Beyond determinants of health: a multidimensional model of health capability applied to rural Senegal[1]

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Abstract

A complex combination of factors plays into the ability of individuals to be healthy. Yet, most studies focus on one-way relationships between a variety of determinants and health status. In this paper, I develop a structural equation modelling (SEM) strategy to estimate a multidimensional and dynamic model of health capability in people living in rural Senegal. The model analyzes interactions between three dimensions of health capability, specifically access to local healthcare services, participation in decision-making, and current self-reported health status, as well as interactions between these dimensions and other demographic, psychosocial and economic variables. In the rural area of Niakhar, access to healthcare is impeded in households with limited resources and in rural villages, whereas older age and household size are associated with lower health status. Additionally, decision-making ability is hindered in single, childless individuals, those living in agricultural households or in semi-urban villages. Moving away from the quantification of individual determinants of health also allows for the identification of vulnerable populations that accumulate vulnerabilities, specifically women permanent residents in the rural area, as well as factors contributing to overall optimal health capability, such as intrinsic motivation. These results suggest a need for a differentiated yet complementary sets of policy in order to promote health capability for all. A SEM-based strategy therefore offers a way forward in analyzing determinants of health as complex, multidimensional, and interactive phenomena.

JEL classification: C31, I14, N37.

Keywords: determinants of health, capability approach, simultaneous equation model, sub-Saharan Africa.

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1. Introduction

The determinants of health and health inequalities, that is to say what influences people's health status either positively or negatively, is one of the main topics of health economics (Williams, 1987). Standard approaches focus on studying the relationship between health status and a variety of monetary and non-monetary resources, in particular the consumption of healthcare goods and services, as well as a set of socioeconomic circumstances which have been broadly defined as the social determinants of health (SDH) (Marmot and Bell, 2012). These include income (Allanson and Petrie, 2013), living conditions (McKeown et al., 1975), educational level (Cutler et al., 2011), employment status (Martikainen and Valkonen, 1996), and area of residence (Chuang et al., 2005).

Recently, authors have argued for more multidimensional and dynamic approaches to examine the determinants of health and health inequalities, for instance by combining socioeconomic factors into a polysocial risk score (Figueroa et al., 2020), or by adapting the capability approach (CA) to health economics (Abel and Frohlich, 2012; Prah Ruger, 2015). The CA was developed in the 1980s as an alternative to standard welfare economics (Sen, 1999, 1980). It is based on a multidimensional concept of well-being that focuses on people's freedom to both set goals for themselves (agency) and to reach these goals (functioning). Unlike achievements, capabilities - in the sense of the ability to do or to be something - cannot be directly observed. A variety of approaches have been used to estimate them including structural equation modeling (SEM) strategies (Krishnakumar, 2007).

Most CA studies to date using SEM to estimate capabilities have identified basic capabilities in specific countries and populations, such as Bolivian children (knowledge and living conditions) (Krishnakumar and Ballon, 2008), young people in the occupied Palestinian territories (health awareness, living conditions and utilities) (Abu-Zaineh and Woode, 2018), and women in West Bengal (health, autonomy and knowledge) (Bhattacharya and Banerjee, 2012). In the field of health, SEM has been used to design CA-inspired indices for women's health agency and empowerment, including a decision-making index in Ethiopian women (Mabsout, 2011), an index of women's perceived obstacles to access healthcare in Burkina Faso (Nikiema et al., 2012), and a relative-autonomy index validated in Nepal (Gram et al., 2017) and Chad (Vaz et al., 2016).

However, these studies analyze latent capabilities either in relation to or in place of health status, and fall short of the truly multidimensional concept of health capability which the health capability model (HCM) incorporates (Prah Ruger, 2010). The HCM is a sophisticated theorization of the capability approach specific to the health field. In the HCM, health status is not the outcome but is one of four essential dimensions of health capability.

More specifically, the HCM places each individual's ability to effectively and confidently achieve optimal health now and in the future (health capability) at the crossroads of these four distinct dimensions which are: (i) having the best health status possible given one's genetic and biological capital, (ii) living in an intermediate social context and (iii) the overall political and economic macro environments propitious for one's health, and (iv) having access to high quality and enabling healthcare services. The concept of health capability focuses on the gaps, or "shortfalls", between a person's actual situation in terms of these four dimensions and optimal health, the latter being defined as one's highest potential as a member of a given community. The CA calls for public policies that help bring everyone closer in order that people can reach their own potential by reducing individual shortfalls in health capability, thereby promoting shortfall equality (Prah Ruger, 2009). These shortfalls therefore need to be measured and their determinants identified.

The present study used a SEM approach to operationalize the HCM in the context of people living in rural Senegal, and to investigate determinants associated with individual shortfalls in this population's ability to be healthy (health capability).

The study applied a novel conceptual framework and brings new evidence to the exploration of determinants of health and health inequalities. First, it operationalized the HCM in a multidimensional and dynamic model where health status was entered into the equation as one of several essential dimensions of health capability. Second, it drew on previous SEM-based studies of basic capabilities in order to identify not one, but several health capability dimensions. Unlike approaches that tend to focus either on healthcare access and consumption or on the social environment, this HCM included both of these dimensions and investigates interactions between them. Finally, it provides empirical results on variables associated with shortfalls in health capability dimensions in both men and women over 15 years of age living in the rural area of Niakhar in Senegal.

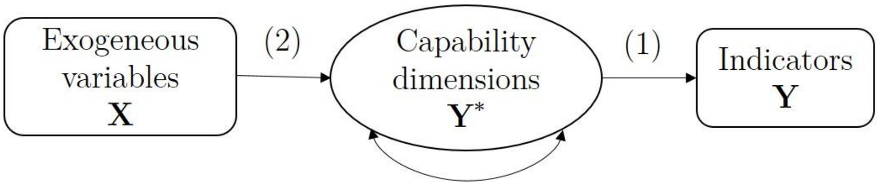
2. Methods

2.1 Econometric model

This study adapted Krishnakumar and Ballon's general theoretical framework (Krishnakumar and Ballon, 2008) to estimate capabilities using an SEM strategy (see Figure 1). More specifically, exogenous variables were included in the estimation as causes of the following three health-related capability dimensions: health status, access to healthcare, and social environment. These dimensions were measured using indicators, which correspond to functionings in the Krishnakumar and Ballon model. The dimensions interact with each other to create an overlapping health capability model (Prah Ruger, 2010).

The econometric model's identification strategy comprised two steps. First, drawing from Abu-Zaineh and Woode (Abu-Zaineh and Woode, 2018), all exogenous variables are 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.

. **Figure 1:** Econometric model



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^*).

$$Y = v + \Lambda Y^* + \zeta \qquad (1)$$

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 (Thompson, 2004). 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 matrixes are examined. Redundant items (values >0.85 in the correlation matrix) were combined to create a new variable. Internal consistency, that is to say the extent to which a given set of items relates to a unique concept, was assessed using the Cronbach alpha (Cronbach and Meehl, 1955) reliability test, with values above 0.8 considered to represent good internal consistency.

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).

$$Y^* = \alpha + \beta Y^* + \Gamma X + \varepsilon \qquad (2)$$

In line with the literature on SEM, the χ^2 test, the Root Mean Square Error of Approximation (RMSEA)(Steiger, 1990), as well as the Comparative Fit index (CFI) (Bentler and Bonett, 1980; Bentler, 1990) and the Tucker-Lewis Index (TLI) (Tucker and Lewis, 1973) were used to evaluate the goodness-of-fit for the model. Even though authors have warned against using strict thresholds to evaluate the goodness of fit(Heene et al., 2012; Maydeu-Olivares et al., 2018; Peugh and Feldon, 2020), it is generally agreed that an 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 (Beauducel and Herzberg, 2006; Holtmann et al., 2016; Lei and Shiverdecker, 2020; Muthén et al., 1997).

2.2 Empirical application

2.2.1 Study setting

Senegal is a country of approximately 15 million inhabitants situated in West Sub-Saharan Africa, ranking 166th out of 189 countries according the 2018 Human Development Index estimates (United Nations Development Program, 2019). It has one of the oldest demographic surveillance systems of the sub-continent - the Niakhar Health and Demographic Surveillance System (HDSS) – which is located in the Fatick region, 165 km east of the capital, Dakar (Delaunay et al., 2013). Founded in 1962, the Niakhar HDSS currently covers over 200km² and 30 villages, home to over 47,000 individuals (2017 estimates) mainly of Serer ethnicity, and of Muslim religion. (Delaunay et al., 2018). This is a rural area, where most residents' main economic activity is household farm work. The population covered by the Niakhar HDSS is characterized by a low education level and large seasonal work migration to cities outside of harvest periods. People live in open compounds (called "*concession*") of housing units, which bring together one or several households ("cuisine") who share meals together. The three main villages (Toucar, Ngayokheme, and Diohine) have semi-urbanized facilities, including a high school, a weekly market, small shops, and primary healthcare dispensaries (first-contact facilities managed by nurses). A healthcare center managed by a physician is located in the village of Niakhar (same name as the area), which is situated just outside the area covered by the HDSS. The regional hospital is located in the town of Fatick, 10 kilometers further away.

2.2.2 The ANRS 12356 AmBASS survey

The ANRS 12356 AmBASS cross-sectional survey 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 virus (HBV) infection in the area (Coste et al., 2019). 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 HBV 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) 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.

2.2.3 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 perception and life experience (Prah Ruger, 2010). 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 capital (measured by self-reported health status), (ii) healthcare accessibility (measured by perceived obstacles to access healthcare services), and (iii) ability to make decisions within their intermediate social context (measured by decision-making latitude within the household).

The questionnaire module on self-reported health status included all 12 questions from the Short Form Health Survey version 2 (SF12v2)(Ware, 2005), 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 obstacles to accessing local healthcare services. Drawing from the Burkinabe study (Nikiema et al., 2012), 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 (Narayan, 2005). In the AmBASS survey, it was measured using the following four "final say" questions (Mabsout, 2011): "*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).

2.2.4 Sociodemographic and socioeconomic 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., the three mentioned above providing semi-urban facilities)). Economic status of participants was characterized using questions on ownership of fields for farming and economic activity outside of common household fieldwork. 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. In addition, the motivation for consulting at a healthcare facility was evaluated using an eight-item adaptation of the relative autonomy index (RAI)(Gram et al., 2017; Vaz et al., 2016) which has been presented as an acceptable proxy for health agency (Alkire, 2005). Data at the household level include household size, recipient status for the Senegalese government Family Social Security Allowance for low-income families (*Bourse de Sécurité Familiale* (BSF)), and two standardized indices measuring household agricultural equipment, and household living conditions respectively.

3. Results

3.1 Sociodemographic and socioeconomic characteristics of the study population

Participants were between 14 and 89 years old. Most (57.2%) were women, 421 (58.2%) were married, and 428 (59.4%) had at least one child (see Table 1). 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 (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. With a median RAI score of six, most participants' motivation to seek healthcare or health information was autonomous (RAI>0) rather than controlled (RAI<0). Household size ranged from 3 to 34 members, with a median of 16 members. One in seven (17.3%) participants lived in a household that received the BSF.

Table 1: Socioeconomic and demographic variables of the study population (n=724)

	N *(%)* Median [IQR]
Individual variables	
Gender	
Men	310 *(42.8)*
Women	414 *(57.2)*
Education	
No formal education	344 *(47.8)*
Primary school	262 *(36.4)*
Secondary school and above	114 *(15.8)*
Village	
Semi-urban	407 *(56.2)*
Rural	317 *(43.8)*
Age (years)	35 [14-89]
Married	421 *(58.2)*
Parent (at least one child)	428 *(59.4)*
Temporary migration from the area	251 *(34.67)*
Sole owner of a field for farming	184 *(25.4)*
Non-agricultural job	202 *(27.9)*
Relative autonomy index (RAI)	6 [0;9]
Household variables	
Household size	16 [11;21]
BSF recipient	127 *(17.5)*
Agricultural resources index+	0.48 [0.04;0.74]
Living conditions index+	0.09 [-0.49;0.81]

+Information on durable goods, agricultural/farming resources and living conditions was used to derive standardized indices at the household level using multiple component analysis.

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 the appendix (see Appendix A1).

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

Health capability dimension	Nb. of items	Cronbach's alpha coefficient	Correlation Matrix [Min-Max]
Current self-reported health	3	0.8110	0.5171-0.6749
Participation in decision-making	4	0.8724	0.5223-0.7765
Access to healthcare	5	0.8659	0.4910-0.7440

For current self-reported health, 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.).

Table 3a: Participants' answers on current self-reported health (n=724)

Indicators	*N* (%)
Role-physical and role-emotional *(m=5)*	
Shortfall	270 (37.3)
Optimal	449 (62.0)
Missing	5 (0.7)
Bodily pain *(m=1)*	
Shortfall	142 (19.6)
Optimal	581 (80.4)
Missing	1 (0.1)
Social functioning *(m=10)*	
Shortfall	177 (24.8)
Optimal	537 (75.2)
Missing	10 (1.4)

The highest Cronbach's alpha coefficients (0.8283) were obtained with five items documenting perceived as obstacles 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 obstacles to accessing healthcare and healthcare advice 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.

Table 3b: Perceived obstacles to accessing healthcare (n=724)

Indicators	*N* (%)
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)

The four-item set for decision-making latitude 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.

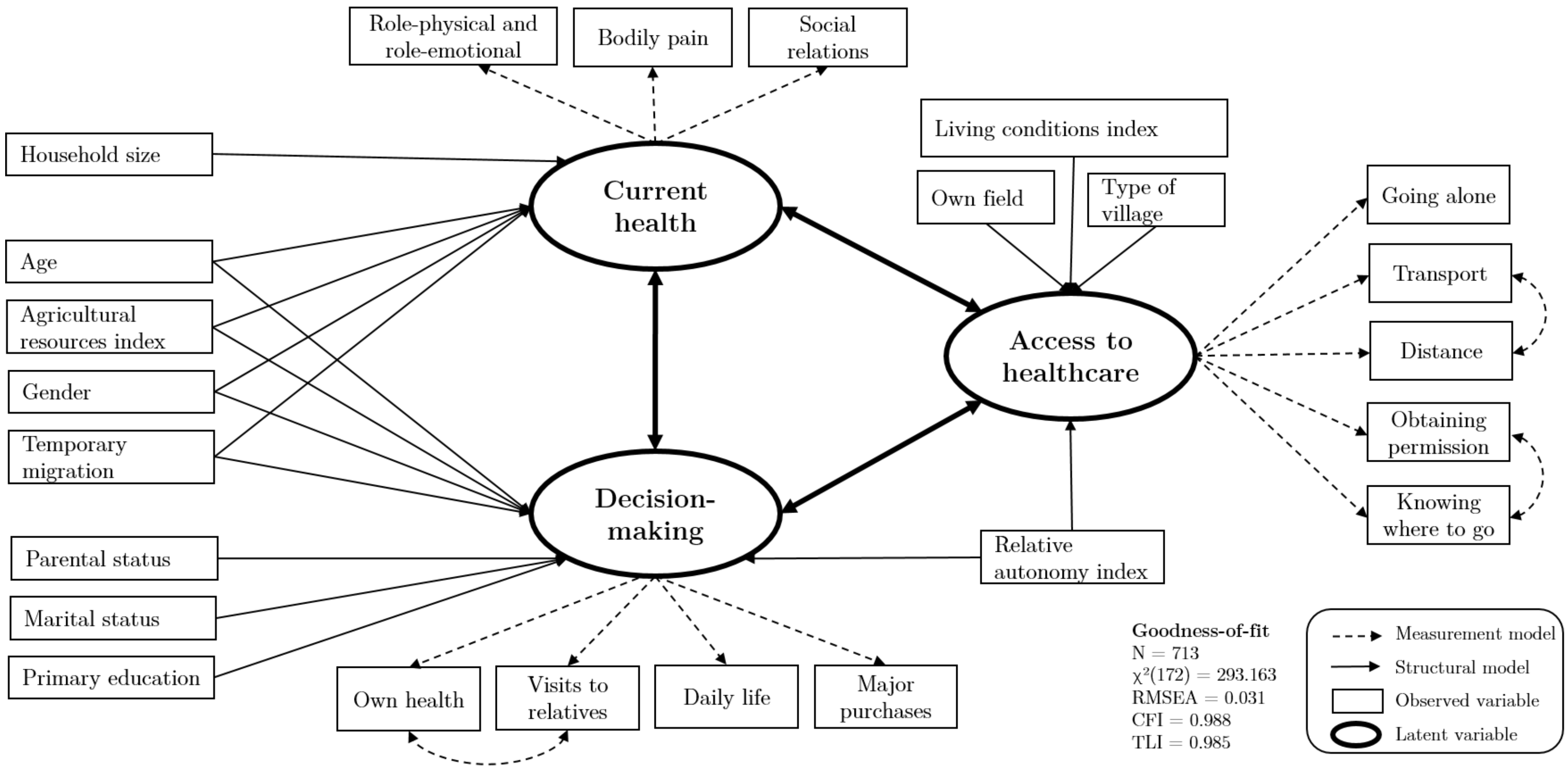
Table 3c. Participation in decisions (n=724)

Indicators	*N* (%)
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)

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 2 displays the final structural model. The variables secondary education, having a non-agricultural job, and benefiting from the BSF were not included in the final structural model (see Appendix A2 for more details). Goodness of fit measures indicated a good fit of the data, with an estimated 0.031 RMSEA (0.025-0.038 90% confidence interval, with a 100% probability of being below 0.05) and CFI and TLI values both above 0.98 (0.988 and 0.985, respectively). The Chi-Squared Test score of 293.163 (a zero p-value, 172 degrees of freedom). Results for the two parts of the SEM are provided in the two subsections below.

Figure 2: Health capability model applied to rural Senegal



3.3.1 Measurement 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 (current health, decision-making latitude 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 the appendix (see Appendix A3).

Table 4. Measurement model estimates (CFA)

	Health		**Decision**		**Access**	
	Raw	*Std.*$^{+}$	*Raw*	*Std.*$^{+}$	*Raw*	*Std.*$^{+}$
Role-physical and role-emotional	0.969***	0.975***	–	–	–	–
Bodily Pain	0.807***	0.848***	–	–	–	–
Social functioning	0.968***	0.974***	–	–	–	–
Final say on own health	–	–	0.917***	0.969***	–	–
Final say on daily life	–	–	0.896***	0.957***	–	–
Final say on major purchases	–	–	0.930***	0.977***	–	–
Final say on visits to relatives	–	–	0.801***	0.894***	–	–
Going alone	–	–	–	–	0.932***	0.951***
Transportation	–	–	–	–	0.857***	0.888***
Distance	–	–	–	–	0.838***	0.872***
Getting permission	–	–	–	–	0.894***	0.920***
Knowing where to go	–	–	–	–	0.893***	0.919***

$^{+}$*raw estimate mutliplied by the standard deviation of the indicator, and divided by the standard deviation of the latent variable;* ***p-value significant at the 1% level.

3.3.2 Final Structural model

Table 5 presents the standardized estimates of the final structural model. The model reveals a relationship between, on the one hand, a lack of participation in decision-making, and on the other hand, younger age, higher agricultural resources, not having children, female gender, not being married, not migrating for work or educational reasons, low intrinsic health-related motivation, and having attended at least primary school. Factors related to suboptimal current self-reported health included older age, female gender, absence of temporary migration, large household, and lower agricultural resources. Furthermore, rural residency (vs. semi-urban), relatively poorer living conditions, not being the sole owner of a field for farming, and low internal health-related motivation, were all associated with obstacles to accessing healthcare. Finally, estimated coefficients on interactions between the three studied health capability dimensions showed an effect of the institutional dimension (access to healthcare) on shortfalls in the social dimension (participation in decision-making latitude). No other relationships between health capability dimensions were identified. In particular, there was no significant relationship between current health and access to healthcare or decision-making.

Table 5. Structural model estimates (standardized coefficients⁺)

	Health	**Decision**	**Access**
Health	–	0.162	0.001
Decision	-0.077	–	-0.041
Access	-0.113	**-0.139****	–
Age	**-0.021*****	**0.017*****	–
Agricultural resources index	**0.120****	**-0.248*****	–
Having a least one child	–	**0.223*****	–
Household size	**-0.018****	–	–
Female gender	**-0.165*****	**-0.262*****	–
Living conditions index	–	–	**0.167****
Currently married	–	**0.167*****	–
Sole owner of a field for farming	–	–	**0.271*****
Temporary migration	**0.171*****	**0.172*****	–
Relative autonomy index	–	**0.030*****	**0.057*****
Primary education	–	**-0.242****	–
Semi-urban village	–	–	**0.251*****

⁺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.

The structural model also specifies indirect effects between exogenous variables and latent dimensions with the two-way interactions between the three dimensions of the HCM studied here (current health, decision-making and access to healthcare). In addition to the direct effects mentioned above, better living conditions at the household level, being the sole owner of a field for farming, and living in a semi-urban village, were all indirectly associated with shortfalls in participation in decision-making, through the direct relationship between access to healthcare and a shortfall in decision-making latitude. Total effects, which account for both direct and indirect effects, are reported in the appendix (see Table A4).

4. Discussion

This study sought to apply the multidimensional health capability model (Prah Ruger, 2010) in order to identify determinants of shortfalls in health capability dimensions for people living in the Niakhar area of rural Senegal. A structural equation modeling strategy was developed to estimate three of the four dimensions of the HCM (healthcare access, intermediate social context, and health status), account for interactions between these factors, and analyze the direct and indirect effects of sociodemographic and socioeconomic variables previously identified as determinants of health status, such as age, gender, education, place of residence, and living conditions.

Results reveal a variety of determinants of shortfalls in the dimensions of health capability unknown to unidimensional models. Some findings are particularly interesting; first, variables associated with shortfalls varied between health capability dimensions (see Table 7). For instance, gender and temporary migration affected self-reported health and decision-making latitude, but did not influence access to healthcare. Similarly, exhibiting controlled rather than intrinsic health-related motivation contributed to shortfalls in accessing healthcare and participation in decision-making processes. However, it did not impact self-reported health. Second, some determinants only indirectly affected health capability dimensions. More specifically, findings highlight that it was through access to healthcare that relatively better living conditions and living in a semi-urban village contributed to shortfalls in participation in decision making (Appendix A4). This result stresses the importance of taking interactions between health capability dimensions into account, as advocated by Ruger (Prah Ruger, 2010).

The final model estimates also showed that some determinants had opposing effects on health capability dimensions. For instance, although living in a household with relatively high agricultural resources contributed to optimal current self-reported health, it was associated with shortfalls in participation in household decision-making. Empirically, these are intuitive results: households with more agricultural resources (livestock, fields for farming and equipment) can better feed their members; in turn, this contributes to better health status. However, decision-making processes are likely to be more complex in such a household – and therefore less participative 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.) indirectly contributed to shortfalls in decision-making participation. In contrast, living in this kind of household was associated with optimal access to healthcare. This may have been partly influenced by possible ownership of a means of transportation.

Table 7. Determinants of **shortfalls** in each health capability dimension

Current health	Decision-making latitude	Access to healthcare
–	**Better access to healthcare**	–
Young age	Old age	–
Few agricultural resources	Plentiful agricultural resources	–
–	**Not having children**	–
Large household	–	–
Female gender	Female gender	–
–	*Better living conditions*	Poorer living conditions
–	**Not currently married**	–
–	Sole owner of a field for farming	Not sole owner of a field for farming
No temporary migration	No temporary migration	–
–	Lower intrinsic motivation	Lower intrinsic motivation
–	**Primary education**	–
–	*Semi-urban village*	Rural village

Bold: variable associated with shortfall in only one dimension; underlined: variable with opposing effects on shortfalls in health capability dimensions; *italic*: indirect effect.

Most empirical results are in line with the literature, such as the contribution of intrinsic motivation in achieving good health (as measured by the RAI) to optimal levels in both access to healthcare and decision-making participation (Ryan and Deci, 2000). It is not surprising that better living conditions and ownership of factors of production (sole ownership of a field for farming) help optimize access to healthcare, as does living in a semi-urban village where the local health dispensaries are located. Lower levels of decision-making latitude in younger women have already been documented in Ethiopia (Mabsout, 2011). The latter study identified matrimonial and parental status as additional demographic variables that affect participation in household decisions. 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 (Rocco et al., 2014) including in Sub-Saharan Africa (Hollard and Sene, 2016).

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 (Garnier et al., 2003). More specifically, the study highlighted a relationship between temporary migration from the area and optimal levels in both self-reported health and decision-making latitude. Indeed, the fact that optimal access to healthcare did not impact self-reported health status contrasts with the literature on health and access to healthcare (Bunker et al., 1994; Gallaher et al., 2017; Gulliford, 2017; Okonofua, 2008; Rutherford et al., 2010; Steele et al., 2019). This may be because access to healthcare was 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(Prah Ruger, 2009). 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 disease (Boye et al., 2020). These are all possible reasons why optimal access to local healthcare facilities was not one of the main determinants of health status in the present study.

This study has limitations. First, it did not investigate one of the four HCM dimensions, specifically the macro-level socio-economic and political environment. This 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 determinants of 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.

Second, 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 CA places a great deal of importance on individuals' perspectives and life experience, 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 an individual's social experience, and can therefore be misleading (Sen, 2002). 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.

Third, broad health capability dimensions were estimated using specific indicators (e.g., intermediate social environment measured through 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 an even more comprehensive and multi-faceted assessment of the interacting dimensions that constitute health capability, for instance by applying the health capability profile (HCP), which operationalizes the HCM into 15 dimensions and over 40 sub-dimensions of internal and external health capabilities (Prah Ruger, 2010). In that case, the HCP identifies no fewer than eight categories of social norms that participate in health capability, with decisional latitude at the household or community level being just one of them. Such a detailed analysis may require a qualitative(Feldman et al., 2015) or mixed methods approach.

5. Conclusion

The adaptation of the capability approach to health economics has been motivated by the belief that a multidimensional conceptual framework reconciles theoretical, empirical and normative considerations and creates a more coherent field (Coast et al., 2008). However, authors who have reviewed attempts to develop capability approach-based questionnaires or to apply capabilities to the field of health have highlighted both a lack of homogeneity in the attempts made (Karimi et al., 2016) and a common trend of expanding analyses beyond health status as the only focus (Mitchell et al., 2017). The application of the HCM presented in this paper offers a way forward.

First, it can be seen as 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 on health status as the sole outcome (Figueroa et al., 2020). In contrast, SEM-applications of the HCM are intrinsically multidimensional: health capability is an overlapping concept that cannot be uniquely estimated by health status. Furthermore, the HCM requires that interactions between its four dimensions be taken into account. Indeed, biological and genetic capital is just one dimension of the HCM.

In addition, the HCM is an operationalization of the health capability paradigm (Prah Ruger, 2009), the latter being a comprehensive and accurate adaptation of the CA to the health field (Sen, 2010). Accordingly, it avoids most of the pitfalls identified in previous applications of the CA. For instance, reductions in shortfalls at the individual level is the HCM's normative focus. As such, arguments over what constitutes “sufficient” capability are avoided (Mitchell et al., 2015).

Finally, the identification of contributors to both shortfalls and optimal levels in health capability dimensions that enhance people's ability to experience optimal health has practical implications. This analysis illustrates how SEM-based applications of the HCM can provide rich empirical results that may be of interest to policy-makers. In the rural area of Niakhar, it could be advisable to develop programs or mechanisms that aim at encouraging health-related intrinsic motivation and which are likely to lead to optimal levels in accessing healthcare and decision-making latitude, for instance with the implementation of motivational interviews or sensitization campaigns. Conversely, factors associated with shortfalls in health capability dimensions should be taken into account: motivational interviews or sensitization campaigns could target women that are full-time residents in the area.

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References

Abel, T., Frohlich, K.L., 2012. Capitals and capabilities: Linking structure and agency to reduce health inequalities. Social Science & Medicine 74, 236–244. https://doi.org/10.1016/j.socscimed.2011.10.028

Abu-Zaineh, M., Woode, M.E., 2018. Investigating the Dimensions of Youth Wellbeing: An Exploratory Structural Equation Modelling Approach Applied to Palestine. Child Ind Res 11, 57–78. https://doi.org/10.1007/s12187-016-9420-0

Alkire, S., 2005. Subjective quantitative studies of human agency. Soc. Indic. Res. 74, 217–260. https://doi.org/10.1007/s11205-005-6525-0

Allanson, P., Petrie, D., 2013. On the choice of health inequality measure for the longitudinal analysis of income-related health inequalities. Health Econ 22, 353–365. https://doi.org/10.1002/hec.2803

Beauducel, A., Herzberg, P.Y., 2006. On the Performance of Maximum Likelihood Versus Means and Variance Adjusted Weighted Least Squares Estimation in CFA. Structural Equation Modeling: A Multidisciplinary Journal 13, 186–203. https://doi.org/10.1207/s15328007sem1302_2

Bentler, P., Bonett, D., 1980. Significance Tests and Goodness of Fit in the Analysis of Covariance-Structures. Psychol. Bull. 88, 588–606. https://doi.org/10.1037/0033-2909.107.2.238

Bentler, P.M., 1990. Comparative fit indexes in structural models. Psychol Bull 107, 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Bhattacharya, J., Banerjee, S., 2012. Women Empowerment as Multidimensional Capability Enhancement: An Application of Structural Equation Modeling. Poverty & Public Policy 4, 79–98. https://doi.org/10.1002/pop4.7

Boye, S., Shimakawa, Y., Vray, M., Giles-Vernick, T., 2020. Limited Awareness of Hepatitis B but Widespread Recognition of Its Sequelae in Rural Senegal: A Qualitative Study. Am. J. Trop. Med. Hyg. 102, 637–643. https://doi.org/10.4269/ajtmh.19-0477

Bunker, J.P., Frazier, H.S., Mosteller, F., 1994. Improving Health: Measuring Effects of Medical Care. The Milbank Quarterly 72, 225–258. https://doi.org/10.2307/3350295

Chuang, Y.-C., Cubbin, C., Ahn, D., Winkleby, M.A., 2005. Effects of neighbourhood socioeconomic status and convenience store concentration on individual level smoking. Journal of Epidemiology & Community Health 59, 568–573. https://doi.org/10.1136/jech.2004.029041

Coast, J., Smith, R., Lorgelly, P., 2008. Should the capability approach be applied in Health Economics? Health Economics 17, 667–670. https://doi.org/10.1002/hec.1359

Coste, M., De Sèze, M., Diallo, A., Carrieri, M.P., Marcellin, F., Boyer, S., ANRS 12356 AmBASS Study Group, 2019. Burden and impacts of chronic hepatitis B infection in rural Senegal: study protocol of a cross-sectional survey in the area of Niakhar (AmBASS ANRS 12356). BMJ Open 9, e030211. https://doi.org/10.1136/bmjopen-2019-030211

Cronbach, L., Meehl, P., 1955. Construct validity in psychological tests. Psychological Bulletin 52, 281–302. https://doi.org/10.1037/h0040957

Cutler, D.M., Lange, F., Meara, E., Richards-Shubik, S., Ruhm, C.J., 2011. Rising educational gradients in mortality: The role of behavioral risk factors. Journal of Health Economics 30, 1174–1187. https://doi.org/10.1016/j.jhealeco.2011.06.009

Delaunay, V., Douillot, L., Diallo, A., Dione, D., Trape, J.-F., Medianikov, O., Raoult, D., Sokhna, C., 2013. Profile: The Niakhar Health and Demographic Surveillance System. Int J Epidemiol 42, 1002–1011. https://doi.org/10.1093/ije/dyt100

Delaunay, V., Sokhna, C., Desclaux, A. (Eds.), 2018. Niakhar, mémoires et perspectives, Coédition. IRD Editions/L'Harmattan, Marseille (France), Dakar (Senegal).

Feldman, C.H., Darmstadt, G.L., Kumar, V., Ruger, J.P., 2015. Women's Political Participation and Health: A Health Capability Study in Rural India. J Health Polit Policy Law 40, 101–164. https://doi.org/10.1215/03616878-2854621

Figueroa, J.F., Frakt, A.B., Jha, A.K., 2020. Addressing Social Determinants of Health: Time for a Polysocial Risk Score. JAMA. https://doi.org/10.1001/jama.2020.2436

Gallaher, J.R., Cairns, B., Varela, C., Charles, A.G., 2017. Mortality After Peritonitis in Sub-Saharan Africa: An Issue of Access to Care. JAMA Surg 152, 408–410. https://doi.org/10.1001/jamasurg.2016.4638

Garnier, D., Simondon, K.B., Hoarau, T., Benefice, E., 2003. Impact of the health and living conditions of migrant and non-migrant Senegalese adolescent girls on their nutritional status and growth. Public Health Nutr. 6, 535–547. https://doi.org/10.1079/PHN2003463

Gram, L., Morrison, J., Sharma, N., Shrestha, B., Manandhar, D., Costello, A., Saville, N., Skordis-Worrall, J., 2017. Validating an Agency-based Tool for Measuring Women's Empowerment in a Complex Public Health Trial in Rural Nepal. Journal of Human Development and Capabilities 18, 107–135. https://doi.org/10.1080/19452829.2016.1251403

Gulliford, M., 2017. Access to primary care and public health. The Lancet Public Health 2, e532–e533. https://doi.org/10.1016/S2468-2667(17)30218-9

Heene, M., Hilbert, S., Freudenthaler, H.H., Bühner, M., 2012. Sensitivity of SEM Fit Indexes With Respect to Violations of Uncorrelated Errors. Structural Equation Modeling: A Multidisciplinary Journal 19, 36–50. https://doi.org/10.1080/10705511.2012.634710

Hollard, G., Sene, O., 2016. Social capital and access to primary health care in developing countries: Evidence from Sub-Saharan Africa. J Health Econ 45, 1–11. https://doi.org/10.1016/j.jhealeco.2015.10.004

Holtmann, J., Koch, T., Lochner, K., Eid, M., 2016. A Comparison of ML, WLSMV, and Bayesian Methods for Multilevel Structural Equation Models in Small Samples: A Simulation Study. Multivariate Behavioral Research 51, 661–680. https://doi.org/10.1080/00273171.2016.1208074

Karimi, M., Brazier, J., Basarir, H., 2016. The Capability Approach: A Critical Review of Its Application in Health Economics. Value in Health 19, 795–799. https://doi.org/10.1016/j.jval.2016.05.006

Krishnakumar, J., 2007. Going Beyond Functionings to Capabilities: An Econometric Model to Explain and Estimate Capabilities. Journal of Human Development and Capabilities 8, 39–63. https://doi.org/10.1080/14649880601101408

Krishnakumar, J., Ballon, P., 2008. Estimating Basic Capabilities: A Structural Equation Model Applied to Bolivia. World Development, Multidimensional Poverty Analysis: Conceptual Issues, Empirical Illustrations, and Policy Implications 36, 992–1010. https://doi.org/10.1016/j.worlddev.2007.10.006

Lei, P.-W., Shiverdecker, L.K., 2020. Performance of Estimators for Confirmatory Factor Analysis of Ordinal Variables with Missing Data. Structural Equation Modeling: A Multidisciplinary Journal 27, 584–601. https://doi.org/10.1080/10705511.2019.1680292

Mabsout, R., 2011. Capability and Health Functioning in Ethiopian Households. Soc Indic Res 101, 359–389. https://doi.org/10.1007/s11205-010-9661-0

Marmot, M., Bell, R., 2012. Fair society, healthy lives. Public Health, Public Health International Conference 2011: Health and Wellbeing – The 21st Century Agenda 8–9 September 2011, London, UK 126, S4–S10. https://doi.org/10.1016/j.puhe.2012.05.014

Martikainen, P.T., Valkonen, T., 1996. Excess mortality of unemployed men and women during a period of rapidly increasing unemployment. The Lancet 348, 909–912. https://doi.org/10.1016/S0140-6736(96)03291-6

Maydeu-Olivares, A., Shi, D., Rosseel, Y., 2018. Assessing Fit in Structural Equation Models: A Monte-Carlo Evaluation of RMSEA Versus SRMR Confidence Intervals and Tests of Close Fit. Structural Equation Modeling: A Multidisciplinary Journal 25, 389–402. https://doi.org/10.1080/10705511.2017.1389611

McKeown, T., Record, R.G., Turner, R.D., 1975. An interpretation of the decline of mortality in England and Wales during the twentieth century. Popul Stud (Camb) 29, 391–422.

Mitchell, P.M., Roberts, T.E., Barton, P.M., Coast, J., 2017. Applications of the Capability Approach in the Health Field: A Literature Review. Soc Indic Res 133, 345–371. https://doi.org/10.1007/s11205-016-1356-8

Mitchell, P.M., Roberts, T.E., Barton, P.M., Coast, J., 2015. Assessing sufficient capability: A new approach to economic evaluation. Soc Sci Med 139, 71–79. https://doi.org/10.1016/j.socscimed.2015.06.037

Muthén, B., du Toit, S., Spisic, D., 1997. Robust inference using weighted least squares and quadratic estimating equations in latent variable modeling with categorical and continuous outcomes – ScienceOpen.

Narayan, D., 2005. Conceptual framework and methodological challenges, in: Measuring Empowerment: Cross Disciplinary Perspectives. The World Bank, Washington, DC, p. 475.

Nikiema, B., Haddad, S., Potvin, L., 2012. Measuring women's perceived ability to overcome barriers to healthcare seeking in Burkina Faso. BMC Public Health 12. https://doi.org/10.1186/1471-2458-12-147

Okonofua, F.E., 2008. Maternal mortality prevention in Africa--need to focus on access and quality of care. Afr J Reprod Health 12, 9–16.

Peugh, J., Feldon, D.F., 2020. "How Well Does Your Structural Equation Model Fit Your Data?": Is Marcoulides and Yuan's Equivalence Test the Answer? CBE life sciences education 19, es5. https://doi.org/10.1187/cbe.20-01-0016

Prah Ruger, J., 2015. Health Economics and Ethics and the Health Capability Paradigm. Journal of Human Development and Capabilities 16, 581–599. https://doi.org/10.1080/19452829.2015.1101411

Prah Ruger, J., 2010. Health Capability: Conceptualization and Operationalization. Am J Public Health 100, 41–49. https://doi.org/10.2105/AJPH.2008.143651

Prah Ruger, J., 2009. Health and Social Justice. Oxford University Press, Oxford, New York.

Rocco, L., Fumagalli, E., Suhrcke, M., 2014. From social capital to health--and back. Health Econ 23, 586–605. https://doi.org/10.1002/hec.2934

Rutherford, M.E., Mulholland, K., Hill, P.C., 2010. How access to health care relates to under-five mortality in sub-Saharan Africa: systematic review. Trop Med Int Health 15, 508–519. https://doi.org/10.1111/j.1365-3156.2010.02497.x

Ryan, R.M., Deci, E.L., 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am Psychol 55, 68–78. https://doi.org/10.1037//0003-066x.55.1.68

Sen, A., 2010. Foreword, in: Health and Social Justice. Oxford University Press, New-York, pp. vii–x.

Sen, A., 2002. Health: perception versus observation. BMJ 324, 860–861.

Sen, A., 1999. Development as Freedom. Alfred Knopf, New York.

Sen, A., 1980. Tanner Lectures on Human Values, Volume 1. Cambridge University Press, Cambridge.

Steele, S.J., Sugianto, H., Baglione, Q., Sedlimaier, S., Niyibizi, A.A., Duncan, K., Hill, J., Brix, J., Philips, M., Cutsem, G.V., Shroufi, A., 2019. Removal of user fees and system strengthening improves access to maternity care, reducing neonatal mortality in a district hospital in Lesotho. Trop Med Int Health 24, 2–10. https://doi.org/10.1111/tmi.13175

Steiger, J., 1990. Structural Model Evaluation and Modification - an Interval Estimation Approach. Multivariate Behav. Res. 25, 173–180. https://doi.org/10.1207/s15327906mbr2502_4

Thompson, B., 2004. Exploratory and confirmatory factor analysis: Understanding concepts and applications, Exploratory and confirmatory factor analysis: Understanding concepts and applications. American Psychological Association, Washington, DC, US. https://doi.org/10.1037/10694-000

Tucker, L., Lewis, C., 1973. Reliability Coefficient for Maximum Likelihood Factor-Analysis. Psychometrika 38, 1–10. https://doi.org/10.1007/bf02291170

United Nations Development Program, 2019. Human Development Report.

Vaz, A., Pratley, P., Alkire, S., 2016. Measuring Women’s Autonomy in Chad Using the Relative Autonomy Index. Feminist Economics 22, 264–294. https://doi.org/10.1080/13545701.2015.1108991

Ware, J.E., 2005. How to score version 2 of the SF-12 health survey (with a supplement documenting version 1). QualityMetric Inc., Lincoln, R.I, Boston, Mass.

Williams, A., 1987. Health economics: the cheerful face of dismal science, in: Health and Economics. Macmillan Press, London.

APPENDIX

A1. Selection of the sets of items used to estimate the three health capability dimensions studied

A1.1 Current self-reported health

The correlation matrix containing the full set of nine candidate items to estimate current self-reported health status, revealed redundancies (correlation > 0.85) between role-emotional and role-physical on the one hand, and mental health and vitality on the other. 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.

Table A1.1a. Full correlation matrix for 'current self-reported health dimension

	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

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

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 6.749, suggesting perfectible consistency (see table A1.1b). Indeed, the reduced set yielded a Cronbach alpha coefficient of 0.7358.

Table A1.1b. Reduced six-item correlation matrix for current 'self-reported health' dimension

	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

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 A1.1c).

Table A1.1c. Final correlation matrix for 'current self-reported health' dimension

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

A1.2 Participation in decision-making

The four-item set for the 'decision-making latitude' 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 A1.2).

Table A1.2. Four-item correlation matrix for 'participation in decision-making' 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

A1.3 Access to healthcare

Six items reflected participant-perceived obstacles 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 A1.3a). 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.

Table A1.3a. Full set correlation matrix for 'access to healthcare' dimension

	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

The correlation matrix did not identify redundancies or outliers among the five remaining items (values ranging from 0.4918 to 0.7440, see Table A1.3b). 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 A1.3b. Five-item correlation matrix ('Access to healthcare' dimension)

	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

A2. Intermediate structural models

Table A2.1 Unstandardized estimates

	Health			Decision			Access		
Models	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
Health	–	–	–	–	–	0.123	–	–	-0.035
Decision	–	–	0.003	–	–	–	–	–	-0.036
Access	–	–	-0.067	–	–	**-0.176*****	–	–	–
Age	**-0.027*****	**-0.026*****	**-0.027*****	**0.017*****	**0.019*****	**0.022*****	0.002	–	–
Agricultural resources index	**0.155*****	**0.162*****	**0.168****	**-0.302*****	**-0.313*****	**-0.339*****	**-0.124***	-0.107	–
Being a parent	0.020	–	–	**0.613*****	**0.613*****	**0.637*****	-0.282	–	–
Attended secondary school	-0.185	–	–	0.158	–	–	-0.168	–	–
Household size	**-0.020****	**-0.021****	**-0.021****	-0.004	–	–	-0.004	–	–
Gender	**-0.308*****	**-0.346*****	**-0.340****	**-0.765*****	**-0.795*****	**-0.768*****	-0.034	–	–
BSF recipient	0.094	–	–	**-0.020**	–	–	0.201	–	–
Living conditions index	0.028	–	–	-0.024	–	–	**0.225****	**0.205****	**0.193****
Being married	0.153	–	–	**0.456*****	**0.469*****	**0.480*****	0.010	–	–
Non-agricultural job	0.192	–	–	0.213	–	–	-0.015	–	–
Sole owner of a field for farming	**-0.271****	**-0.234***	-0.151	0.132	–	–	**0.739*****	**0.754*****	**0.688*****
Temporary migration	**-0.343*****	**-0.392*****	**-0.386*****	**-0.485*****	**-0.574*****	**-0.535*****	-0.084	–	–
Relative autonomy index (RAI)	**-0.022***	-0.018	–	**0.027****	**0.028****	**0.041*****	**0.061*****	**0.063*****	**0.065*****
Attended primary school	0.104	–	–	**-0.354****	**-0.320****	**-0.332****	0.156	–	–
Semi-urban village	–0.044	–	–	-0.097	–	–	**0.639*****	**0.587*****	**0.582*****

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

Table A2.2 Goodness-of-fit

Model	Direct effects	Interactions between latent factors	N obs.	Chi² (df)	RMSEA [90% CI]	CFI	TLI
(1)	All	No	708	364.822 (183)	0.037 [0.032-0.043]	0.981	0.975
(2)	10 % level	No	713	275.514 (172)	0.029 [0.023-0.035]	0.989	0.987
(3)	10% level	Yes	713	294.201 (171)	0.032 [0.026-0.038]	0.987	0.984

A3. Measurement model: Confirmatory factor analysis (CFA) versus Explanatory factor analysis (EFA)

Table A3.1 Unstandardized estimates

	Health		Decision		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 A3.2 Goodness of fit

Model	N obs.	Chi² (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

These are estimates for measurement models only (no structural set of equations between latent factors or with exogenous variables).

In the three-factor EFA, two CFA indicators of Access to Healthcare services - distance and transportation – loaded on Health status. Conceptually, it is not surprising that the latent dimension of current 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 'decision making' 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 'decision making' 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.

A4 Total effects of the structural model

Table A4. Raw and standardized estimates

	Health		Decision		Access	
	Raw	*Std.*	*Raw*	*Std.*	*Raw*	*Std.*
Health	–	–	0.191	0.161	-0.005	-0.005
Decision	-0.060	-0.071	–	–	-0.034	-0.041

Access	-0.106	-0.102	**-0.193****	**-0.156****	–	–
Age	**-0.026*****	**-0.022*****	**0.019*****	**0.014*****	-0.001	-0.001
Agricultural resources index	**0.162****	**0.137*****	**-0.319*****	**-0.227*****	0.011	0.010
Parental status	-0.038	-0.016	**0.635*****	**0.222*****	-0.021	-0.009
Household size	**-0.021****	**-0.018****	-0.004	-0.003	0.000	0.000
Gender	**-0.345*****	**-0.144*****	**-0.817*****	**-0.287*****	0.027	0.012
Living conditions index	-0.020	-0.017	**-0.037***	**-0.026***	**0.192****	**0.168****
Marital status	-0.029	-0.012	**0.473*****	**0.166*****	-0.016	-0.007
Sole owner of a field for farming	-0.075	-0.028	**-0.137****	**-0.042****	**0.714*****	**0.272*****
Temporary migration	**0.391*****	**0.157*****	**0.589*****	**0.199*****	-0.019	-0.008
Relative autonomy index	-0.009	-0.008	**0.029****	**0.021****	**0.064*****	**0.056*****
Primary education	0.020	0.009	**-0.338****	**-0.120****	0.011	0.005
Semi-urban village	-0.061	-0.026	**-0.111*****	**-0.039*****	**0.581*****	**0.253*****

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