.09	0.28	0.00	1.00
	Had a handicap	Binary	0.05	0.22	0.00	1.00
	Had a poorer health	Binary	0.58	0.49	0.00	1.00
	SF-12 Mental Component Summary (MCS-12)	Continuous	47.89	7.81	18.92	70.56
	SF-12 Physical Component Summary (PCS-12)	Continuous	49.53	9.52	17.51	65.27
	Perception of healthcare quality	Continuous	0.52	0.53	0.00	2.56
	Risk tolerance	Discrete	5.18	2.48	0.00	10.00
	Generalized trust	Discrete	5.20	2.23	0.00	10.00
Catastro-phic health expendi-tures	Had catastrophic health expenditures, 40% threshold (HH level)	Binary	0.06	0.24	0.00	1.00
	Had catastrophic health expenditures, 30% threshold (HH level)	Binary	0.11	0.31	0.00	1.00
	Had catastrophic health expenditures, 20% threshold (HH level)	Binary	0.17	0.38	0.00	1.00

	Forgone medical consultation (HH level)	Binary	0.35	0.48	0.00	1.00
	Forgone medical treatment (HH level)	Binary	0.24	0.43	0.00	1.00
Healthcare services utilization	Consulted in a health structure following an episode of illness	Binary	0.33	0.47	0.00	1.00
	Self-medicated following an episode of illness	Binary	0.31	0.46	0.00	1.00
	Gave birth in a health facility	Binary	0.54	0.50	0.00	1.00
	Number of prenatal consultations	Discrete	3.33	1.26	0.00	6.00

Notes: Means were computed for continuous and discrete variables, and proportions were computed for binary variables. All variables measured at the individual level, unless when HH-level specified. Data were weighted using sampling weights to account for choice-based stratified samples.

Abbreviations: N=number of observations, HH=household, CBHI=community-based health insurance.

Appendix C4. Graphical representation of the univariate regression results

Figure C4.1 Graphs 1-3: PBMC score and determinants of healthcare seeking

Linear regressions (variables in CFA francs)

Monthly consumption expenditures per adult equivalent (in CFA francs)

Coefficient estimates (95% & 90% CI)
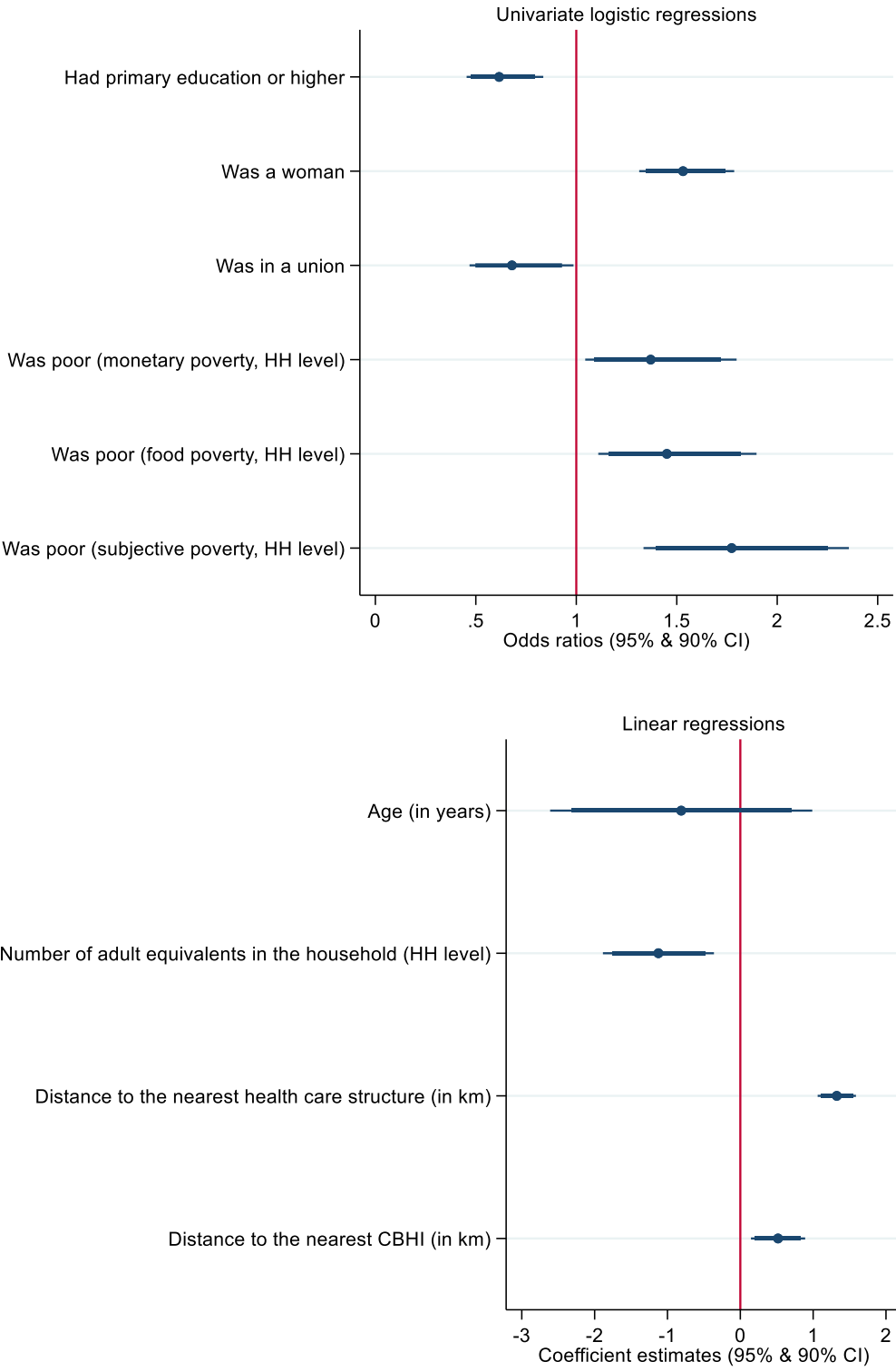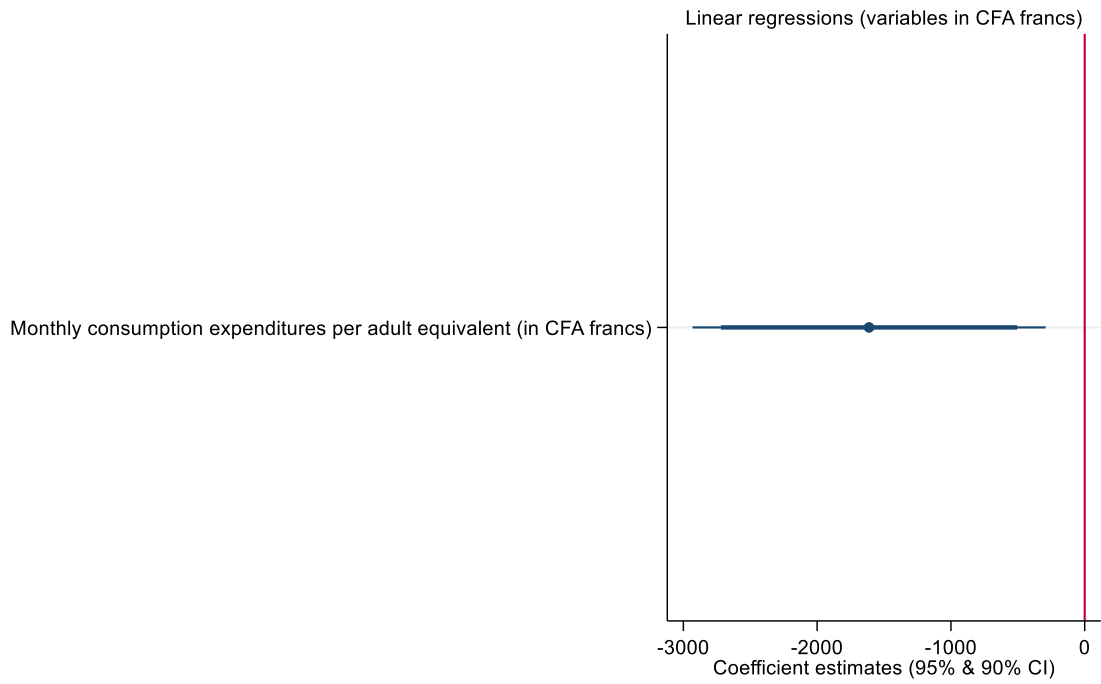
Figure C4.2 Graphs 4-6: PBMC score and other variables of interest

Univariate logistic regressions

Had an at least fair knowledge of CBHI

Health insurance status: Enrolled (voluntary) (RRR)

Health insurance status: Enrolled (subsidized) (RRR)

Had a chronic illness

Had a handicap

Had a poorer health

Odds ratios (95% & 90% CI)

193

Linear regressions

SF-12 Mental Component Summary (MCS-12)

SF-12 Physical Component Summary (PCS-12)

Perception of healthcare quality

Risk tolerance

Generalized trust

Coefficient estimates (95% & 90% CI)

Linear regressions (variables in CFA francs)

Willingness to pay for CBHI (in CFA francs)

Coefficient estimates (95% & 90% CI)

Figure C4.3 Graph 7: PBMC score and catastrophic health expenditures

Univariate logistic regressions

Had catastrophic health expenditures, 40% threshold (HH level)

Had catastrophic health expenditures, 30% threshold (HH level)

Had catastrophic health expenditures, 20% threshold (HH level)

Odds ratios (95% & 90% CI)
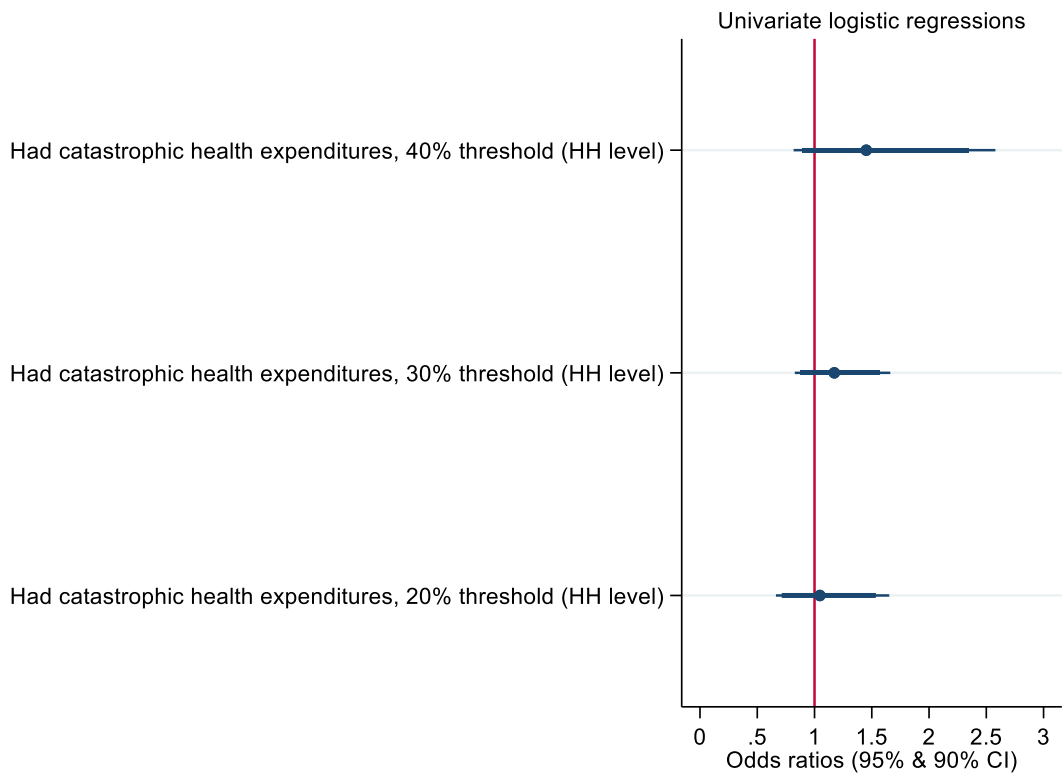
Figure C4.4 Graph 8: PBMC score and health services utilization and non-utilization

Univariate logistic regressions

Forgone medical consultation (HH level)

Forgone medical treatment (HH level)

Consulted in a health structure following an episode of illness

Self-medicated following an episode of illness

Gave birth in a health facility

Number of prenatal consultations (IRR)

Odds ratios (95% & 90% CI)
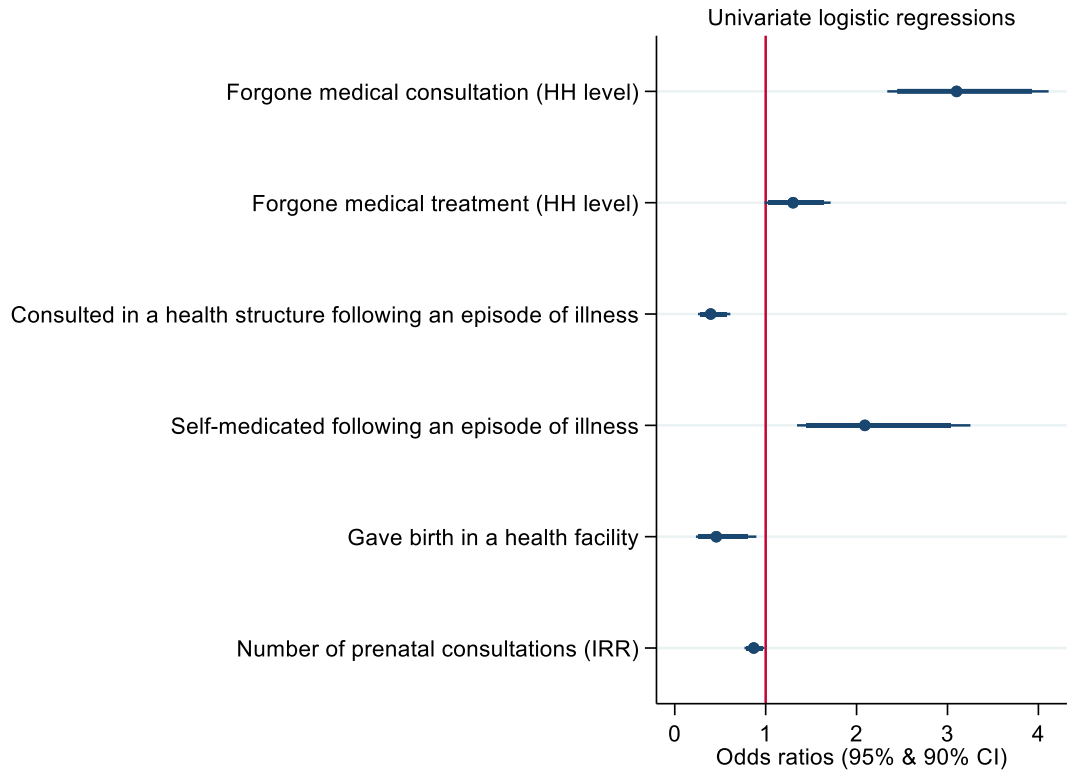
Appendix C5. Confirmation of the score on the ANRS12356 AmBASS dataset

The AmBASS survey was conducted between October 2018 and July 2019 in 12 villages of the Niakhar HDSS. Households were randomly selected, and all their residents (over 6 months of age) were invited to participate, ensuring a sample representative of people living in the Niakhar area. DHS-based items were administered to all 724 participants, age 15 and above, interviewed between January and July 2019.

1. Perceived barriers to medical care in the AmBASS dataset

Compared with the CMUtuelleS dataset (see Figure C5.1.), a smaller share of participants reported having money, distance, and finding transport as a 'big problem' (11% vs. 55%, 5% vs. 15%, and 2% vs. 10%, respectively), and a bigger share of participants identified knowing where to go and getting the permission to go as 'a small problem' (13% vs. 2% and 12% vs. 1%, respectively).
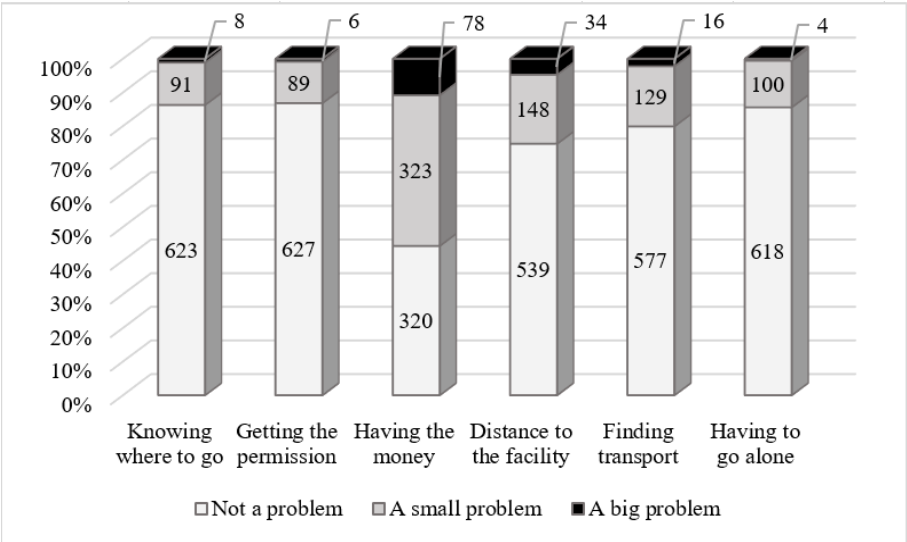
Figure C5.1 Perceived barriers to medical care (items considered for the score)

2. Confirmatory factor analysis

Table C5.1 presents results from confirmatory factor analysis on the AmBASS dataset. We first conducted CFA on the 'reduced' set of items validated in the CMUtuelleS survey, specifically items (3), (4), (5), and (6). Goodness of fit measures indicated an excellent fit of the data, better than when including the full set of items, and even after including co-variates (models (2) and (3) respectively).

Table C5.1 Goodness of fit measures of the CFA analysis

CFA models	Chi2 (p-value)	RMSEA	SRMR	CFI	TLI
(1) AmBASS: reduced	5.49 (0.0642)	0.049	0.016	0.996	0.988
(2) AmBASS: full	241.943 (0.00)	0.190	0.064	0.860	0.767
(3) AmBASS: full with co-variates	18.967 (0.00)	0.055	0.019	0.992	0.981

3. Building the score in the AmBASS dataset

Our sample passed the Bartlett test of sphericity, rejecting the null hypothesis that variables are not inter-correlated (χ^2=1674.965(15), p-value=0.000), and gave a value for the Kaiser-Meyer-Olkin measure sufficiently large (0.807) to justify running a factor analysis. Stepwise descendant factor analysis showed that removing any of the items would significantly reduce the quality of the factor analysis. Subsequent factor analysis was therefore conducted on all 6 items. Following EFA and scree plot analysis, only one dimension was retained (3.28 eigenvalue, explaining 55% of variations, see Figure C5.2).

```
Factor analysis/correlation                 Number of obs    =       720
    Method: principal-component factors     Retained factors =         1
    Rotation: (unrotated)                   Number of params =         6

    Factor   |  Eigenvalue   Difference        Proportion   Cumulative
    ---------+-----------------------------------------------------------
    Factor1  |    3.27607      2.38445            0.5460       0.5460
    Factor2  |    0.89163      0.13074            0.1486       0.6946
    Factor3  |    0.76089      0.33655            0.1268       0.8214
    Factor4  |    0.42434      0.05164            0.0707       0.8922
    Factor5  |    0.37270      0.09833            0.0621       0.9543
    Factor6  |    0.27438         .               0.0457       1.0000

LR test: independent vs. saturated:  chi2(15) = 1677.30 Prob>chi2 = 0.0000
```
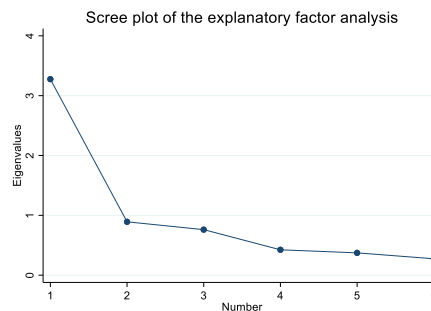

Figure C5.2 Exploratory factor & scree plot analysis

Rotations with weights revealed that all items significantly contributed to dimension one (loadings > 0.4). The 0.79 Cronbach's alpha indicated excellent internal consistency. We, therefore, built a factor-based score with the average of items (1)-(6) on individuals without missing values (n=720). For comparison and cross-validation purposes, we also

built a reduced score as the average of items (3)-(6). This reduced score exhibited good internal consistency with a 0.71 Cronbach's alpha. Table C5.2 presents the score (bar charts are also provided in Figure C5.3).

Table C5.2 Summary statistics and internal consistency of the full and reduced PBMC scores

Score	Items	Mean (min;max)	Median [IQR]	Cronbach's α
Reduced PBMC	(3)-(6)	0.33(0;2)	0.25[0-1]	0.71
Full PBMC	(1)-(6)	0.27(0;2)	0.17[0-0.33]	0.79
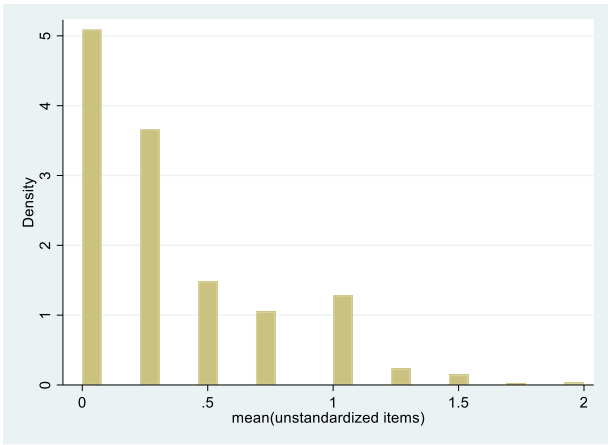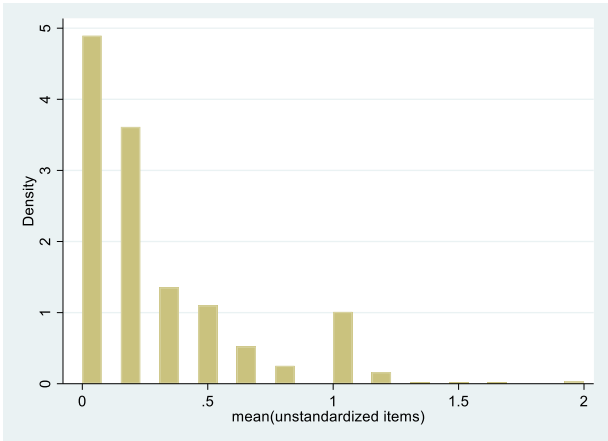
Reduced BMC score   Full PBMC score

Figure C5.3 Full and reduced PBMC scores

Table C5.3 displays the results of the univariate regressions of the score on similar variables than in the main analysis. Results suggested that the choice of items can be sample dependent, but had no impact on the validity of the score (i.e., no significant differences between reduced and full PBMC scores).

Table C5.3 Univariate regressions of the full and reduced PBMC score

Variable group	Dependent variable	Model	Type of estimate	Estimates		N
				Reduced set	Full set	
Determinants of healthcare seeking	Had primary education or higher	Logistic	OR	0.34*** (0.73)	0.34*** (0.09)	711
	Being a woman	Logistic	OR	1.45* (0.28)	1.42 (0.31)	720
	Was in a union	Logistic	OR	1.65** (0.42)	1.50 (0.45)	720
	Age	Linear	CE	5.69*** (1.77)	5.00** (2.00)	720
	Over 20 years of age	Logistic	OR	1.78** (0.49)	1.75** (0.60)	720
	Living in a semi-urban village	Logistic	OR	0.20*** (0.06)	0.19*** (0.07)	720
	Living conditions index	Linear	CE	-0.53*** (0.13)	-0.57*** (0.15)	720
	Agricultural resources index	Linear	CE	0.39*** (0.15)	0.47*** (0.18)	720
	Number of adults in the household	Linear	CE	-1.13** (0.57)	-1.29* (0.69)	720
	Monetary resources (HH level)	Linear	CE	-1650719** (774846.6)	-2017058*** (936073.9)	720
Other potentially-associated variables	Ever heard of hepatitis B	Logistic	OR	0.44** (0.15)	0.38** (0.16)	720
	Covered by insurance	Logistic	OR	0.04*** (0.04)	0.03*** (0.06)	720
	SF-12 Mental Component Summary (MCS-12)	Linear	CE	4.44*** (1.21)	6.35*** (1.39)	699
	SF-12 Physical Component Summary (PCS-12)	Linear	CE	-5.46*** (0.75)	-6.20*** (0.84)	699
Healthcare services utilization	Consulted a shaman during a recent episode of illness	Logistic	OR	29.03*** (17.30)	19.64*** (18.22)	102
	Place of birth delivery (last pregnancy) Ref=at home	Multinomial logistic	RRR (dispensary)	-0.37 (0.42)	-0.49 (0.49)	180
			RRR (medicalized)	-2.06** (0.84)	-2.95*** (1.06)	180
	Visited a health facility for CHB management Ref= no visit (registry)	Logistic	OR	0.07** (0.08)	0.07** (0.09)	74

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. All variables measured at the individual level, unless when HH-level specified. Robust standard errors (clustered at the household level to account for intra-household correlation) in parenthesis. Regressions were weighted using sampling weights to account for choice-based stratified samples. For linear models, predictions are linear predictions of the dependent variable. For logistic and multinomial logistic models, predictions are predicted probabilities of the dependent variable. Abbreviations: N=number of observations, HH=household, OR=odds ratio, CE=coefficient estimate, RRR=relative-risk ratio.

D.   Data collection tools of the AmBASS-PeCSen study

Appendix D1. Quantitative survey

General information

VILL. Village name: _____
HAM. Hamlet name: _____
A0. Concession code: |__|__|__|
A1. Household code: |__|__|
ID. Individual ID: |__|__|__| |__||__| |__|

DVIS. Date of visit: |__| |__| |__|
                            Day Month Year
ENQ. Investigator: _____

Gender   □ 1. Male   □ 2. Female

Date of birth |__|__| |__|__| |__|__|__|__|
                         Day   Month   Year

What is your marital status?
□ 1. Married   □ 2. Single   □ 3. Widow(er)   □ 4. Divorced

If you are married, are you in a union...
□ 1. Monogamous   □ 2. Polygamous

How many children do you have? |__|__|
(Note 0 if the person has no children)

In the past 12 months, how much time did you spend in the household? |__ |__| month |__| days

Are you currently studying or training?   □ 1. Yes   □ 2. No

What education/training are you pursuing?
□ 1. Middle school   □ 2. High School   □ 3. Higher education (university)
□ 4. Professional training   □ 5. Other => Specify: _____

Where are you undertaking this education/training?
□ 1. In the Fatick region => Do you go back to your household every night?   □ 1. Yes □ 2. No
□ 2. In Dakar   □ 3. In another region of Senegal (outside of Dakar)   □ 4. In another country

Internal capability n°1: Health status and health functioning

SELF-REPORTED HEALTH

In the past 3 months, how would you rate the impact of your health on your ability to work?
Consider days when you were limited in the amount or type of work you could have done, such as if you had to work less time or could not work as well as usual.
□ 1. My health problems have had no effect on my work (or I have no health problems)
□ 2. Because of my health problems, I have had some difficulty working
□ 3. Because of my health problems, I had a lot of difficulty working
□ 4. Because of my health problems, I have not been able to work at all

In the past 3 months, how would you rate the impact of your health on your ability to perform your usual daily activities?
By usual daily activities, we mean activities that you do on a regular basis, such as housework, shopping, childcare, studying, etc. Consider days when you were limited in the amount or type of activity you could have done, for example if you did less than you would have liked.
□ 1. My health problems have had no effect on my daily activities (I have no health problems)
□ 2. Because of my health problems, I have had some difficulties in performing my daily activities
□ 3. Because of my health problems, I had a lot of difficulty performing my daily activities
□ 4. Because of my health problems, I have not been able to do my daily activities at all

SF12 SCALE (VERSION 2 ADAPTED)

Overall, do you think your health is:
□ 1. Excellent   □ 2. Very good   □ 3. Good   □ 4. Fair   □ 5. Poor

Here is a list of activities you may have to do in your daily life:
(For each of these, indicate whether you are bothered by your current health condition)
- Moderate physical effort such as moving a table, sweeping the floor, walking slowly for about 20 minutes on level ground
□ 1. Limited a lot   □ 2. Limited a little   □ 3. Not limited at all
- Climb several flights of stairs, walk up a steep hill for a few minutes, or walk quickly for 100 meters
□ 1. Limited a lot   □ 2. Limited a little   □ 3. Not limited at all

In the past 4 weeks, and due to your physical condition:
- Did you do less than you would have liked?
□ 1. All of the time   □ 2. Most of the time   □ 3. Some of the time
□ 4. A little of the time   □ 5. None of the time
- Did you have to stop doing certain things?
□ 1. All of the time   □ 2. Most of the time   □ 3. Some of the time
□ 4. A little of the time   □ 5. None of the time

In the past 4 weeks, and due to your emotional state (feeling sad, nervous or depressed):
- Did you do less than you would have liked?
□ 1. All of the time   □ 2. Most of the time   □ 3. Some of the time
□ 4. A little of the time   □ 5. None of the time
- Did you find it difficult to do what you had to do with such care and attention?
□ 1. All of the time   □ 2. Most of the time   □ 3. Some of the time
□ 4. A little of the time   □ 5. None of the time

In the past 4 weeks, how much have your physical aches and pains interfered with your work or home activities?

☐ 1. Not at all   ☐ 2. A little bit   ☐ 3. Moderately   ☐ 4. Quite a bit
☐ 5. Extremely

In the past 4 weeks, have there been times when your health condition, either physical or emotional, has interfered with your life and your relationships with others, family, friends, acquaintances?

☐ 1. All of the time   ☐ 2. Most of the time   ☐ 3. Some of the time
☐ 4. A little of the time   ☐ 5. None of the time

The following questions are about how you have felt over the past 4 weeks.
In the past 4 weeks, were there times when:
- You felt calm and relaxed

☐ 1. All of the time   ☐ 2. Most of the time   ☐ 3. Some of the time
☐ 4. A little of the time   ☐ 5. None of the time
- You felt energized

☐ 1. All of the time   ☐ 2. Most of the time   ☐ 3. Some of the time
☐ 4. A little of the time   ☐ 5. None of the time
- You felt sad and downcast

☐ 1. All of the time   ☐ 2. Most of the time   ☐ 3. Some of the time
☐ 4. A little of the time   ☐ 5. None of the time

FATIGUE

Now I'm going to ask you to rate your current level of fatigue.

☐ 1. I don't feel tired at all / I don't feel any fatigue   ☐ 2. I feel a little tired
☐ 3. I feel very tired   ☐ 4. I am exhausted/I feel extremely tired

Approximately how long have you been feeling tired? |_|_| Days |_|_|Weeks |_|_| Months |_|_| Years

Are you bothered by the fatigue you feel at the moment when carrying out your daily activities or work?

☐ 1. Not at all: the fatigue I feel does not hinder me at all in my activities or my work

☐ 2. A little / sometimes: sometimes the fatigue I feel hinders me from carrying out my activities or my work

☐ 3. A lot / often: the fatigue I feel bothers me a lot / often

☐ 4. Because of the fatigue I feel, I am unable to perform my daily tasks or work

DISABILITY

Do you currently have a disability?   ☐ 1. Yes   ☐ 2. No

What is your disability?
☐ 1. Alteration or loss of vision   ☐ 2. Speech impairment
☐ 3. Inability to walk or move (paralysis or amputation of a lower limb)
☐ 4. Inability to use an upper limb (paralysis or amputation of an upper limb)
☐ 5. Other => Specifiy: _____

ONLY FOR CHB PATIENTS – ADMINISTERED BY THE AMBASS STUDY PHYSICIAN
BODY-MASS INDEX & CURRENT HEALTH CONDITIONS

Weight: |_|_|_| kg

Height: |_| m |_|_| cm

Blood pressure: |_|_| |_|

Fever (over 38 degrees) □ 1. Yes => |_|_| degrees   □ 2. No

Current chronic condition?   □ 1. Yes   □ 2. No
□ 1. Diabetes   □ 2. AVC   □ 3. Sickle cell disease   □ 4. HTA
□ 5. Heart failure   □ 6. Renal insufficiency □ 7. Other => Specify _____

Current acute condition?
□ 1. Yes => Specify: _____   □ 2. No

CHB-RELATED HISTORY & SYMPTOMS

    CHB STATUS *(as a result of home-based testing using)*
    □ 1. AgHBs+ (CHB patient)   □ 2. AgHBs-

Have you been vaccinated against hepatitis B? □ 1. Yes   □ 2. No

If yes: How many doses did you receive? |_|

Has anyone close to you ever had any of the following diseases?
Spouse
□ 1. Liver cirrhosis □ 2. Liver cancer ("big belly")   □ 3. Viral hepatitis   □ 4. Stroke
Father
□ 1. Liver cirrhosis   □ 2. Liver cancer ("big belly") □ 3. Viral hepatitis   □ 4. Stroke
Mother
□ 1. Liver cirrhosis   □ 2. Liver cancer ("big belly") □ 3. Viral hepatitis   □ 4. Stroke
Brothers/sisters
□ 1. Liver cirrhosis   □ 2. Liver cancer ("big belly") □ 3. Viral hepatitis   □ 4. Stroke
Father's parents
□ 1. Liver cirrhosis   □ 2. Liver cancer ("big belly") □ 3. Viral hepatitis   □ 4. Stroke
Mother's parents
□ 1. Liver cirrhosis   □ 2. Liver cancer ("big belly") □ 3. Viral hepatitis   □ 4. Stroke
Other family member => Specify: _____
□ 1. Liver cirrhosis   □ 2. Liver cancer ("big belly") □ 3. Viral hepatitis   □ 4. Stroke

CLINICAL EXAMINATION

Presumptive evidence of liver disease (current or past)
Digestive haemorrhages   □ 1. Yes => □ 1.Hematemesis □ 2. Melaena □ 3. Rectorrhagia
          □ 2. No
Edema   □ 1. Yes, in the past   □ 2. Yes, on-going   □ 3. No, never
Ascites   □ 1. Yes, in the past   □ 2. Yes, on-going   □ 3. No, never
Icterus   □ 1. Yes, in the past   □ 2. Yes, on-going   □ 3. No, never
Cirrhosis   □ 1. Yes, in the past   □ 2. Yes, on-going   □ 3. No, never

| Encephalopathy | □ 1. Yes, in the past | □ 2. Yes, on-going | □ 3. No, never |

Presumptive evidence of extrahepatic disease (current or past)

Vacsulities	□ 1. Yes, in the past	□ 2. Yes, on-going	□ 3. No, never
Cryoglobulinemia	□ 1. Yes, in the past	□ 2. Yes, on-going	□ 3. No, never
Vascular purpura	□ 1. Yes, in the past	□ 2. Yes, on-going	□ 3. No, never
Arthromyalgia	□ 1. Yes, in the past	□ 2. Yes, on-going	□ 3. No, never
Kidney damage	□ 1. Yes, in the past	□ 2. Yes, on-going	□ 3. No, never
Livedo	□ 1. Yes, in the past	□ 2. Yes, on-going	□ 3. No, never
Mono-polyneuritis	□ 1. Yes, in the past	□ 2. Yes, on-going	□ 3. No, never

RISKS FACTORS FOR CHB EVOLUTION OR TRANSMISSION

- ALCOHOL USE

In the past 6 months, have you ever consumed alcohol?

□ 1. Never   □ 2. Once a month or less   □ 3. 2-4 times a month
□ 4. 2-3 times a week   □ 5. 4-6 times a week   □ 6. Every day

On the days you drank alcohol, how many drinks did you have?
Number of traditional alcoholic drinks |__|__|
Number of large bottles of beer (6 3cl) |__|__|
Number of small bottles of beer (33 cl)|__|__|
Number of alcohol packages |__|__|
Number of glasses of other alcohol |__|__|=> Specify other alcohol and its content: _____

In the past 6 months, have you ever had 6 or more drinks (and/or 3 or more large bottles of beer) on one occasion?

□ 1. Never   □ 2. At least once a month   □ 3. Several times a month
□ 4. Once a week   □ 5. Every day or so

- TOBACCO

Do you smoke conventional cigarettes?

□ 1. No, I never smoked   □ 2. No but I smoked in the past   □ 3. Yes, I currently smoke

When did you start smoking? |__|__| years ago

How many cigarettes do you smoke per day? |__|__|

SEXUAL BEHAVIORS

Now I'm going to talk about intimate issues, which may put you at risk of transmission. Everything we talk about is strictly confidential and your answers are anonymous.

In the past six months, have you had sexual intercourse?   □ 1. Yes   □ 2. No

If yes, how many partners have you had in the past 6 months? |__|__|

In the past 6 months, have you used a condom with your spouse (husband/wife) or fiancé(e)/boyfriend (if not married)?

□ 1. Yes always   □ 2. Yes sometimes   □ 3. No never   □ 4. Not applicable

In the past 6 months, have you used a condom with your other partners?
□ 1. Yes always □ 2. Yes sometimes □ 3. No never □ 4. Not applicable

Do you ever have casual sexual partners (including prostitutes) while traveling for work?
□ 1. Yes □ 2. No □ 3. Not applicable (no travel for work)

If yes, the last time you had a casual partner, did you use a condom? □ 1. Yes □ 2. No

Internal capability n°2: Health-related knowledge

GENERAL KNOWLEDGE ON CHB

Have you ever heard of liver diseases (also called fat bellies or yellow eyes)?
□ 1. Yes (at least one of these) □ 2. No

If yes, do you or someone you know suffer from any of these diseases?
Yourself	□ 1. Yes	□ 2. No
A member of your household	□ 1. Yes	□ 2. No
A family member (not living in your household)	□ 1. Yes	□ 2. No
An acquaintance	□ 1. Yes	□ 2. No

Have you ever heard of hepatitis B? □ 1. Yes □ 2. No, today is the first I've heard of it.

If yes, do you think there is a link between liver disease and hepatitis B? □ 1. Yes □ 2. No

Do you think a person who has hepatitis B can transmit the disease in the following situations?
During unprotected sex □ 1. Yes □ 2. No
When talking with another person □ 1. Yes □ 2. No
By contact with blood □ 1. Yes □ 2. No
Through saliva □ 1. Yes □ 2. No
From mother to child during pregnancy/childbirth □ 1. Yes □ 2. No

Is there is a vaccine that protects against hepatitis B? □ 1. Yes □ 2. No

Have you ever been tested for CHB? □ 1. Yes □ 2. No
=> *If possible, ask to consult the health record to verify this information*

Date of last CHB testing? Month: |_|_| Year: |_|_|

Do you know what your test result was?
□ 1. Yes positive □ 2. Yes negative □ 3. No (don't know)

=> If never tested: Why were you never tested for CHB?
□ 1. Had never heard of it/been offered a test □ 2. No money to pay for it
□ 3. Didn't want to know □ 4. Afraid of discriminations / confidentiality breaches
□ 5. Other => Specify: _____

Internal capability n°3: Health seeking skills and beliefs, and self-efficacy

PERCEIVED COMPETENCY

Please respond to each of the following items in terms of how true it is for you with respect to dealing with your health.

- I feel confident in my ability to manage my health

☐ 1. Fully agree ☐ 2. Agree ☐ 3. Neither agree nor disagree
☐ 4. Disagree ☐ 5. Fully disagree

- I am capable of handling my health now

☐ 1. Fully agree ☐ 2. Agree ☐ 3. Neither agree nor disagree
☐ 4. Disagree ☐ 5. Fully disagree

- I am able to control my behaviors to achieve positive

☐ 1. Fully agree ☐ 2. Agree ☐ 3. Neither agree nor disagree
☐ 4. Disagree ☐ 5. Fully disagree

- I feel able to meet the challenges of remaining healthy

☐ 1. Fully agree ☐ 2. Agree ☐ 3. Neither agree nor disagree
☐ 4. Disagree ☐ 5. Fully disagree

Internal capability n°7: Intrinsic motivation to achieve desirable health outcomes

When you go to the dispensary, or the hospital for a health issue or a question about your health you do it...

-	Because it is your duty/responsibility	☐ 1. Agree	☐ 2. Disagree
-	Because you will get in trouble otherwise	☐ 1. Agree	☐ 2. Disagree
-	Because it corresponds to your preferences	☐ 1. Agree	☐ 2. Disagree
-	Because that is what your family members tell you to do	☐ 1. Agree	☐ 2. Disagree
-	Because you want to	☐ 1. Agree	☐ 2. Disagree
-	So your family members won't get angry with you	☐ 1. Agree	☐ 2. Disagree
-	Because you personally believe it's the right thing to do whether or not your family members agree	☐ 1. Agree	☐ 2. Disagree
-	Because you want your family members to like you	☐ 1. Agree	☐ 2. Disagree

External capability n°9: Social norms

In your household, when a decision has to be made about...	Who has the last word?
... your health	☐ 1. You alone ☐ 2. You along with someone else ☐ 3. Someone else
... daily needs	☐ 1. You alone ☐ 2. You along with someone else ☐ 3. Someone else
... large household purchases	☐ 1. You alone ☐ 2. You along with someone else ☐ 3. Someone else
... visits to family and relatives	☐ 1. You alone ☐ 2. You along with someone else ☐ 3. Someone else

External capability n°12: Material circumstances

ECONOMIC ACTIVITY

In the past 12 months, have you been involved in your household's farming activities?
□ 1. Yes □ 2. No

If no, during the previous winter, were you hired by another household to work in the fields?
□ 1. Yes   □ 2. No

How much did you earn for the entire farming period? |_|_|_| |_|_| CFA

In addition to the common fields in your household, do you cultivate a field (peanut, niebe,
bissap, watermelon, ...) that belongs to you?   □ 1. Yes   □ 2. No
During the last 12 months, other than working in the fields, did you engage in any other
economic activity?
□ 1. Yes   □ 2. No

If yes, which activity?
□ 1. Fisherman - Breeder
□ 2. Street trade
□ 3. Small business (donuts in front of the house, doorstep business, ...)
□ 4. Established business (business with a store, restaurant owner - refreshment stand)
□ 5. Health personnel (nurse, lab technician, midwife...)
□ 6. Educator/Teacher
□ 7. Domestic worker/gardener/cook
□ 8. Craftsman/Mechanic/Mason
□ 9. Community health worker/matron/traditional birth attendant
□ 10. Clerk /employee
□ 11. Driver, chauffeur
□ 12. Seamstress / Laundry
□ 13. Other => Specify: _____

In the past 12 months, how much did you earn for this activity?
    |_|_|_| |_|_| CFA

➔ FOR THE INACTIVE
If in the past 12 months you have not worked/been economically active, what is your current
situation?
□ 1. Looking for a job   □ 2. Elderly person no longer working/retired
□ 3. Study/training   □ 4. Disability/ permanent disability/ long-term illness
□ 5. Other (homemaker)

  HOUSEHOLD AGRICULTURAL RESOURCES

Does your household have an agricultural activity?   □ 1. Yes   □ 2. No

If yes, how much income did your household get from the sale of all its crops for the year 2017
(January-December)? |_|_|_| |_|_|_| |_|_|_| CFA

Does your household grow peanuts? □ 1. Yes   □ 2. No

If yes, how much was produced for the year 2017 (January-December)? |_|_|_| |_|_|_| kg

Did your household sell any of it?   □ 1. Yes □ 2. No

If yes, how much income did your household get from the sale of peanuts for the year 2017 (January-December)? |__|__|__| |__|__|__| |__|__|__| CFA

How many animals do you estimate you have in your kitchen (livestock)?
- Poultry (chickens, ducks, etc.)   □ 1. None   □ 2. Less than 10 heads □ 3. ≥ 10 heads
- Small livestock (goats, sheep, pigs) □ 1. None   □ 2. Less than 10 heads □ 3. ≥ 10 heads
- Large livestock (cows, horses, donkeys) □ 1. None □ 2. Less than 10 heads □ 3. ≥ 10 heads

In 2017, did you sell any animals (poultry, small livestock, large livestock)? □ 1. Yes □ 2. No

If yes, how much money was obtained from the sale of these animals? |__|__| |__|__|__| |__|__|__|CFA
How many of the following animals or farm equipment do you own? (*code 0 if the person does not own the animal or equipment listed*)

Horse	|__|__|	Donkey	|__|__|
Cow	|__|__|	Seeding drill	|__|__|
Hoe	|__|__|	Tractor	|__|__|
Plough	|__|__|	Mill	|__|__|
Other => Specify: _____	|__|__|		

OTHER SOURCES OF INCOME

In 2017, did you receive money from relatives living in Senegal or abroad? □ 1. Yes □ 2. No

How much did you receive (for the year 2017)? |__|__| |__|__|__| |__|__|__|CFA

Have you ever applied for the Family Security Grant from the Government of Senegal?
□ 1. Yes □ 2. No

If yes, what was the result?
□ 1. Recipient □ 2. Waiting List => Since when |__|__| Month |__|__| Year   □ 3. Not eligible

If not, why did you no apply? □ 1. Did not know about this grant / never heard of it
□ 2. Application too long/complicated   □ 3. Don't need it/don't think the household is eligible
□ 4. Other. Specify: _____

➔ *Only for recipients of the Government Family Security Grant*
When did you receive the first payment? |__||__| Month |__|__| Year
How many payments have you received? |__|__|
Amount of your last payment: |__|__|__| |__|__|__|CFA

FOOD SECURITY

During the May-November 2017 agricultural season, did your kitchen grow millet?
□ 1. Yes   □ 2. No

Did you start eating the new millet before the 2018 harvest ended? □ 1. Yes   □ 2. No

During the last lean season (May-June 2018), did you need to buy millet?
□ 1. Yes   □ 2. No

If yes, how much millet did you buy? |_||_| TAC
If yes, for what amount? |_|_|_| |_|_| CFA

With what money did you buy this millet? *(several answers possible)*
□ 1. By selling other agricultural crops   □ 2. By selling animals
□ 3. With the help of income from off-farm activities
□ 4. Through a loan (from a relative, neighbor)
□ 5. Barter   □ 6. With the help of savings (money set aside)
□ 7. Other => Specify: _____

During the year 2017, did you receive food aid?   □ 1. Yes   □ 2. No
If yes, how much millet did you receive? |_||_| TAC

Source of food aid
□ 1. Donation of a related or neighboring kitchen   □ 2. Loan of grain from a related or neighboring kitchen   □ 3. State Food Assistance Program   □ 4. Other => Specify: _____

During the year 2017, did you give or lend money to another kitchen? (several answers possible)
□ 1. Yes, donating money to another kitchen   □ 2. Yes, lending money to another kitchen
□ 3. No
If donations or loans to another kitchen
2017 donations |_|_|_| |_|_| CFA   2017 loans |_|_|_| |_|_| CFA

HOUSING & EQUIPMENT
Does your household have the following goods?
□ 1. Radio   □ 2. TV   □ 3. DVD payer or CD/MP3 player
□ 4. Mobile phone/cell phone   □ 5. Bicycle   □ 6. Motorbike
□ 7. Solar panels or generator   □ 8. Fan   □ 9. Air conditioner
□ 10. Mosquito net   □ 11. Living room furniture

Does your household have any of the following goods that can generate income through rental?
(assets on site and in working order)
□ 1. Car   □ 2. Truck or bus   □ 3. Cart
□ 4. Refrigerator or freezer   □ 5. Sewing machine   □ 6. Shelling machine
□ 7. Oil mill/press   □ 8. Millet mill   □ 9. Computer/tablet
□ 10. Storage warehouse   □ 11. Equipment for a craft activity (mason, cabinetmaker, welder)

Does your kitchen have a small store?   □ 1. Yes   □ 2. No

What is the main source of water for your household?
□ 1. Drilling in the concession   □ 2. Faucet in the concession
□ 3. Drilling / fountain in the village   □ 4. Well in the concession
□ 5. Well in a neighboring concession
What energy source do you use for lighting?
□ 1. Wood/straw/candle fires   □ 2. Lamp (oil / gas / oil)   □ 3. Flashlight (batteries)
□ 4. Grid electricity   □ 5. Solar panel   □ 6. Generator

What is the main source of energy for cooking meals in your kitchen?
□ 1. Grid electricity   □ 2. Gas cylinder   □ 3. Oil, gasoline
□ 4. Manure, dung   □ 5. Charcoal   □ 6. Wood

How many rooms (huts or bedrooms) does the household's compound have for sleeping? |_||_|

Does the household have room(s) for rent?　□ 1. Yes　　□ 2. No

How many rooms for rent does the household have? |__|__| rooms

In 2017, what revenue was generated from the rental of this(ese) room(s)? |__|__|__| |__|__| CFA

Please indicate for the main living area, the composition of the roof, walls and floor *(to be completed by the interviewer)*
- Roof

□ 1. Straw　　□ 2. Sheet metal　　□ 3. Fibrocement　　□ 4. Cement
- Walls

□ 1. Millet stems　□ 2. Banco or clay　　□ 3. Stabilized banco

□ 4. Cement　　□ 5. Wood　　□ 6. Sheet metal
- Floor

□ 1. Banco　　□ 2. Cement　　□ 3. Sand　　□ 4. Tile

External capability n°13: Political, economic and social security

JOB QUALITY AND SECURITY

Is farming your main activity (the one you spend the most time on)?
□ 1. Yes, it's my main activity　□ 2. No, I have a secondary activity　　□ 3. No, I do not farm

During the last 12 months, did you engage in an economic activity other than farming?
□ 1. Yes　□ 2. No

If yes, in this activity, you work as a:　□ 1. Civil servant　　□ 2. Employee (written contract)
□ 3. Employee (oral agreement)　　□ 4. Self-employed (no employees)
□ 5. Contractor with employee(s)　　□ 6. Apprentice　　□ 7. Home help

In the past 12 months, how many months did you work for this activity?　|__|__| months

On average, how many days did you work in a month of activity? |__| full days　|__|half days

As part of this activity, did you have to leave your home to work (at least 7 days away)?
□ 1. Yes => How long (over the past 12 months)? |__|__| days OR|__|__| months　　□ 2. No

HEALTH INSURANCE

Do you have health insurance or a community health insurance plan?　　□ 1. Yes □ 2. No

If yes, what type of health insurance do you have?
□ 1. Community health insurance　　□ 2. Health insurance through your employer
□ 3. Other types of insurance => Specify: _____

Are you the primary member? *(Primary member = person who pays the membership fee)*
□ 1. Yes (= I pay the fee)　　□ 2. No (= my spouse or other household member pays)

If yes, how much do you pay?　　　|__|__|__|__|__|CFA　　Period: □ 1. Monthly □ 2. Annual

If no, who pays?　　|__|__|__|__|__| *Interviewer instruction: find the individual identifier*

Who is covered by this insurance/mutual? *(multiple answers possible)*
□ 1. Yourself □ 2. Your children □ 3. Your spouse(s)
□ 4. Other members of the kitchen

Are you up to date with your dues? □ 1. Yes □ 2. No

CERTIFICATES OF INDIGENCE

Have you ever heard of the indigent status or of the certificates of indigence? □ 1. Yes □ 2. No

Have you, or anyone in your kitchen, ever applied for indigent status/certificate?
□ 1. Yes, me personally □ 2. Yes, another member my kitchen □ 3. No/don't know

To whom? □ 1. Village chief □ 2. Services of the Prefecture
□ 3. Social Services at the hospital □ 4. Other. Specify: _____

When did you apply? *(if multiple requests, date of last request)* Month: |_|_| Year: |_|_|

Did you get it? □ 1. Yes □ 2. No
If yes, were you able to receive free or reimbursed (covered) care because of this certificate?
□ 1. Yes, only once □ 2. Yes, many times □ 3. No
If yes, for what total amount? (consider all care obtained free of charge or reimbursed since obtaining the certificate) |_|_|_| |_|_|_| |_|_|_| CFA

External capability n°14: Access and utilization of healthcare services

In the past 12 months, have you been hospitalized? □ 1. Yes □ 2. No

In the past 3 months, have you had a health problem (illness or injury)? □ 1. Yes □ 2. No

Because of this health problem, how many days in the last 3 months have you been unable to work? |_|_| days

Because of this health problem, how many days in the last 3 months have you not been able to do your daily activities? |_|_| days

Have you consulted for this illness? □ 1. Yes □ 2. No

Who did you consult? (*several answers possible*)
□ 1. Healer-marabou / Malongo center □ 2. Case □ 3. Dispensary
□ 4. Health Center □ 5. Hospital □ 6. Other => Specify:

If you did not consult, why not?
□ 1. Not a serious illness □ 2. Too expensive □ 3. No doctor
□ 4. Health services too far □ 5. Waiting time too long □ 6. Not well received
□ 7. Didn't need anyone □ 8. No treatment available □ 9. Other => Specify:

For this illness, did you use self-medication? (= taking medication without consulting a caregiver/healthcare professional authorized to prescribe them) □ 1. Yes □ 2. No

If yes, where did you get these medications?
□ 1. Grocery store □ 2. Drug depot or pharmacy □ 3. Store
□ 4. Market □ 5. Friend/Family □ 6. Other => Specify:

➔ FOR WOMEN

Have you ever had a pregnancy carried to term?
□ 1. Yes => Number of pregnancies (carried to term): |__|__| □ 2. No

Did you have a cesarean section for any of your deliveries?   □ 1. Yes   □ 2. No

Are you currently pregnant (for at least 3 months)?   □ 1. Yes   □ 2. No

If yes, for your current pregnancy, did you go to antenatal care visits (ANC) at a health facility?
□ 1. Yes => How many ANC visits did you go to? |__|__| □ 2. No

For your last full-term pregnancy, did you go to antenatal care visits (ANC) at a health facility?
□ 1. Yes => How many ANC visits did you go to? |__|__| □ 2. No
When did you last give birth? |__|__| (month) |__|__| (year)

Did you give birth in a health facility?   □ 1. Yes   □ 2. No

➔ *TO ALL*
In the past 3 months, have you used the following healthcare services:
- Medication
□ 2. No
□ 1. Yes => Who paid? □ 1. You □ 2. Your spouse □ 3. A household member □ 4. Someone else
     => Was this care (or part of this care) covered by your insurance? □ 1. Yes □ 2. No
     If yes, amount covered: |__|__| |__|__|__| |__|__|__|CFA
- Consultation with health professionals
□ 2. No
□ 1. Yes => Who paid? □ 1. You □ 2. Your spouse □ 3. A household member □ 4. Someone else
     => Was this care (or part of this care) covered by your insurance? □ 1. Yes □ 2. No
     If yes, amount covered: |__|__| |__|__|__| |__|__|__|CFA
- Medical exams (laboratory, radiology, ...)
□ 2. No
□ 1. Yes => Who paid? □ 1. You □ 2. Your spouse □ 3. A household member □ 4. Someone else
     => Was this care (or part of this care) covered by your insurance? □ 1. Yes □ 2. No
     If yes, amount covered: |__|__| |__|__|__| |__|__|__|CFA
- Hospitalization
□ 2. No
□ 1. Yes => Who paid? □ 1. You □ 2. Your spouse □ 3. A household member □ 4. Someone else
     => Was this care (or part of this care) covered by your insurance? □ 1. Yes □ 2. No
     If yes, amount covered: |__|__| |__|__|__| |__|__|__|CFA

- During the last 3 months, have you had expenses for travel (transportation: cab, bus, etc.)
related to your health care (going to the hospital/health center/dispensary ... to consult, to have
exams, to buy medicine, ...)?
□ 1. Yes => What was the amount? ||__|__|__| |__|__|__|CFA   □ 2. No

ONLY FOR CHB PATIENTS – follow-up post-survey (PeCSEN study)

Retrieved CHB testing results □ 1. Yes □ 2. No

Undertook further examination to assess stage of liver disease   □ 1. Yes   □ 2. No

Referral to a healthcare facility for follow-up
□ 1. No referral   □ 2. Niakhar healthcare center   □ 3. Fatick healthcare center
□ 4. Fatick hospital   □ 5. Sen-B cohort (Fann hospital)   □ 6. Other => Specify _____

Follow-up visits: |__| visits (July 2019-September 2021)

PERCEIVED ABILITY TO OVERCOME BARRIERS TO HEALTHCARE SEEKING

Many different factors can prevent someone from getting medical advice or treatment for themselves. When you are sick and want to get medical advice or treatment, is each of the following not a problem, a small problem or a big problem?

Knowing where to go is…   □ 1. Not a problem   □ 2. A small problem   □ 3. A big problem
Getting permission to go is… □ 1. Not a problem   □ 2. A small problem   □ 3. A big problem
Getting the money to pay is… □ 1. Not a problem   □ 2. A small problem   □ 3. A big problem
The distance to the facility is…   □ 1. Not a problem   □ 2. A small problem
                                       □ 3. A big problem
Having to take transport is… □ 1. Not a problem   □ 2. A small problem   □ 3. A big problem
Not wanting to go alone is…   □ 1. Not a problem   □ 2. A small problem   □ 3. A big problem
Concern that you might be discriminated is…   □ 1. Not a problem   □ 2. A small problem
                                       □ 3. A big problem
   |-> For which reason?   □ 1. Ethical or cultural identity   □ 2. Gender
   □ 3. Sexual orientation   □ 4. Age   □ 5. Illness or disability   □ 6. Religion
   □ 7. Socio-economic group □ 8. Education level   □ 9. Other => Specify _____

Appendix D2. One-on-one interviews

Table D2.1 Check-list to guide questions and document the entirety of the profile

Themes	*Possible questions*
Health status and health functioning – *How is your health?*	
▢ General health (physical and mental health, fatigue)	Can you tell me about your health (pain, emotional problems, fatigue...)?
▢ Hepatitis B status	Do you know if you have hepatitis B?
▢ Other diseases	Do you have any other diseases?
Health knowledge – *What do you know of hepatitis B?*	
▢ Own CHB status	Do you know if you have chronic hepatitis B infection?
▢ CHB transmission and course of the disease	What is chronic hepatitis B infection? How does one get it? What happens when someone has chronic hepatitis B?
▢ Prevention of infection (vaccine) and complications (treatment)	Can we protect ourselves from chronic hepatitis B? Is there a vaccine? a medication? tests?
▢ Risk behaviors (alcohol, tobacco, food)	Are there things that should be done (or avoided) in relation to hepatitis B?
▢ Sources/search for **good** information	How do you get credible information about health? about hepatitis B? *(WHO, Ministry of Health, Hepatitis Program, radio, health post, healer, internet, etc.)*
Health-seeking skills and beliefs, self-efficacy – *For you, is it easy to be healthy?*	
▢ Confidence in avoiding disease and avoiding CHB infection and complications	Is it easy for you to avoid getting sick? Is it easy to avoid getting sick with CHB?
▢ Ability to learn about health and/or CHB	Have you ever learned any health-related skills (e.g., how to take a medication, how to prevent, or how to monitor a health problem such as CHB)?
▢ Ability to change health behavior in relation to CHB	Have you ever changed your habits for health reasons (for example, going on a diet, or stopping drinking or smoking)? for CHB?
Health values and goals – *How important is health to you?*	
▢ Health goals in general, compared to other priorities	How often do you think about your health? Do you think about it more or less than your work, or your family?
▢ Disease/CHB goals	Is it important to you not to get sick with CHB? Do you think about it often?
▢ Goals in relation to habits and health	Is it important/do you often think about changing things in your habits for your health or for CHB?
▢ Conflicting goals in the family	Do people around you not want some of the things you do in relation to health or CHB? How do you react?
(Perceived) self-governance & self-management to achieve health outcomes – *How do you organize your life in relation to health?*	
▢ Organization in everyday life	Can you tell me about a normal day, and explain how you organize your life between family, work, etc.?
▢ Domestic and extra-familial tasks	Is it hard to manage things at home and things outside (work, health)? How do you do it?
▢ Controlling health behaviors	Are you stopping yourself from doing things for your health/CHB?
▢ Help and resources available for health	Do you ever ask for help from family or neighbors and get money or transportation for example, in relation to your health?

Effective health decision-making – *How do/did you make decisions about your health, and CHB?*	
□ Searching for and using information about CHB	Where did you look for information about CHB? Did it help you? How did you use the information?
□ Changes in CHB habits	Have you decided to change any of your habits regarding CHB *(diet, alcohol consumption)*?
□ CHB symptoms, consultation and treatment route	Do you have any signs of CHB-related disease? Have you decided to go see people about the disease *(healer, doctors)*? Take medication or have tests *(screening, follow-up)*?
□ Prevention of CHB infection and complications	Do you do anything to protect yourself or your family *(vaccine, hygiene)*?
Intrinsic motivation – *Why did you make these decisions?*	
□ Internal motivation	Why do you decide to do things (or not do things) for your health or in relation to CHB? Is this important to you?
□ External motivation	Is someone telling you to do this? Is it important to that person or group?
Positive expectations – *How do you see you future?*	
□ Expectations and concerns about CHB	Are you afraid of CHB (e.g., getting or being very sick with CHB)? Are you confident?
□ Expectations and concerns about health in general	Do you fear for your health (e.g. getting sick, dying young)? Do you have confidence?
I am now going to ask you about your environment: the things and people around you, in your village, in the area and the region.	
Social norms – *What do people <u>in the area</u> think of CHB, and what do they do about it?*	
□ Social norms on hepatitis B, vaccine, blood sampling	What do people think about CHB in the area? of hepatitis B vaccines? of people doing blood sampling?
□ Social norms on chronic carriers, alcohol, tobacco	What do they think of people with big bellies? of people who drink alcohol? of people who smoke?
□ Quantification of people who engage in these behaviors	Does it concern many people (see behaviors listed in 1. and 2.) or specific people? Which ones?
□ Discrimination and stigmatization of CHB patients and others in health facilities	Are some people or groups of people unable to get vaccinated or tested? Are some people not well received at the health center (e.g., if they have CHB, if they drink alcohol)?
□ Social norms on health and CHB decision-making in the family	In a household, how does someone decide to go to the hospital if they are sick? Do you decide alone, or with the head of the household, or with someone else?
□ Changes in social norms related to CHB	Have people changed their minds about vaccination or alcohol or CHB? Do you think this is a good thing?
Social networks and social capital for achieving positive health outcomes – *Do you have help for your health and CHB?*	
□ Help available to do things	Are there people who can help you if you need to go to the clinic for a health problem?
□ Help available to talk about hepatitis B	Is there anyone you could talk to about your health problems, for example, about CHB?
□ Health information sharing processes	How do people share information about health and CHB (radio, marketplace, social networks)?
□ Poor health information related to hepatitis B	Are there people who share rumors about CHB or about certain behaviors, such as drinking a lot of alcohol...?
Group membership influences – *What do people <u>close to you</u> think of, and do about CHB?*	
□ Membership in groups/associations	Are you part of a group? an association? a political party? a team?
□ Social norms of these groups on hepatitis B	What do people in these groups think about CHB?

Material circumstances – *Can you tell me about your living conditions?*	
□ Economic situation: work (quantity, quality) and monetary resources	Do you have a job (temporary, permanent)? Do you earn money? Enough to live on?
□ Neighborhood: noise, cleanliness, facilities	What do you think of your hamlet (cleanliness, noise, facilities and access to the road/Fatick)?
□ Water (cleanliness, access), hygiene, waste	Where do you get water to drink? To go to the bathroom? To wash yourself? Is the water clean? What do you do with the garbage?
□ Housing: comfort, heat protection	Where do you live? Is your home comfortable (heat protection, number of inhabitants)?
□ Food (quantity, diversity, quality)	Do you eat well? Who is in charge of choosing and cooking the food? What happens if there is not enough to eat?
□ Environment: pollution, disease	Are there any pollution problems around you (e.g. air pollution or pesticides)? Are there many diseases (including CHB)?
Economic, political and social security – *What do you think of the economic, social and political situation in your area/country?*	
□ Quality of work and protection of workers	How easy is it to find a good job? What happens if someone is sick and can no longer work?
□ Social security (social services, health insurance)	Who can help if people are sick or need money to go for treatment (the government, social service, family, neighbors)? Do you know about non-for-profit community-based insurance companies?
□ General political situation	What is the political situation (elections, corruption…) in the area/region/country? Is there insecurity or delinquency?
Utilization and access to health services – *What do you do when you have a serious health problem? What would you do if you had a serious health problem related to CHB?*	
□ Symptoms of CHB-related diseases	Do you have any signs of a CHB-related illness (e.g., yellow eyes, stomach pain, swollen belly)?
□ Symptoms of other diseases	Do you have any signs of other health problems?
□ Willingness to seek medical attention for a health problem	Tell me about the last time you went to see someone for your health (which problem, traditional practitioner or doctor…)
□ Availability of CHB health services	Do you know if it is possible to be vaccinated, screened or followed for CHB in your area?
□ Barriers and obstacles to accessing care	Do you have any problems going to the health center or hospital (finding money, getting around, long waits…)?
Enabling public health and health care systems – *What is your perception on the work the healthcare facilities and health authorities (ministry representatives, physicians, dispensaries, health center, regional hospital and hospitals in Dakar) are doing in helping you taking care of your health, including when it comes to CHB?*	
□ Information and advice on CHB	In health centers or hospitals, what information/advice have you been given about CHB?
□ Protection against CHB (screening, vaccine)	Have you ever been offered CHB screening or vaccine? Are you being monitored for CHB?
□ Efficiency and quality of care (including accountability)	Have you ever had a problem with a doctor, health center or hospital for yourself or your family? Tell me about your last experience at a health center (if none, ask about the family).

Appendix D3. Interviews with local CHB stakeholders

Table D3.1 Discussion guide (focus groups or one-on-one interviews depending on availability)

Social norms – *What do people <u>in the Niakhar area</u> think of CHB, and what do they do about it?*	
□ Social norms on hepatitis B, vaccine, blood sampling	What do people think about CHB in the area? of hepatitis B vaccines? of people doing blood sampling?
□ Social norms on chronic carriers, alcohol, tobacco	What do they think of people with big bellies? of people who drink alcohol? of people who smoke?
□ Quantification of people who engage in these behaviors	Does it concern many people (see behaviors listed in 1. and 2.) or specific people? Which ones?
□ Discrimination and stigmatization of CHB patients and others in health facilities	Are some people or groups of people unable to get vaccinated or tested? Are some people not well received at the health center (e.g., if they have CHB, if they drink alcohol)?
□ Social norms on health and CHB decision-making in the family	In a household, how does someone decide to go to the hospital if they are sick? Do they decide alone, or with the head of the household, or with someone else?
□ Changes in social norms related to CHB	Have people changed their minds about vaccination or alcohol or CHB? Do you think this is a good thing?
Social networks and social capital for achieving positive health outcomes – *Do people have help for their health and CHB?*	
□ Help available to do things	Do people get help if they need to go to the clinic for a health problem?
□ Help available to talk about hepatitis B	Do people have support to talk about their health problems, for example, about CHB?
□ Health information sharing processes	How do people share information about health and CHB (radio, marketplace, social networks)?
□ Poor health information related to hepatitis B	Are there people who share rumors about CHB or about certain behaviors, such as drinking a lot of alcohol...?
Group membership influences – *What do people <u>in groups</u> think of, and do about CHB?*	
□ Membership in groups/associations	What are the main group, associations, political party, sports team active in the Niakhar area?
□ Social norms of these groups on CHB	What do people in these groups think about CHB?
Material circumstances – *What are people's living conditions?*	
□ Economic situation: work (quantity, quality) and monetary resources	Do most people have a job (temporary, permanent)? Do they earn enough money to live comfortably?
□ Neighborhood: noise, cleanliness, facilities	What are most people's neighborhoods like (cleanliness, noise, facilities and access to the road/Fatick)?
□ Water (cleanliness, access), hygiene, waste	Where do people get water to drink? To go to the bathroom? To wash themselves? Is the water clean? What do they do with the garbage?
□ Housing: comfort, heat protection	Are people's homes comfortable (heat protection, number of inhabitants)?
□ Food (quantity, diversity, quality)	Do they eat well? Who is in charge of choosing and cooking the food? What happens if there is not enough to eat?
□ Environment: pollution, disease	Are there any pollution problems around (e.g. air pollution or pesticides)? Are there many diseases (including CHB)?
Economic, political and social security – *What is the economic, social and political situation in the area/country?*	
□ Quality of work and protection of workers	How easy is it to find a good job? What happens if someone is sick and can no longer work?
□ Social security (social services, health insurance)	Who can help if people are sick or need money to go for treatment (the government, social service, family, neighbors)? Do they know about non-for-profit community-based health insurance companies?
□ General political situation	

	What is the political situation (elections, corruption…) in the area, region or country? Is there insecurity or delinquency?
Utilization and access to health services – *What do people do when they have a serious health problem, including related to CHB?*	
□ Symptoms of CHB-related diseases □ Symptoms of other diseases □ Willingness to seek medical attention for a health problem □ Availability of CHB health services □ Barriers and obstacles to accessing care	What do people do when they have any signs of a CHB-related illness (e.g., yellow eyes, stomach pain, swollen belly)? When they have signs of other health problems? Do you know if it is possible to be vaccinated, screened or followed for CHB in the Niakhar area? Do people have any problems going to the health center or hospital (finding money, getting around, long waits…)?
Enabling public health and health care systems *What is your perception on the work the healthcare facilities and health authorities (ministry representatives, physicians, dispensaries, health center, regional hospital and hospitals in Dakar) are doing in helping people taking care of their health, including when it comes to CHB? What are the strengths and weaknesses, and how could it be improved?*	
□ Information and advice on CHB	In health centers or hospitals, what information/advice are given about CHB?
□ Protection against CHB (screening, vaccine)	Are people systematically offered CHB screening or vaccine? Are they being monitored for CHB?
□ Efficiency and quality of care (including accountability)	Do people often encounter problems with a doctor, health center or hospital related to the efficiency or quality of care? What usually happens when it is the case?

Appendix D4. Health facility survey

MODULE 1: GENERAL INFORMATION

Date   l__l__l / l__l__l / l__l__l

Investigator _____

Name of the facility _____

Type of health facility □₁ Public □₂ Private for-profit □₃ Private denominational
Town/city _____

-      Staff

	Full time	Part-time (> 1day/week)
a. Number of physicians	l__l__l	l__l__l
b. Number of nurses	l__l__l	l__l__l
c. Other staff (including cleaning, security, administration, etc.)	l__l__l__l	l__l__l__l

How many hospital beds does the health facility have? l__l__l__l *(set up at the time of the survey)*

Does the health facility have the following equipments?

a. Electrocardiography	□₀ No □₁ Yes →Was it working at the time of the survey □₁ Yes □₀ No
b. Ultrasound	□₀ No □₁ Yes →Was it working at the time of the survey □₁ Yes □₀ No
c. Radiology	□₀ No □₁ Yes →Was it working at the time of the survey □₁ Yes □₀ No
d. Scanner	□₀ No □₁ Yes →Was it working at the time of the survey □₁ Yes □₀ No
e. GenExpert	□₀ No □₁ Yes →Was it working at the time of the survey □₁ Yes □₀ No

MODULE 2: RESOURCES FOR CHB VACCINATION, TESTING AND MANAGEMENT
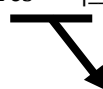
Activity	Available	Workload over the past month *(indicate 0 if none in the past month but activity available)*
Birth dose	☐₁ Yes ☐₀ No	|_|_|_|_|_|_|
Pentavalent vaccine	☐₁ Yes ☐₀ No	|_|_|_|_|_|_|
CHB testing	☐₁ Yes ☐₀ No	|_|_|_|_|_|_| ⇨ |_|_|_| positive results
CHB follow-up exams/consultations	☐₁ Yes ☐₀ No	|_|_|_|_| CHB patients
CHB treatment prescription/follow-up	☐₁ Yes ☐₀ No	|_|_|_|_| treated patients

- Staff involved in hepatitis B activities (including laboratory and administrative staff e.g., social services)

	Level of education/training	Job	Working here since (month/year)	Hepatitis B activities (vacccination, couseling, consultation, analysis, etc.)	Ever trained for CHB ? (yes/no, cumulative duration of training)
1					
2					
3					

- Pharmacy

Is there tenofovir in the health facility ? ☐₀ No ☐₁ Yes   \|_\|_\|_\|_\| boxes available

☐₁ For VIH patients
☐₂ For CHB patients
(several answers possible)

Place of storage : _____

Rate of supply: \|_\| _\|per week/month/year

- Exams associated with CHB management

	Available
Blood count	☐₁ Yes ☐₀ No
AST	☐₁ Yes ☐₀ No
ALT	☐₁ Yes ☐₀ No
Creatinine	☐₁ Yes ☐₀ No
Glycemia	☐₁ Yes ☐₀ No
Urea	☐₁ Yes ☐₀ No
Liver ultrasound	☐₁ Yes ☐₀ No
Fibroscan	☐₁ Yes ☐₀ No
HBsAg (testing)	☐₁ Yes ☐₀ No
Viral load	☐₁ Yes ☐₀ No
HBeAb	☐₁ Yes ☐₀ No
HIV	☐₁ Yes ☐₀ No
HDV	☐₁ Yes ☐₀ No
HCV	☐₁ Yes ☐₀ No

MODULE 3: TESTING

Is hepatitis B testing offered to pregnant women during ANC visits? □$_1$ Yes □$_0$ No

If yes, where are pregnant women are referred to? _____

Distance between the referral place and the health facility |_|_|_| km

Is hepatitis B testing grouped with other analyses included in the antenatal care exams? □$_1$ Yes □$_0$ No

⇨ *Go to the next module*

For ANC visits, is hepatitis B testing grouped with other analyses included in the antenatal care exams?
□$_1$ Yes □$_0$ No

Type(s) of test(s) available for CHB testing

Rapid test: □$_1$ Yes => _____ □$_0$ No

Serological test: □$_1$ Yes => _____ □$_0$ No

Resources employed during testing *(to be filled through observation)*

Resources	Quantity
Counseling	
Staff involved in counseling *(indicate average time for one patient)*	*Example: head nurse (20 minutes)* 1. 2.
Testing	
Consumables *(indicate quantity for one test)*	*Example : needles (1 needle)* 1. 2.
Staff involved *(indicate average time for one patient)*	1. 2.
Analysis	
Consumables *(indicate quantity for one test or quantity of tests analyzed at once if grouped in a bundle)*	1. 2. 3.
Machines/devices *(indicate the reference and date of purchase)*	1. 2.
Staff involved *(indicate average time for one test or bundle of tests)*	1. 2.
Counseling post-test	
Time between the test and the results delivered to the patient	In the past month - Minimum time - Maximum time - Average time
Consumables *(indicate quantity for result delivery to one patient)*	1. 2.
Staff involved *(indicate average time for one patient)*	1. 2.
Notes on the information delivered (content and quality)	

MODULE 4: CHB MANAGEMENT

Go to the next module if CHB management is NOT available in this health facility

Resources	Quantity
Consultation/medical examination	
Staff involved *(indicate average time for one patient)*	*Example : Physician (20 minutes)* 1. 2.
Blood sampling	
Consumables *(indicate quantity for one patient)*	*Example: sampling tubes (5 tubes)* 1.
Staff involved *(indicate average time for one patient)*	1. 2.
Imagery	
Consumables *(indicate quantity for one patient)*	*Example: echography gel (1/50 tube)* 2. 3. 4.
Machines/devices *(indicate the reference and date of purchase)*	1. 2.
Staff involved *(average time for one patient)*	1. 2.
Result delivery/follow-up visit	
Time between the test and the results delivered to the patient	In the past month - Minimum time - Maximum time - Average time
Consumables *(quantity for one patient)*	1. 2.
Staff involved *(average time for one patient)*	1. 2.

Observation

First visit

- General organization
- Clinical examination
- Exams prescribed
- Time until the next visit : jusqu'à prochaine visite :

Follow-up visits

Frequency: ☐ Quaterly ☐ Bi-annual ☐ Annual ☐ Other =>_____

Key exams	Resources required	Challenges[gg]
Echography		
Fibroscan		
Viral load		

[gg] Is it working at the moment? Does it often breaks down? Ever running out of consumables/reagents? Any other issues?

MODULE 5: COSTS FOR THE HEALTH FACILITY

Consumables *(to be filled with information from module 3 and 4)*

Type of consumable and quantity (unit/bundle)	Cost	Date of the invoice used for the cost estimation
Example: box of 10 needles	*3,000 CFA*	*February 2022*

Equipments

Equipment *n*	
Type of equipment (brand)	
Price (date of purchase)	
Costs of revision (frequency)	
Staff training (duration in days)	

Staff (including support and administration)

Job/training	Monthly salary	Date of the reference salary
Example: nurse	*300,000 CFA*	*January 2022*

Fixed costs (buildings, invoices, cars, etc.)

Type of costs	Cost (monthly or yearly)	Reference month/year
Example : electricity	*1,000,000 CFA (monthly)*	*January 2020*

MODULE 6: COSTS FOR THE PATIENTS

Type of intervention	Amount paid (0 if free)	Co-payment (insurance, free care for children/elderly/indigents)?
Testing		
Counseling/consultation before CHB testing	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Testing	|_|,|_|_|_|,|_|_|_|CFA	₁ Yes □₀ No
Result/post-test counseling	|_|,|_|_|_|,|_|_|_|CFA	Details: _____
CHB management		
Consultation	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Blood count	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
AST/ALT	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Creatinin	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Glycemia	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Urea	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Liver echography	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Fibroscan	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Viral load	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
HBeAb	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
HIV	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
HDV	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
HCV	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Hospitalization (per day)	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
Treatment		
Medication _____	|_|,|_|_|_|,|_|_|_|CFA Duration : _____ *(monthly/yearly)*	□₁ Yes □₀ No Details: _____
Other (e.g., transport, administrative costs, etc.)		
	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____
	|_|,|_|_|_|,|_|_|_|CFA	□₁ Yes □₀ No Details: _____