The Demography of Cognitive Health Among Mature Adults in a Low-Income High HIV-Prevalence Context

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Abstract

Cognitive skills and cognitive health are an important dimension of well-being in their own right, and they are a very important indicator of human capital in population with low levels schooling such as older individuals in low-income countries. Despite this central importance of cognitive abilities, however, very few studies have investigated cognitive health in sub-Saharan Africa’s (SSA) growing population of mature adults (= persons age 45+). Using data from the Malawi Longitudinal Study of Families and Health (MLSFH), this paper provides a first picture of the demography of cognitive health (CH) among mature adults in a low-income high HIV-prevalence context. Females have more difficulty with poor CH than males, and experience a steeper decline of CH with age. Poor CH is associated with adverse outcomes, such as less nutrition intake and reduced work efforts. Poor CH is strongly associated with poor physical health and increased levels of depression and anxiety among older adults. Together, our analyses therefore characterize a process of declining cognitive health among mature adults, with significant gender differences and possibly important productivity and well-being implications, in a rapidly-growing but understudied portion of the SSA population.

1. Introduction

Poor Cognitive Health (CH) is a significant and growing contribution to the global burden of disease (Murray et al. 2012). It is an integral part of global population health, and in resource-poor contexts, poor CH has been widely recognized as having important implications for individual productivity, individual/family-level well-being, and overall economic development (Sosa et al 2012). This focus on cognitive health as a public health issue is emphasized in a recent National Academy of Sciences monograph which states that At this point in time, when the
older population is rapidly growing in the United States and across the globe, it is important to carefully examine what is known about cognitive aging (Blazer et al. 2015). But in low-income contexts such as sub-Saharan Africa (SSA), almost nothing is known about cognitive health at the population level. Despite its growing relevance, CH continues to be poorly documented and inadequately understood in low-income countries (LICs) and SSA countries affected by HIV/AIDS. To help fill this research gap, this paper will address essential but under-researched questions about the demography of CH among mature adults, defined as individuals aged 45 and older, in rural Malawi. For example: In this low-income high-HIV-prevalence context, how does the prevalence of poor CH increase with age? Why do women have poorer levels of CH than men across all mature adult ages? And, how does poor CH correlate with depression, anxiety, and physical health?

2. Context, Data and Measures

Malawi is one of the poorest countries in the world, ranked 174 of 187 in terms of the human development index (UNDP 2014), with about 15% of its population considered “ultra-poor”, i.e., with an estimated food consumption below the minimum level of dietary energy requirement (UNDP 2010). Life expectancy at birth is estimated to be 51 for men and 55 for women in 2010, and healthy life expectancy at birth is estimated at 44 years for males and 46 years for females (Salomon et al. 2012). In rural areas, where our study population is based, the majority of individuals engage in home production of crops, complemented by some market activities. HIV/AIDS is clearly widespread, as are worries about HIV and the household-level experience of AIDS-related mortality and morbidity. However, the vast majority of the population—more than 85% of adults aged 15-49, and an even higher fraction among adults aged 50 and over—is
HIV negative (Freeman and Anglewicz 2012; Malawi DHS 2011). Yet, HIV-negative individuals also confront a high disease-risk environment characterized by high levels of poverty, episodic malnutrition, poor sanitation, a high prevalence of infectious diseases and endemic parasites, and limited access to health care facilities.

The Malawi Longitudinal Study of Families and Health (MLSFH) (Kohler et al. 2014) is one of very few long-standing publicly-available longitudinal cohort studies in a SSA LIC context with eight data collection rounds during 1998—2013 for up to 4,000 individuals. The MLSFH is also one of the very few studies in SSA that provide information about the cognitive abilities and cognitive health of older individuals.

The MLSFH is collected in three regions: Balaka in the south, Mchinji in the center, and Rumphi in the north. The MLSFH cohorts were selected to represent the rural population, where the majority of Malawians (85%) live. A “Cohort Profile” of the MLSFH, providing detailed discussion of MLSFH sampling procedures, survey methods, survey instruments, and analyses of attrition has been published in the International Journal of Epidemiology (Kohler et al. 2014).

Our analyses focus on the MLSFH mature adults sample, consisting of respondents aged 45 and older who participated in the 2012 ($N = 1,266$) and 2013 ($N = 1,257$) MLSFH mature adult surveys (see Kohler et al. 2014 for additional details). Most important for this paper, Data were collected as part of the Malawi Longitudinal Study of Families and Health (MLSFH; Kohler et al. 2014). Specifically, the 2012 and 2013 MLSFH included the International Cognitive Assessment (ICA), a brief screening test for adolescents and adults. It is designed to be relatively culture-free and appropriate for populations with limited education. It assesses six cognitive domains: basic language ability, orientation, visual/constructional skills,
attention/working memory, executive functions, and delayed memory/recall. The maximum score is 30. Specific questions included in the ICA are included as Appendix A. The team is currently in the process of norming the scores to a healthy population in Malawi to determine thresholds for mild, moderate, and severe levels of cognitive impairment.

3. Preliminary Results

Our analyses show that many mature adults experience poor CH, and that CH declines substantially with age. Poor CH is systematically associated with adverse outcomes, such as less nutrition intake and substantially reduced financial earnings and savings (Table 1). Poor CH is more frequent among women than men, increases substantially with age for both females and males (Figure 1). The marked gender gap in CH is not explained by a differential exposure to socioeconomic stressors. Our analyses suggest that declining cognitive health with age among mature adults in Malawi is importantly related to declines in physical health. Weak hand grip strength and limitations in daily activities resulting from poor physical health are strongly associated with poor CH, as is low BMI (Table 2). Moreover, due to their gender differentials and increasing prevalence with age, these factors explain a substantial part of the age-gradient and gender gap in CH.

4. Summary and Discussion

Most of the research investigating the prevalence and determinants of poor cognitive health is conducted in high-income countries. Yet, cognitive health represents a neglected health dimension in middle and low-income settings, and possible interactions of cognitive health with HIV risks, HIV prevention and AIDS treatments, and the rising burden of NCDs in SSA give a
particular urgency to research on cognitive health in sub-Saharan Africa. Our analyses in this paper focus on the demography on cognitive health among mature adults (= persons aged 45+) in rural Malawi. Our analyses also show that reductions in CH are systematically associated with adverse outcomes, such as less nutrition intake, reduced subjective well-being, and substantially reduced earnings and savings.

We show that poor CH is much more frequent among women than men, and poor CH increases substantially with age for both females and males. Together, our analyses therefore characterize a process of declining cognitive health among mature adults, with significant gender differences and possibly important productivity and well-being implications, in a rapidly-growing but understudied portion of the SSA population.

Our results are also important as they help inform the health policies and health sector strategies required for preparing for the growing population of mature adults and elderly individuals in SSA LICs. The average annual growth rate of the population age 60 and above in SSA is projected to increase from over 2% (already higher than the 60+ growth rate in developing countries) to over 4% during the next 45 years---4-times the growth rate expected in developed countries. In countries like Malawi, this rapid growth of the mature adult and older population occurs while the overall age structure of the population will remain relatively young. Hence, while rapid population growth continues to be a major social and policy issue in SSA, current demographic and epidemiological trends foreshadow the coming challenge of a growing elderly population in SSA. Due to high levels of morbidity, low levels of economic development, and widespread poverty, individual aging and population aging in SSA will likely be associated with a unique set of demographic and economic concerns. Yet, there is a dearth of understanding
among national and international decision-makers about the magnitude of the aging problem in SSA. Evidence from more developed contexts is often not sufficient for understanding the health issues and health-care-needs associated with a growing aging population in SSA. In Malawi and other SSA countries, health sector strategies are beginning to recognize the importance of mental health disorders that will gain further prominence in coming decades (Abderon & Beard 2015). Our findings provide important insights into the potential gains in well-being and economic productivity that can arise from investments in the mental health of mature adults in SSA LICs, and they highlight importance of expanding the identification and treatment of mental health disorders in these contexts.
Figure 1)

![Graph showing total ICA score by age for females and males with controls for schooling and region.](image-url)
<table>
<thead>
<tr>
<th>Mean of dep. Var.</th>
<th>Subj. well-being&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Food intake&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Earnings (log) past year&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Any Savings&lt;sup&gt;d&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.53</td>
<td>2.90</td>
<td>10.18</td>
<td>0.40</td>
</tr>
<tr>
<td>Std dev</td>
<td>0.97</td>
<td>1.93</td>
<td>1.31</td>
<td>0.49</td>
</tr>
</tbody>
</table>

**Regression on:**

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>OLS</th>
<th>OLS</th>
<th>Logit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cognitive Score</td>
<td>0.018***</td>
<td>0.024**</td>
<td>0.039***</td>
<td>0.045***</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>0.009</td>
<td>0.007</td>
<td>0.011</td>
</tr>
</tbody>
</table>

Notes: p-values: * p < 0.05, ** p < 0.01, *** p < 0.001. Analyses are pooled across 2012 and 2013 MLSFH mature adult survey. Standard errors are adjusted for clustering within respondents. All analyses additionally control for age, age squared, female, region and MLSFH wave. (a) Based on question: How satisfied are you with your life, all things considered? 1 = very unsatisfied, 6 = very satisfied. (b) Based on question: About how many days last week did you eat chicken, fish or meat? (c) Based on question: Think about all of the work that you have done in the past 12 months in which you have been paid cash or kind. How much do you estimate that you have earned in the past year? 268 observations (11%) were excluded when taking logs because zero earnings were reported. (d) Based on question: Do you currently have any savings for the future, such as a bank account, savings group, or cash?
Table 2: Total ICA cognitive health score and physical-health- and mental-health-related stressors: 2012–2013 MLSFH mature adults

<table>
<thead>
<tr>
<th>Stressor: ¹</th>
<th>Work limitation, due to phys. health ²</th>
<th>Pain interfered with work ³</th>
<th>Grip Strength ⁴</th>
<th>Body Mass Index ⁵</th>
<th>Blood pressure (systolic) ⁶</th>
<th>PHQ9 depression score ⁷</th>
<th>GAD7 anxiety score ⁸</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accomplished less, due to phys. health ²</td>
<td>-0.59**, -0.096</td>
<td>-0.64**, -0.098</td>
<td>-0.63**, -0.088</td>
<td>0.18**</td>
<td>0.019</td>
<td>-0.0016</td>
<td>-0.16**</td>
</tr>
<tr>
<td>Work limitation, due to phys. Health ²</td>
<td>-0.64**, -0.098</td>
<td>-0.63**, -0.088</td>
<td>0.18**</td>
<td>0.019</td>
<td>-0.0016</td>
<td>-0.0046</td>
<td>-0.027</td>
</tr>
<tr>
<td>Pain interfered with work ³</td>
<td>-0.63**, -0.088</td>
<td>-0.019</td>
<td>-0.026</td>
<td>-0.0046</td>
<td>-0.027</td>
<td>-0.0027</td>
<td>-0.035</td>
</tr>
<tr>
<td>Grip Strength ⁴</td>
<td>0.18**</td>
<td>0.019</td>
<td>-0.026</td>
<td>-0.0046</td>
<td>-0.027</td>
<td>-0.0027</td>
<td>-0.035</td>
</tr>
<tr>
<td>Body Mass Index ⁵</td>
<td>0.019</td>
<td>-0.026</td>
<td>-0.0046</td>
<td>-0.027</td>
<td>-0.0027</td>
<td>-0.035</td>
<td></td>
</tr>
<tr>
<td>Blood pressure (systolic) ⁶</td>
<td>-0.0016</td>
<td>-0.0046</td>
<td>-0.027</td>
<td>-0.035</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHQ9 depression score ⁷</td>
<td>-0.16**</td>
<td>-0.027</td>
<td>-0.035</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>GAD7 anxiety score ⁸</td>
<td>0.23**</td>
<td></td>
<td></td>
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</table>

Notes: Analyses are pooled across the 2012–13 MLSFH mature adult data, and standard errors (adjusted for clustering within individuals) are reported in parentheses. p-values: * p < 0.05, ** p < 0.01.

1) The stressors related to perceived risk and uncertainty were measured in the MLSFH through the following questions: (a) During the past 4 weeks, how much of the time have you accomplished less than you would like with your work or other regular daily activities, as a result of your physical health?, with answers ranging from 1 = none of the time to 5 = all of the time. (b) During the past 4 weeks, how much of the time have you been limited in the kind of work or other regular daily activities, as a result of your physical health?, with answers ranging from 1 = none of the time to 5 = all of the time. (c) During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?, with answers ranging from 1 = not at all to 5 = extremely. (d) Grip strength is the average left and right hand, each obtained by averaging three measurements using a hand-held dynamometer; (e) BMI is obtained from measured height and weight; available for 2013 only, and in the pooled analyses, the 2013 BMI values is used for both 2012 and 2013. (f ) Systolic blood pressure is the average of three measurements, obtained using upper-arm blood pressure monitors. (g) Score on the PHQ9 depression scale. (h) Score on the GAD7 anxiety scale.

2) Regression coefficient for each of these physical-health- and mental-health-related stressors obtained in linear regressions of the total ICA cognitive score on the respective stressor, age, female, and selected controls (region, schooling, MLSFH wave).
References:


Dan G. Blazer, Kristine Yaffe, and Catharyn T. Liverman, Editors. 2015. Cognitive Aging: Progress in Understanding and Opportunities for Action. Committee on the Public Health Dimensions of Cognitive Aging; Board on Health Sciences Policy; Institute of Medicine


Appendix A: Domains and Measures in the International Cognitive Assessment.

1. Language and Orientation
A. Confrontation Object Naming Administration: The examiner points to each drawing while asking the subject, “Tell me the name of this.”
B. Comprehension Administration: Point to the black & white circles and squares, sweeping your finger across the entire row, saying, “Look at these black and white circles and squares.”
C. Sentence Repetition: The examiner explains, “I am going to read a sentence. Repeat it after me, exactly as I say it.” Read the sentence aloud slowly and clearly, “The child is chasing the goat.”
D. Orientation: The examiner asks the subject each orientation question on the test form, including the date, current president, and current season.

2. Visual/Constructional
A. Dot Location Administration: The examiner points to the sample item and says, “There is one dot in the bottom square and several dots in the top square. Point to the dot in the top that is in the SAME location as the dot in the bottom.”
B. Constructional Ability Administration: The subject is provided with a pencil. The examiner points to the first figure and instructs the subject, “Copy this figure as accurately as you can in the space below.” If the subject is not accustomed to using a writing implement, then instruct him/her to draw the figure with their finger in the dirt/sand. Repeat instructions for the second figure. After both figures have been drawn by the subject, say, “Please remember these figures because I will ask you to draw them later from memory.” If the subject draws the figures in the dirt, take a photograph of their copies and then erase the figures by smoothing the dirt/sand.

3. Memory
Word List Administration: The examiner reads aloud the list of five words at a rate of one word per second. Give the following directions: “This is a memory test. I am going to read a list of words. After I read the list, tell me as many words as you can remember. The order you say them does not matter.” Then say, “Try to remember these words because I will ask you to recall them again at the end of the test.”

4. Attention/Working Memory
Forward Digit Span Administration: The examiner says, “I am going to read some numbers. When I finish, repeat the numbers in the same order.”
Backward Digit Span Administration: The examiner says, “I am going to read some numbers. When I finish, repeat the numbers to me backwards, that is in reverse order. For example, if I say 7-3, you would say [pause] 3-7.
Digit Span Scoring: Give one point for each sequence correctly repeated.
Sustained Attention Administration: The examiner says, “I am going to read a list of numbers. Every time I say the number TWO, clap your hands once. Do NOT clap for any other numbers.” The examiner reads the list of numbers at the rate of one per second.
5. Executive Functions

Trail Making Administration: Have the subject count aloud from 1 to 7. The examiner points to the test item and says, “In this box there are black and white circles with numbers in them. I want you to use the pencil to connect the circles in order by going from white to black. Go from the white 1 (point to the white 1) to the black 2 (point to the black 2), and so on until you reach the last number. Begin here (again point to the 1 in the white circle) and connect the numbers in order, alternating white and black circles.”

Category Verbal Fluency: The examiner instructions the subject, “Tell me as many different animal as you can, as quickly as you can say them, until I tell you to stop.”

Impulsivity/Inhibition Administration: Go No-Go Task. Demonstrate and say, “I am going to show you one or two fingers. If I show one finger, you clap your hands once. If I show two fingers, you should not respond. You should not clap.”

Visual/Motor Sequencing Administration: Demonstrate the series of three hand positions. Using the subject’s non-dominant hand, have subject copy you twice for practice. The entire three hand positions make up one sequence: 1) Clench hand to make a fist on flat surface; 2) Put hand on flat surface palm down; 3) Put hand perpendicular with fifth digit (little finger) on flat surface. Begin timing (10 seconds) and have subject perform the hand sequence with the non-dominant hand as quickly as possible.

Abstract Reasoning Administration: The examiner points to the two items in the top row of the sample item and says, “These are all alike because they are all what?” If the subject responds correctly (fruit), say “Yes, that is correct. They are all fruit.” If the subject does not respond or gives an incorrect answer, explain, “They are all the alike because they are all fruit.” Next say, “Look at the objects in the boxes below and point to the one that goes with the fruit above.” If the subject points to the correct answer (mango), say “Yes, that is correct because it is also a fruit.” If the subject makes an error by picking an object other than the fruit, or is not sure of the correct answer, point to the mango and say, “This is a mango, it is also a fruit. So it goes with the fruit above.” Next the examiner administers the two test items one at a time, by pointing and saying, “All of the objects on the top are alike in some way, pick the one item from below that goes with the items above.” Do not provide any additional help or correct the subject’s answers.

6. Memory Delayed Recall

Verbal Recall (Sentence): The examiner says, “Earlier you repeated a sentence. Then I asked you to remember the sentence. Now I want you to say the sentence again, exactly as I read it.”

Visual Recall: Free Recall Format: The examiner gives the subject a pencil and points to the space provided on the test form and says, “You copied two figures earlier, which I asked you to remember. Draw one figure in each space.”

Verbal Recall Words: Free recall format: The examiner says to the subject, “I read a list of words to you earlier, which I asked you to remember. Tell me as many of those words as you can remember.”