

Path dependence in Disability

Neha Agarwal

Department of Economics, University of Otago, PO Box 56, Dunedin 9054, New Zealand
neha.agarwal@otago.ac.nz, Phone: +64 3 479 5296

Hans-Peter Kohler

Population Studies Center, University of Pennsylvania, Philadelphia
Department of Sociology, University of Pennsylvania, Philadelphia, PA 19104, USA
hpkohler@pop.upenn.edu, Phone: +1 215 898 7686

Subha Mani

Department of Economics and Center for International Policy Studies, Fordham University,
Bronx, NY 10458, USA
Population Studies Center, University of Pennsylvania, PA 19104, USA
IZA, Bonn, Germany
smani@fordham.edu, Phone: +1 718 817 3636

Acknowledgements: We gratefully acknowledge the support for the Mature Adults Cohort of the Malawi Longitudinal Study of Families and Health (MLSFH-MAC) by the Swiss Programme for Research on Global Issues for Development (SNF r4d Grant 400640_160374) and the pilot funding received through the Penn Center for AIDS Research (CFAR), supported by NIAID AI 045008 and the Penn Institute on Aging. We are also grateful for support for the Malawi Longitudinal Study of Families and Health (MLSFH) by the National Institute of Child Health and Human Development (NICHD, Grant Nos. R01 HD044228, R01 HD053781, R01 HD087391); the National Institute on Aging (NIA, Grant Nos. P30 AG12836 and R21 AG053763); the Boettner Center for Pensions and Retirement Security at the University of Pennsylvania; and the NICHD Population Research Infrastructure Program (Grant Nos. R24 HD-044964), all at the University of Pennsylvania. We also thank Brian Dillon, one anonymous referee and Sophie Mitra for detailed comments. Molly Sheets, Katherine Lee, Pranava Kadiyala, and Timothy Kell-Fien provided excellent research assistance.

Path dependence in Disability

Abstract: The average prevalence of disability in most African countries is 10% but for many it exceeds the global disability prevalence rate of 15%. The extent to which this disability capturing functional and activity limitations results in permanent job loss, lowered lifetime income, and assets, in part, depends upon the extent to which the onset of limitations becomes permanent. In this paper we use five rounds of longitudinal data from rural Malawi, a low income African country with high prevalence of disability, to examine path dependence in activity limitations. We estimate a dynamic linear panel data model where the coefficient on the one-period lagged health outcome captures path dependence in limitations. Our preferred Arellano-Bover estimates show that males experience persistence in both the incidence and intensity of severe limitations but are able to recover from all other limitations, whereas, females exhibit no significant persistence on any type of limitations. Our findings have important policy implications for computing the long-term costs associated with onsets of activity limitations as these costs can be moderated by the recovery exhibited in these limitations.

Keywords: Disability, Activity limitations, ADLs, Panel Data, Malawi

JEL Classification: J 14, I 15, I 10

1. Introduction

The World Report on Disability (WHO-World Bank 2011) notes that nearly a billion individuals live with some disability. Most African countries recorded at least a 10% disability prevalence rate and many exceeded the global disability prevalence rate of 15.6%.¹ Among the poorer countries in Africa—the disability prevalence rate is 11.8% in Burkina Faso, 14.2% in Ethiopia, 16.05% in Zimbabwe, and 16.6% in Malawi (Mitra and Sambamoorthi (2014)).

The extent to which these disabilities measured by functional and activity limitations result in permanent job loss, lowered lifetime income, reduced assets, and other economic losses in Africa, in part, depends on the extent to which the onset of limitations become permanent. If functional and activity limitations were not permanent then at least some of the negative effects associated with the onset of limitations in the short run could be reversed in the long run.

In this paper, we examine whether activity limitations are transitory or permanent in an African country. We use a dynamic linear panel data model to estimate the persistence in activity limitations, where a coefficient of one on the lagged dependent variable indicates permanency in limitations, that is, the onset of limitations in the short run become permanent. Whereas a coefficient of zero on the lagged dependent variable would suggest that limitations are completely transitory, that is, only influenced by contemporary factors. Lastly, a coefficient between zero and one on the lagged dependent variable indicates partial persistence, that is, only some of the limitations observed in the short run will become chronic. We estimate the dynamic model using a unique panel data set among mature and old individuals in Malawi.

¹ Mitra and Sambamoorthi (2014) examine the prevalence of disability using respondent's self-evaluation on functional and activity limitations in the World Health Survey across 54 countries including 16 African countries.

Malawi is a low-income rural African country with a fairly high prevalence of disability and very limited access to resources at both the individual level as well as state level making it an appropriate setting for our research question (see Section 2 for more details).

Functional difficulties (e.g. seeing, hearing, communicating) and activity limitations (e.g. self-care) are administered in some large-scale household surveys and capture respondents' self-evaluation of disability. For instance, the World Health Survey (WHS) includes four questions that capture difficulty in seeing/recognizing people across the road, difficulty in moving around, difficulty in concentrating or remembering things and difficulty with self-care.² The responses to each of these four questions could vary between 1 and 5 (where 1 is no difficulty and 5 is extreme difficulty or unable to do it). Activity of Daily Living (ADL) limitation questions (e.g. bathing, eating, cooking) were developed for older people: they are considered to be a good proxy of physical disabilities and are measured more precisely than morbidity (Dow et al., 1997).

Functional and activity limitations are shown to be associated with lower schooling and higher multidimensional poverty in Sub-Saharan Africa (Filmer, 2008; Mizunoya et al. 2016, Mitra et al. 2013). Some country specific studies further note that functional and activity limitations are associated with higher poverty in Uganda (Hoogeveen, 2005), lower employment

² Some of the WHS questions are similar to the short list of six questions on functionings, developed, tested and put together by the Washington Group of Disability Statistics. Cross-sectional data on disability capture temporary limitations, however, to capture persistence in functional and activity limitations, researchers often examine limitations over time for the same respondent using panel data, which is limited in developing countries, especially Africa. Mitra (2018) shows that 5.54% of individuals in Ethiopia report severe limitations in any wave, but only 1.17% of individuals report persistence in severe limitations (that is those who report severe limitations in two consecutive survey rounds). Similarly, the author notes that in Uganda the incidence of severe limitations in any wave is approximately 6% and the incidence of persistent severe limitation reduces to 1.82%. Other large scale panel surveys such as the Indonesian Family Life Survey (IFLS) use nine questions to capture bodily functioning (such as walking) and activity limitations (such as sweeping, dressing) where each round of data reflects temporary limitations but multiple waves of the IFLS can be combined to construct persistence in limitations (see Mani et al., 2018). Filmer (2008) uses cross-sectional data from the Demographic and Health Surveys as well as the Living Standards Measurement Study (LSMS) surveys administered by the World Bank although there is quite a bit of variation in the disability questions used in the Filmer (2008) study.

population ratios in Burkina Faso and Mauritius (Mizunoya and Mitra, 2013), lower subjective well-being in Malawi (Payne, Mkandaire and Kohler, 2013), and lower asset ownership in Ethiopia and Tanzania (Mitra, 2018).³

The negative consequences associated with functional and activity limitations are of particular concern for the aging population as the onsets of limitations can intensify with age. Mitra (2018) shows that the prevalence of disability is higher among older people in Africa (Ethiopia, Malawi, Tanzania, and Uganda) and that, “*the prevalence of functional difficulties at the household level ranges from one in five to one in three households*”.⁴ The disability prevalence rates among individuals under 40 years across Burkina Faso, Ghana, Kenya, Malawi, Mauritius, Zambia and Zimbabwe are between 3.94% (lowest in Kenya) and 10.34% (highest in Malawi) and doubles among individuals 40 years and older (Mitra et al., 2013). The disability prevalence rates are almost three to four times larger among individuals aged 40 and above in Zimbabwe, Ghana, and Burkina Faso. Overall, the incidence of disability is high among the aging population making them vulnerable to job losses, lower earnings, higher medical expenditures, and lower subjective well-being.

Several studies note transitions in and out of functional and activity limitations pointing towards the lack of permanency in these limitations in developing countries (Mani, Mitra and Sambamoorthi (2018) for Indonesia, Mitra (2018) for Ethiopia and Tanzania). However, these studies report simple correlates that do not allow us to obtain unbiased estimates on the persistence

³ The negative association between functional and activity limitations and development outcomes (such as labor force participation, schooling, earnings, assets) have also been noted in other developing countries outside Africa (see Mitra, 2018 for an excellent review).

⁴ Mitra (2018) examines the prevalence of disability in four African countries using nationally representative cross-sectional datasets for Malawi, Tanzania and Uganda. The dataset from Ethiopia is only representative of rural and small towns in Ethiopia. The author records the prevalence of disability (measured using functional limitations) in Ethiopia is 12.85%, in Malawi is 10.78%, in Tanzania is 15.05% and in Uganda is 15.36%.

parameter. The correlations/transitions noted in the literature do not address the presence of time-invariant unobservables present in both current and lagged measures of disability that confound the coefficient estimate on the persistence parameter.

This paper contributes to the literature on health, disability, and African studies by analyzing the extent to which short run activity limitations become permanent in Malawi. Specifically, we examine persistence in the incidence, intensity and severity of ADL limitations using the Arellano-Bover estimation strategy that accounts for the presence of time-invariant unobservables between current and lagged ADL limitations. We do so using five rounds of data from the Malawi Longitudinal Study of Families and Health (MLSFH), a unique panel data set on adult health available from sub-Saharan Africa.

The preferred Arellano-Bover estimates on the dynamic specification show that males experience persistence in both the incidence and intensity of severe ADL limitations, but experience full recovery on any ADL limitations as well as ADL score (that captures the entire distribution of limitations). Females, on the other hand, exhibit full recovery on both any and severe ADL limitations. Further, exploratory analysis suggests that the low persistence in ADL limitations among females may be attributed to the reduced number of hours spent on domestic duties as well as unpaid household farm work and increased expenditure on own health among females with limitations compared to those without limitations. Attrition related selection in severe ADL limitation among females may also limit our ability to detect path dependence. Our results have important policy implications for computing the long-term costs associated with ADL limitations in the literature, which treats onsets as chronic. We find partial recovery and hence, these long-term costs must be significantly moderated by the recovery exhibited in ADL limitations.

The rest of the paper is organized as follows. In Section 2, we provide details on our context, prevalence and causes of disability in Malawi. The empirical specification is discussed in Section 3. In Section 4 we describe the data and the main results are presented in Section 5. We present robustness checks in Section 6 and concluding remarks follow in Section 7.

2. Context: Disability in Malawi

Incidence of Disability

As per the World Report on Disability (WHO-World Bank 2011), among those aged 15-59 in Africa, 3.3% experienced severe disability and 19.1% experienced moderate to severe disability. For individuals aged 60 and older in Africa, it is estimated that 16.9% of individuals experienced severe disability and 53.3% of individuals experienced moderate to severe disability.

The 2018 Malawi Population and Housing Census provides detailed data on the disabled population. The census captures disabilities by noting if individuals have difficulties with seeing, hearing, communicating, walking, cognition, and self-care capturing the incidence and severity in both functional and activity limitations. The Census uses questions from the Washington Group (Altman 2016) that seeks to identify persons with similar types and levels of limitations in basic activities, regardless of nationality or culture in census formats. The Washington Group asks six simple questions related to difficulties caused by 'health problems' to understand the incidence of disability. The incidence of disability is high for a low-income country like Malawi where 15.7% of individuals above the ages of 5 years report some functional and activity limitation.⁵ The census data also shows that the incidence of disability increases non-linearly with age in Malawi. The incidence of disability is: 9.2% among 15-29 year olds, 13.2% among 30-44, 30.4% among 45-59,

⁵ This does not account for the fact that same individual may report multiple difficulties.

and increases to 73.7% among 60+. Lastly, the incidence of disability is much higher in rural areas (16.7%) than urban areas (10.5%) with the incidence being smallest among urban men (at 10%) and highest among rural women (17.9%).

The incidence of disability among 30+ males is 24% whereas among females it is 32.4%. In Appendix Table A1, we use the Census data to provide a distribution of functional (e.g., seeing) and activity (e.g., self-care) limitations experienced by males and females aged 30+ in Malawi. Few interesting observations emerge from this table. First, we find that the majority of respondents among the 30+ age group have a disability, with limitations in seeing, followed by walking, hearing, intellectual, and self-care activities – this ordering remains the same for both males and females. Second, in each of these disability domains, males are more likely to report a complete inability– though the differences are not very large except for the self-care domain. On the other hand, females are more likely to report "some difficulty" in walking, seeing and hearing, and self-care than males. Overall, females are more likely to have disabilities while males are more likely to report higher severity of disability.

Causes of Disability

The 2018 Malawi Population and Housing Census also reports on the causes of individuals' disability. Disease and illness are the predominant causes of walking-and sight-based disabilities. The majority of self-care and intellectual disabilities are caused by undisclosed factors or events. Congenitalities are cited as the primary cause for speaking-based disabilities. The cause for the majority of hearing-based disabilities is unknown. A substantial number of cognitive disabilities are also caused by unknown factors or events.

Similar to the census, other studies from Malawi also report illness to be the primary reason for disability. For instance, Loeb and Eide (2004) found that in a nationally representative survey

in Malawi, 48.3% of disabled individuals reported physical illness as the cause of their disability, 17.2% of disabled individuals reported their disability was congenital, 10.6% of disabled individuals reported accident as the cause of their disability, 3.8% of disabled individuals reported their disability was caused by witchcraft, 3.2% of disabled individuals report disability was caused by mental illness, 1% of disabled individuals reported their disability was caused by an animal related incident, 0.6% of disabled individuals reported their disability was caused by violence, and 0.3% of disabled individuals reported their disability was caused by alcohol or drug abuse.

Munthali et al. (2004) conducted a study in the Mzimba, Ntchisi, Ntcheu, Zomba and Chikwawa regions of Malawi. The results of this survey found that the leading causes of disability in men were physical illness (55.3%), road accidents (16.4%), congenital (13.7%), witchcraft (4.0%) and other (7.1%). The leading causes of disability in women were physical illness (64.1%), road accidents (14.1%), congenital (14.1%) and other (3.1%). Eide and Munthali (2018) report on the causes of disability stratified by gender in Malawi. The main cause for both males and females is disease illness, with females attributing an additional six percentage points to disease illness as compared to males (60.7% versus 54.7%). The second most common cause is from birth/congenital, where males report at 28.6% compared to 25.9%. Males are more likely to become disabled by accident, violence outside the house, and stress. Females are more likely to become disabled by fall and beatings by family members.

Economic activity and disability

According to Loeb & Eide (2004), 42.3% of disabled Malawi individuals were employed, while the overall employment rate was 46.2% in 2003. This high employment rate is consistent with the World Report of Disability's assessment that low income countries have higher rates of

employment for disabled people relative to higher income countries. This is also perhaps due to a lack of social protection schemes available in low income countries.

In the 2018 Malawi Population and Housing Census, we can see that of the 2,574,210 economically inactive individuals in Malawi, 47,768 (~2 percent) individuals report injury, illness or disability as the reason for their inactivity. The census also provides insight towards the type of work being done by disabled individuals. The vast majority of those with disabilities perform work in elementary, agricultural, and service and sales occupations. Females with disabilities work in service and sales, agriculture, craft, and elementary occupations at a greater rate than males with disabilities. As expected, rural residents with disabilities are more likely to hold agricultural and elementary occupations while urban residents tend to hold managerial and professional occupations.

Social Protection Policies

Malawi is a signatory to the UN Convention on the Rights of Persons with Disabilities (CRPD) and the Convention on the Rights of the Child (CRC). In 2012, the Malawi Parliament passed the *Disability Act* to promote the rights of persons with disabilities. In 2017, the Government of Malawi developed the third *Malawi Growth and Development Strategy* (MGDS III). MGDS III views disability as a cross-cutting issue and emphasizes the need to reconstruct and renovate schools to ensure they are accessible and to upgrade health services. However, a lack of funding for disability projects has hindered Malawi's progress in adhering to international conventions regarding disability rights. The majority (about 60%) of the Malawi Government's budget for disability resources is allocated to the Malawi Council for the Handicapped (MACOHA) (UNICEF, 2019). MACOHA is inadequately funded, and has difficulty in delivering disability resources (Eide and Munthali, 2018). The other 40% is allocated to the Disability Headquarters

under the Ministry of Gender, Children, Disability, and Social Welfare (MoGCDSW) and the Kachere Rehabilitation Centre. The majority (75%) of these resources are directed to cover salaries, with little left for programs and activities.

Loeb & Eide (2011) note that while 84% of individuals with disabilities were aware of the health resources available to them, only 64% received these services in Malawi. The authors also note considerable gaps in welfare services, assisted device services, counseling services for disabled populations, and medical rehabilitation across Malawi, Namibia, Zambia and Zimbabwe.

Persons with disabilities are also not always aware of the programs offered. When offered the programs may not be adapted to the individual's needs, and persons with disabilities who are aware of programs may experience other barriers preventing them from enrolling. For instance, 94% of persons with disabilities in Malawi said they needed but did not receive welfare services, 18% higher than the average response of the 9 countries surveyed (UN, 2018).⁶ 76% of Malawians with disabilities reported needing but not receiving rehabilitation services.⁷

Civil society organizations have also emerged to the aid of disabled individuals. Seeking to assist disabled individuals in Malawi to overcome accessibility issues and lack of information is the Federation of Disability Organizations in Malawi (FEDOMA), an umbrella NGO that encompasses all of the Disabled People's Organizations in Malawi. The Malawi Union of the Blind (2020) has sought to increase the quality of life of visually impaired individuals in Malawi by improving socioeconomic welfare and increasing access to educational and health services. The Malawi National Association of the Deaf (MANAD) has training programs for

⁶ Countries with similar response rates are Zambia (90%) and Mozambique (87%)

⁷ Zambia reported higher (80%), and Lesotho (74%), Eswatini (70%), Mozambique (66%), Zimbabwe (57%), and Botswana (46%) all reported lower.

teaching sign language and producing materials that inform deaf individuals about HIV and AIDs (MANAD: Achievements, 2012).

Overall, there is quite a bit of awareness and commitment for improving the life of the disabled, yet resource constraints make it difficult to improve the living conditions of the disabled populations in Malawi. Greater effort has to be made to improve the budgetary shares allocated for policy responses that target the disabled population.

3. Empirical Specification

To examine the extent to which activity limitations reported in one period become persistent and remain in the next period, we estimate the following dynamic linear panel data model:

$$H_{it} = \beta_0 + \beta_1 H_{it-1} + \sum_{j=2}^R \beta_j X_{jit} + \sum_{k=1}^Z \delta_k Z_{ik} + \mu_i + \varepsilon_{it} \quad \text{-----} \quad (1)$$

where H_{it} is the measure of disability for individual i surveyed at time t . We use five measures of Activity of Daily Living (ADL) limitations as our dependent variables: any ADL, number of any ADLs, severe ADL, number of severe ADLs, and ADL score. We use the following two questions to construct our dependent variables: (1) Do you have any health problems that limit you in carrying out moderate activities? (For example, cooking and cleaning, walking to meetings in the village, or tending to cattle and livestock. If so, how much?), and (2) Do you have any health problems that limit you in carrying out strenuous activities? (For example carrying heavy loads, working on the farm, pounding maize, or digging a pit latrine. If so, how much?). Both questions can be answered on a scale of 0 to 2: 0 – not limited at all, 1 – yes, limited a little, and 2 – yes, limited a lot.

Any ADL takes a value 1 if the individual responds “yes, limited a lot” or “yes, limited a

little” to either of the above two questions, 0 otherwise. Number of any ADLs is the sum of the times the respondent says “yes, limited a lot” or “yes, limited a little” to the above two questions, taking a minimum value of 0 and a maximum value of 2. To capture the severity in activity limitations, we also construct two other variables – any severe ADL and number of severe ADLs. Severe ADL take a value 1 if the individual responds “yes, limited a lot” to either of the above two questions, 0 otherwise, and the number of severe ADLs is the sum of the times the respondent says “yes, limited a lot”. Lastly, to capture the entire distribution of limitations, we follow Stewart and Ware (1992) and Mani, Mitra and Sambamoorthi (2018) and construct the ADL score variable as the normalized sum of answers on the two questions.⁸ The ADL score provides a more pluralistic measure of physical limitations.

Next we define the X’s and Z’s used in equation (1) that capture all time-varying and time-invariant regressors that impact adult health respectively. Our controls are motivated by the reduced form conditional determinants of adult health (example: Strauss et al. (1993), Wolfe and Behrman (1984)). Specifically, we control for age and age squared, indicator for whether the respondent had primary education, indicator for whether the respondent had secondary or higher education allowing for the impacts of both education and age to be non-linear with health. We also control for religion, ethnicity, whether the respondent is married, and whether the household has a metal roof (a proxy for wealth).⁹ Similar to Mani, Hoddinott and Strauss (2013), we include

⁸ ADL Score = (Sum – Minimum Score)/ (Maximum Score – Minimum Score) where Sum is the sum total of the values reported on two the questions. Hence, the minimum score can be 0 (not limited at all on both questions) and maximum score can be 4 (yes, limited a lot on both questions).

⁹ The MLSFH did not collect detailed wealth data in all five waves used in our analysis sample and hence we are unable to use the wealth index as a control variable in our regressions. However, we examine correlation between the metal roof indicator (used in our analysis) and the wealth index using three waves of the MLSFH when both measures are available and find that there is a very high positive and significant correlation between the metal roof indicator and the wealth score (correlation coefficient = 0.60, p-value<0.01). Moreover, studies using the MLSFH data consistently rely on the metal roof indicator to capture variation in relative wealth as most individuals in rural Malawi are poor and live in house made of mud with a thatch roof with only 21% of MLSFH respondents living in a house

village-by-time fixed-effects that control for both time-varying observables and unobservables at the village level (ex: access to health centers, access to electricity, transportation cost to health center, crop failure and other village level factors that impact health). The regressions also include year dummies to capture time specific shocks and other time trends that may affect health. There are two sources of unobservables in our model: μ_i and ε_{it} . Adult's inherent healthiness and individual specific ability to absorb nutrients and fight illnesses is captured by μ_i . ε_{it} includes individual specific time-varying unobservables that are unobserved to the econometrician. To account for any unobserved correlation present among individuals living in a village, we present robust standard errors that are clustered at the village level.

The main coefficient of interest is β_1 that captures path dependence (over two survey rounds) in ADL limitations. A coefficient of *one* on β_1 indicates perfect path dependence/persistence in ADL limitations, that is, no recovery from onset of ADL limitations. A coefficient of *zero* suggests perfect recovery from an ADL limitation between survey rounds/no persistence in limitations, and a coefficient between *zero* and *one* indicates partial recovery from an ADL limitation, that is, some but not all of the ADL limitations will become chronic. The OLS estimate on the lagged dependent variable does not result in an unbiased estimate for β_1 as the condition of zero correlation between the error term and H_{it-1} is never satisfied in dynamic models (Wooldridge, 2002). We use the Arellano-Bover (1995) estimation strategy to deal with the endogeneity bias in H_{it-1} (lagged health), wherein the change in H_{it-1} (ΔH_{it-1}) is used as an instrument for lagged health, H_{it-1} .¹⁰ We will discuss instrument validity related concerns in Section 6.1 below.

with a metal roof (Kohler et al. 2015). In fact, it is common to use an indicator of metal roof for capturing relative wealth (which an asset index does) in other parts of Africa too, as done by Field et al. (2009) in Tanzania.

¹⁰ This estimation strategy has been previously used in Fedorov and Sahn (2005) and Mani (2012), to address the endogeneity concerns in lagged health among children.

4. Data

This study uses longitudinal data from the 2006, 2008, 2010, 2012, and 2013 rounds of the Malawi Longitudinal Study of Families and Health (MLSFH).¹¹ The MLSFH cohort was selected to represent the rural population in Malawi. The survey collects rich information on morbidity, mortality, and economic activities. The survey covers three districts in rural Malawi: Rumphi in the northern region, Mchinji in the central region, and Balaka in the southern region. All three regions are poor with the main source of livelihood being subsistence agriculture and work effort being highly seasonal. The three districts are similar in epidemiological and socioeconomic characteristics but vary in terms of their marriage, religion, land ownership, and inheritance patterns (See Kohler et al. (2015) for more details on the survey and sampling strategy).

Our analysis focuses on adult individuals of age 30 and above in each round as disability rates are fairly low among the younger population. The 2012 and 2013 MLSFH rounds were administered to mature adults aged 45+ as part of the MLSFH Mature Adult Cohort (MLSFH-MAC; see Kohler et al. (2020) for details), and consequently, the last two rounds have different age-composition than the first three rounds.¹²

Descriptive statistics are presented in Table 1. In 2006, 22% of the sample reports any ADL limitations and this number almost doubles to 42% by 2013. The incidence of severe limitations is much smaller at 4% in 2006, but steadily increases over time and more than doubles to 10.8% by 2013. The intensity and severity of limitations captured by the number of any ADL limitations,

¹¹ The MLSFH data collection is performed jointly by University of Pennsylvania and University of Malawi. The data collections and analyses of the MLSFH has been approved under various protocols by the IRB at the University of Pennsylvania and in Malawi (COMREC or NHSRC). The analyses of this paper utilized de-identified MLSFH data that could not be linked to any identifying information.

¹² As shown in Appendix Table A4, the main results reported in the paper are robust to restricting our sample to the 45+ year individuals in all five-survey rounds.

number of severe ADL limitations, and ADL score also all consistently increase between 2006 and 2013. These results are consistent with existing evidence collated from several countries which shows that functional and activity limitations become more common with age and that incidence of any limitations is higher than severe limitations (WHO–World Bank (2011), Mitra and Sambamoorthi (2014)).¹³ The sample has more females compared to males. Almost 59 percent of the sample has primary education but only 9 percent has any secondary education. Christianity is the most prevalent religion in Malawi with about three-fourth of the sample identifying as Christian. Between 15 to 33 percent of the sample reports having a metal roof – an indicator of relative wealth in this setting.

5. Results

5.1 Path dependence in ADL limitations

As mentioned above, there are noticeable gender gaps in the prevalence of disability across African countries. The gender gap is high in Malawi where the prevalence of disability is 12.5% for women vs. 8.98% for men (Mitra, 2018). The gender disparity in disability also grows larger with age: the prevalence of severe disability is 10 percentage points higher for women than men in the age group of 50-65 years in Ethiopia and Uganda. Similar gender gaps in the prevalence of disability are also noted in Mitra and Sambarmoorathi (2014) and WHO-World Bank (2011). The gender difference in the prevalence of ADL limitations suggests that males and females are likely

¹³ We also examine correlations between any ADL, severe ADL and ADL score used in our analysis with three additional measures on health – self-reported general health status (higher number is associated with poor health), pain interfering with normal work (higher number is associated with pain interfering with normal work), and health interfering with social engagement (higher number is associated with physical or mental health limiting one’s ability to interact socially). We find that all three measures are positively and significantly correlated with all measures of ADLs used in the paper for both males and females. Furthermore, we also examine year by year correlation between these measures over waves/rounds of MLSFH and do not find these correlations to decrease due to learning – these results are available from the authors upon request.

to experience differential levels of path dependence in these limitations. Further, persistence in limitations is also likely to vary by the intensity and severity of these limitations. Hence, we present our results on path dependence in the incidence, intensity, and severity of ADL limitations separately for males and females in Tables 2 and 3 respectively.¹⁴

The OLS estimates on the lagged dependent variable β_1 are reported in Panel A and the preferred Arellano-Bover estimates are reported in Panel B of Tables 2 and 3. The preferred Arellano-Bover estimates account for the presence of time-invariant unobservables by using *changes* in the lagged dependent variable as an instrument for the lagged dependent variable, thereby removing time-invariant unobservables from the instrument. We discuss instrument validity related concerns in Section 6.1 in more detail.

The OLS estimate in Column 1, Panel A of Table 2 suggests that the presence of any ADL limitation among males in one period increases the probability of reporting a limitation in the next period by 24 percentage points. Estimates reported in Columns 2-5 of Panel A, Table 2 also suggest that almost a quarter of the limitations reported in any period are likely to persist into the next period for all measures of ADLs that capture the incidence, intensity, and severity of limitations among males. However, once we account for endogeneity in the lagged dependent variable, the preferred Arellano-Bover estimates in Panel B, Table 2 show that there is no path dependence in any ADL limitation and in the intensity of any ADL limitations as captured by

¹⁴ Table 1 captures the raw data available on mature and old adults in Malawi in each round which includes both males and females 30 years and above. However, for estimating the dynamic model, we need respondents to be present in at least two consecutive rounds for the OLS specification and respondents must be present in at least three consecutive rounds for the Arellano-Bover specification. Therefore, observations in panel A of Tables 2 and 3 correspond to the number of observations available in at least two consecutive rounds. This corresponds to 2096 males in Table 2 and 2836 females in Table 3. In panel B, for our Arellano-Bover estimates, we require each person to appear in at least three consecutive rounds reducing the sample to 1267 such observations among males in Table 2 and similarly, 1673 females in Table 3.

both the number of any ADL limitations and the ADL score variables presented in Panel B, Columns 1, 2, and 5 of Table 2. Except, we do find that the presence of severe ADL limitation in one period increases the probability of reporting a severe ADL limitation in the next period by approximately 12 percentage points (see Panel B, Column 3, Table 2). We also find path dependence in the number of severe ADL limitations (see Panel B, Column 4, Table 2). The preferred Arellano-Bover estimates show that a fifth of the number of severe limitations remain persistent into the next period. The coefficient estimates on both lagged severe ADL and lagged number of severe ADLs are significantly different from zero, rejecting the null of perfect recovery, indicating partial path dependence in severe ADL limitations for males. These results suggest that even though fewer (6%) males in the sample experience severe activity limitations – among those who do, there is evidence of persistence in these limitations.

Similarly, we examine path dependence in the incidence, intensity, and severity of ADL limitations among females. OLS estimates on path dependence are reported in Panel A, Table 3 and our preferred Arellano-Bover estimates are reported in Panel B, Table 3. The OLS estimate in Column 1, Table 3 suggests that the presence of any ADL limitation among females in one period increases the probability of experiencing a limitation in the next period by 17 percentage points. Estimates reported in Columns 2-5 of Panel A, Table 3 also suggest that between one-fifth and one-quarter of the limitations reported in any period is likely to persist into the next period for all measures of ADLs that capture the incidence, intensity, and severity of limitations among females. However, once we account for endogeneity in the lagged dependent variable in our preferred Arellano-Bover estimates reported in Panel B of Table 3, we find that there is no evidence of path dependence in the incidence, intensity, and severity of limitations, as we cannot reject the null of perfect recovery (or no path dependence) at even the 10 percent significance

level. Overall, the findings reported in Tables 2 and 3 suggest that onset of most ADL limitations are transient in nature for both males and females and allows them to recover from these ADL limitations in the short to medium run, except when males experience severe ADL limitations – those become somewhat persistent.¹⁵

Payne, Mkandawire and Kohler (2013) document transition between different states of disabilities using the 2006-2010 rounds of the MLSFH. In line with our findings, the authors find high transition probability between different disability states and note that, “59% experienced at least one and 22% experienced two transitions between different disability states”. For the case of Mexico, Díaz-Venegas and Wong (2016) find that for respondents with one or two limitations in 2001, 18.1% have no limitation in 2012; for those with more severe ADL limitations (three or more) 6.8% recovered completely (no limitation) 8% partially recovered (one or two). However, these analyses do not account for unobserved correlation between current and lagged measures of disability.

Lastly, we also examine the robustness of our results to two types of concerns – Type I error and choice of controls. Type I error increases with multiple outcomes, that is, the probability that we reject the null of no effects increases in the number of outcomes tested. To address this concern, following Anderson (2008) and Dasgupta et al. (2020) we also report the FDR sharpened q -values in square brackets of Tables 2 and 3. Our results remain robust to concerns over Type I error. Health status of other members can induce more burden on the household in terms of stress or physical care requirements which may make the activity limitations more persistent. We

¹⁵ We have very few individuals who report severe limitations in all five periods, only 18 individuals, consistent with our main findings that limitations are largely transient in nature. And only 186 respondents report no ADL limitation in any of the five periods which again points to transitions in and out of limitations making them largely transient.

examine the robustness of our results to inclusion of additional controls related to health status of other members in the household. Specifically, we additionally control for the following two variables in our regressions – (a) a household level per capita measure of illness reported in the past 12 months (excluding the respondent’s own health status) and (b) a per capita measure of the self-reported general health status of all members in the household (again excluding the respondent’s health status). We find that our results are largely robust to the inclusion of these controls. These results are available from the authors upon request.

5.2 Pathways

Our findings on differential persistence in ADL limitations between males and females could be due to pre-existing differences in age and the onset of limitations between genders. To explore this, we examine baseline differences in age and ADL limitations between males and females in our sample. We find that females are on average three years younger than males ($p\text{-value}<0.01$) and that females experience higher baseline disability: females are 9 percent more likely to report any ADL limitation than males ($p\text{-value}<0.01$), females also report 0.15 number of ADL limitations more than males ($p\text{-value}<0.01$), females are 2 percent more likely to report any severe ADL limitation than males ($p\text{-value}<0.01$), however, the number of severe ADL limitations reported by females is not significantly different than males ($p\text{-value}=0.222$). Overall, at baseline, females are younger and report more ADL limitations than males both of which would point to higher catch up among females during the later waves.

Next we examine the impact of lagged any ADL limitation and lagged severe ADL limitation on coping mechanisms such as the amount of help received due to poor health (equals the total number of household members who helped the respondent due to poor health divided by household size), agricultural work (=1 if the respondent reports main occupation as agricultural

work, 0 otherwise), expenditure on health (total medical expenses made by the respondent or respondent's household in past 3 months divided by household size), hours spent on domestic duties (during the last week), and hours spent on unpaid household farm work (during the last week).¹⁶ Any improvement in the coping variables due to onset of ADL limitation can decrease the persistence in ADL limitations over rounds. Table 4 reports these auxiliary regressions of coping variables on lagged ADL are estimated separately for males and females as well as lagged any ADL and lagged severe ADL.

We find that males are more likely to receive help at home and reduce agricultural work after the onset of any ADL limitations and females reduce the number of hours spent on domestic duties due to onset of any ADL limitations and that both males and females spend more on their own health. These results can possibly explain why both males and females experience catch up in the incidence of any ADL limitations. The results in Table 4 also show that onset of severe ADL limitation among males reduces their hours spent on unpaid household farm work alone. On the other hand, females experience a reduction in both the likelihood of working outside and the hours spent on domestic duties as well as unpaid household farm work. This might partly explain why males still experience some persistence in severe limitations whereas females experience no persistence in severe limitations.¹⁷

6. Robustness

¹⁶ Note that data on health expenditure is available in all waves, hours spent on domestic duties and unpaid household farm work is only available during the last three waves, and per capita measure of help received due to poor health is available in the first three waves.

¹⁷ A lot of physical disability is interactional, that is, it depends on personal factors (e.g., age, gender), structural factors (e.g., markets, terrain), and resources (e.g., assets, cane). Therefore it is possible that some limitations disappear not because the health condition fully disappears but because the environment changed (for example, a disabled person could have gotten a cane between rounds and therefore can now go back to tending to their cattle) in way that it no longer causes an activity limitation in which case understanding the changes in environment that make this possible is crucial for disability policy formulation.

6.1 Arellano-Bover – Instrument validity and Serial correlation

In this section, we first show that the instruments used for obtaining the preferred specification are strong. Second, we show that the underlying assumptions necessary for obtaining consistent estimates from the Arellano-Bover specification are valid.

First, the instrument, the change in the dependent variable between periods $t-1$ and $t-2$ (ΔH_{it-1}) must be relevant and strong, that is, the excluded instruments should show strong correlation with the lagged dependent variable (Murray, 2006). The F-statistic on the excluded instruments is reported in Tables 2 and 3 and the associated first-stage regression results are presented in Appendix Tables A2 and A3. The F-statistics presented in Tables 2 and 3 are well above the Staiger and Stock (2003) rule-of-thumb of 10 as well as the Lee et al. (2020) rule of thumb of 104.7 showing that our instrument is relevant and in fact strongly correlated with the lagged endogenous variable. Note that the F statistic on the excluded instruments reported here are the Kleibergen–Paap Wald rk F statistic that is robust to the presence of heteroskedasticity, autocorrelation, and clustering (Kleibergen and Paap, 2006).

Second, our preferred estimates assume the errors specified in levels (see equation 1) to be serially uncorrelated, which implies, the first-differenced residuals should then depict negative first-order serial correlation but no significant second-order serial correlation (Bond, 2002). The Arellano and Bond (1991) m1 and m2 statistics test for first-order and second-order serial correlation in the first-differenced residuals respectively. For all four panels in Tables 2 and 3, the m1 statistic is less than zero and statistically significant rejecting the null of no first-order serial correlation in the first-differenced residual. Additionally, the m2 statistic suggests that we cannot reject the null of no second order serial correlation in the first-differenced residuals. The m1 and m2 statistics together suggest that our preferred specification is valid, that is, the errors in the levels

specification are indeed serially uncorrelated. Therefore, our preferred Arellano-Bover estimates produce consistent results on the lagged dependent variable.

6.2 Attrition

Our analysis is based on an unbalanced sample of adults (above 30 years) followed during the multiple rounds of MLSFH conducted between 2006 and 2013 and attrition related selection could bias the coefficient estimate on the lagged dependent variable. For instance, if individuals with higher incidence of baseline disability were more likely to drop out of the sample due to illness then that would bias the coefficient estimate on the lagged dependent variable downwards. Similarly, if individuals with lower baseline disability were more likely to drop out of the sample due to higher economic activity then that would overestimate the coefficient estimate on the lagged dependent variable. Hence, to rule out attrition related biases we examine if attrition is correlated with baseline disability.

Note that our dynamic preferred Arellano-Bover estimates require that we have data on ADL limitations on at least any three consecutive survey rounds (which could include rounds 1, 2 and 3, or 2, 3 and 4, or 3, 4, and 5, or 1, 2, 3 and 4, or 1, 2, 3, 4 and 5, or 2, 3, 4 and 5), hence, a person gets dropped/attrites from our empirical analysis sample only if they do not appear in any three consecutive rounds (such as those who appear in rounds 1, 2 and 4, or those who appear in rounds 1 and 2 only or those who appear in rounds 1, 2 and 5) and not otherwise. If the respondent appears in rounds 1, 2 and 3 or 2, 3 and 4 or 3, 4 and 5 - they will be part of the non-attrited analysis sample. Hence, in Table 5 we define attrition as a dummy variable that takes a value of 1 if an individual does not appear in any three consecutive time periods, 0 otherwise. We test whether ADL limitations at baseline predict attrition in the sample after controlling for the full set of controls included in Tables 2 and 3. These results are reported below in Table 5. We find no

evidence that baseline ADL limitations predict attrition for males. However, there is some evidence of selective attrition for females. For instance, incidence of severe ADLs in the baseline among females is positively correlated with attrition. As a result, we would expect more women with better baseline health to remain in our sample, decreasing path dependence in severe ADLs among females. Hence our estimates for severe ADLs (both incidence and intensity as measured by severe ADL and no. of severe ADLs) among females are likely to be biased downward, that is, more likely to depict recovery in ADL limitations than actually present in the severe ADL measures used here. Thus, our results on severe limitations among females must be interpreted with caution.

6. Conclusion

We are globally witnessing an epidemiological transition where mortality is declining and morbidity is increasing (Shrestha 2000). This is particularly relevant for a low-income country such as Malawi that does not have pensions and old age support programs. As onset of disability increases with age, in the presence of transitory ADL limitations some of the negative effects associated with the onset of limitations could be reversed.

This paper contributes to the literature on health, disability and African studies by examining the persistence/path dependence in ADL limitations using a dynamic linear panel data model that can account for endogeneity concerns in the lagged dependent variable. We find that for males, there exists persistence in the incidence and severity of severe ADL limitations but full recovery in less severe limitations. We also find full recovery in any and severe limitations among females which can potentially decrease the projected long-term cost of ADL limitations for females.

However, these predictions are based on partial equilibrium findings and the general equilibrium response to physical limitations could differ.¹⁸ For instance, increase in physical limitations in Malawi could decrease household investment in both physical and human capital of aging individuals in the family and thereby depress growth. At the same time, it is also possible that people may start investing in physical health at younger ages to delay the onset of ADL limitations related job losses which might contribute positively to growth as well. Hence, we think the general equilibrium impact of ADL limitations could go in either direction.

Our study focuses on only one measure of disability, that is, ADL limitations. Future research in this area should use data on other measures of disability, and in particular functional difficulties (e.g. seeing, hearing) from developing countries to investigate these topics further. More research is also needed on whether such path dependence in limitations occurs for mental health related concerns. It would also be valuable to examine both the economic (access to pensions and social safety net programs, access to health facilities) and cultural (such as co-residence with children) factors that facilitate recovery in ADL limitations. These questions have received substantial attention from developed countries, but not much from LMICs due to lack of panel data available on ADLs and disability in general.

References

- Altman, B. M. (Ed.). (2016). International measurement of disability: Purpose, method and application, the work of the Washington group. Social indicators research series 61. Springer: Cham.
- Anderson, M. L. (2008). Multiple inference and gender differences in the effects of early intervention: A reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects. *Journal of the American Statistical Association*, 103(484), 1481-1495.

¹⁸ Fried and Lagakos (2020) show that the general equilibrium impacts of power outages on output per worker are much larger than the partial equilibrium impacts of electricity outages.

- Arellano, M., & Bond, S.R. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application of employment equations, *Review of Economic Studies* 58 (3), 277–297.
- Arellano, M., & O. Bover. (1995). Another look at the instrumental variable estimation of error-components models, *Journal of Econometrics*, 68(1), 29-51.
- Bond, S.R. (2002). Dynamic panel data models: a guide to micro data methods and practice, *Portuguese Economic Journal*, 1 (2): 141-162.
- Dasgupta, U., S. Mani, S. Sharma and S. Singhal. (2020). Effects of Peers and Rank on Cognition, Preferences and Personality, *The Review of Economics and Statistics*, Forthcoming. https://doi.org/10.1162/rest_a_00966
- Díaz-Venegas, C., & R. Wong. (2016). Trajectories of limitations in activities of daily living among older adults in Mexico, 2001–2012, *Disability and Health Journal*, 9(3), 524-532.
- Dow, W., P. Gertler, R.F. Schoeni, J. Strauss, & D. Thomas. (1997). Health care prices, health and labor outcomes: Experimental evidence. Labor and Population Program, working paper series 97-01, Rand, Santa Monica CA.
- Eide, A., & A. Munthali. (2018). *Living conditions among persons with disabilities in Malawi* (Rep.). SINTEF.
- Fedorov, L., & D.E. Sahn. (2005). Socioeconomic determinants of children’s health in Russia: a longitudinal study, *Economic Development and Cultural Change*, 53(2), 479-500.
- Field, E., O. Robles, & M. Torero. Iodine deficiency and schooling attainment in Tanzania, *American Economic Journal: Applied Economics* 1.4 (2009): 140-69.
- Filmer, D. (2008). Disability, poverty and schooling in developing countries: Results from 14 household surveys. *The World Bank Economic Review*, 22(1), 141–163.
- Fried, S., & D. Lagakos. (2020). Electricity and Firm Productivity: A General-Equilibrium Approach (No. w27081). National Bureau of Economic Research.
- Government of Malawi. (2017). *The Malawi Growth and Development Strategy (MGDS) III (2017-2022)*. https://www.undp.org/content/dam/malawi/docs/UNDP_Malawi_MGDS%20III.pdf
- Hoogeveen, J. G. (2005). Measuring welfare for small but vulnerable groups: Poverty and disability in Uganda, *Journal of African Economies*, 14(4), 603– 631.
- Kleibergen, F., & R. Paap. (2006). Generalized reduced rank tests using the singular value decomposition, *Journal of Econometrics*, 133 (1), 97–126.
- Kohler, H.-P., S.C. Watkins, J.R. Behrman, P. Anglewicz, I.V. Kohler, R.L. Thornton, J. Mkandawire, H. Honde, A. Hawara, B. Chilima, C. Bandawe, V. Mwapasa, P. Fleming, and L.

- Kalilani-Phiri. (2015). Cohort Profile: The Malawi Longitudinal Study of Families and Health (MLSFH), *International Journal of Epidemiology*, 44(2): 394-404.
- Kohler, I. V., C. Bandawe, Chiwoza, Ciancio, Alberto, Kä mpfen, Fabrice, Payne, Collin, Mwera, James, Mkandawire, James & Kohler, Hans-Peter. (2020) ‘Cohort Profile: The Mature Adults Cohort of the Malawi Longitudinal Study of Families and Health (MLSFH-MAC)’, *BMJ Open* 2020;10: e038232. doi: 10.1136/bmjopen-2020-
- Lee, D.L., J. McCrary, M.J. Moreira, & J.Porter. (2020). Valid t-ratio Inference for IV. arXiv preprint arXiv:2010.05058.
- Loeb, M.E., & A.H. Eide. (2004). *Living Conditions among People with Activity Limitations in Malawi. A National Representative Study*. Oslo, SINFEF.
- Malawi Union for the Blind: Programs. (n.d.). Retrieved September 05, 2020, from <https://mubmalawi.org/about-us/>
- MANAD: Achievements. (2012). Retrieved September 05, 2020, from <http://www.manadmw.org/achievement.htm>
- Mani, S. (2012). Is there complete, partial, or no recovery from childhood malnutrition?—Empirical evidence from Indonesia, *Oxford Bulletin of Economics and Statistics*, 74(5), 691-715.
- Mani, S., J. Hoddinott, & J. Strauss. (2013). Determinants of Schooling – Empirical Evidence from Rural Ethiopia, *Journal of African Economies*, 22(5): 693-731.
- Mani, S., S. Mitra, & U. Sambamoorthi. (2018). Dynamics in health and employment: Evidence from Indonesia, *World Development*, 104, 297-309.
- Mitra, S., A. Posarac, & B. Vick. (2013) Disability and poverty in developing countries: a multidimensional study, *World Development*, 41, 1-18.
- Mitra, S., and U. Sambamoorthi. (2014). Disability prevalence among adults: Estimates for 54 countries and progress toward a global estimate, *Disability and Rehabilitation*, 36, 940–947.
- Mitra, S. (2018). ‘Prevalence of Functional Difficulties. In: Disability, Health and Human Development’, Palgrave Studies in Disability and International Development. Palgrave Pivot, New York.
- Mizunoya, S., & S. Mitra. (2013). Is there a disability gap in employment rates in developing countries?, *World Development*, 42, 28-43.
- Mizunoya, S., S. Mitra, S., & I. Yamasaki. (2016). Towards inclusive education: The impact of disability on school attendance in developing countries. Innocenti (Working Paper No.2016–03). Florence: UNICEF Office of Research.
- Munthali, A., P. Mvula, & S. Ali. (2004). Effective HIV/AIDS and reproductive health information to people with disabilities. Blantyre: FEDOMA.

- Murray, M. P. (2006). Avoiding invalid instruments and coping with weak instruments, *Journal of Economic Perspectives*, 20(4), 111-132.
- National Statistic Office of Malawi. (2018). *2018 Malawi Population and Housing Census*. http://www.nsomalawi.mw/index.php?option=com_content&view=article&id=226&Itemid=6
- Payne, C. F., J. Mkandawire, & H.P. Kohler. (2013). Disability transitions and health expectancies among adults 45 years and older in Malawi: A cohort-based model, *PLoS Medicine*, 10(5), e1001435.
- Shrestha, L. B. (2000). Population Aging in Developing Countries: The elderly populations of developing countries are now growing more rapidly than those in industrialized nations, thanks to health advances and declining fertility rates, *Health Affairs*, 19(3), 204-212.
- Staiger, D., & J. H. Stock. (2003). 'Testing for Weak Instruments in Linear IV Regression', Working Paper Series. Harvard University.
- Stewart, A.L., & J.E Ware. 1992. Measuring functioning and well-being: the medical outcomes study approach. Duke University Press.
- Strauss, J., P. Gertler, O. Rahman, & K. Fox. (1993) 'Gender and Life-Cycle Differentials in the Patterns and Determinants of Adult Health', *The Journal of Human Resources*, 28(4), 791-837.
- United Nations Department of Economic and Social Affairs. (2018). *Disability and Development Report*. <https://www.un.org/development/desa/disabilities/wp-content/uploads/sites/15/2019/07/disability-report-chapter2.pdf>
- UNICEF. (2019). 2018/2019 Disability Budget Brief. <https://www.unicef.org/esa/sites/unicef.org.esa/files/2019-04/UNICEF-Malawi-2018-Disability-Budget-Brief.pdf>
- WHO–World Bank. (2011). World report on disability. Geneva: World Health Organization.
- Wooldridge, J. M. (2002) 'Econometric Analysis of Cross Section and Panel Data', MIT Press, Cambridge, MA.
- Wolfe, B., and J.R. Behrman. (1984) 'Determinants of Women's Health Status and Health Care Utilization in a Developing Country: a Latent Variable Approach', *The Review of Economics and Statistics* 56(4): 696-703.

Table 1: Descriptive statistics

	2006	2008	2010	2012	2013
	Mean	Mean	Mean	Mean	Mean
	(sd)	(sd)	(sd)	(sd)	(sd)
Percent any ADL	0.221 (0.42)	0.281 (0.45)	0.376 (0.48)	0.411 (0.49)	0.423 (0.49)
Number of any ADL	0.339 (0.68)	0.412 (0.71)	0.639 (0.87)	0.674 (0.86)	0.681 (0.86)
Percent severe ADL	0.040 (0.20)	0.062 (0.24)	0.099 (0.30)	0.114 (0.32)	0.108 (0.31)
Number of severe ADL	0.052 (0.27)	0.078 (0.32)	0.145 (0.46)	0.164 (0.49)	0.153 (0.47)
ADL score	0.098 (0.21)	0.122 (0.23)	0.196 (0.29)	0.209 (0.30)	0.209 (0.29)
Percent male	0.476 (0.50)	0.418 (0.49)	0.418 (0.49)	0.428 (0.49)	0.424 (0.49)

Primary education	0.598 (0.49)	0.595 (0.49)	0.631 (0.48)	0.575 (0.49)	0.575 (0.49)
Secondary education	0.089 (0.28)	0.079 (0.27)	0.100 (0.30)	0.063 (0.24)	0.065 (0.25)
Muslim	0.246 (0.43)	0.251 (0.43)	0.247 (0.43)	0.276 (0.45)	0.269 (0.44)
Christian	0.703 (0.46)	0.666 (0.47)	0.695 (0.46)	0.672 (0.47)	0.680 (0.47)
Percent Yao	0.251 (0.43)	0.257 (0.44)	0.247 (0.43)	0.275 (0.45)	0.269 (0.44)
Percent Chewa	0.281 (0.45)	0.306 (0.46)	0.300 (0.46)	0.271 (0.44)	0.271 (0.44)
Percent Tumbuka	0.316 (0.46)	0.285 (0.45)	0.306 (0.46)	0.316 (0.47)	0.322 (0.47)
Percent married	0.914 (0.28)	0.836 (0.37)	0.816 (0.39)	0.768 (0.42)	0.755 (0.43)
Percent with metal roof	0.154 (0.36)	0.206 (0.40)	0.252 (0.43)	0.307 (0.46)	0.333 (0.47)
Age	43.898 (10.47)	49.570 (14.22)	49.643 (14.42)	58.926 (11.62)	59.762 (11.64)
Observations	1913	2731	2686	1264	1254

Table 2: Path dependence in ADL limitations: Males

Panel A: OLS Estimates					
	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
Lagged ADL	0.237*** (0.04) [0.001]	0.238*** (0.04) [0.001]	0.228*** (0.05) [0.001]	0.274*** (0.07) [0.001]	0.288*** (0.05) [0.001]
Observations	2096	2096	2096	2096	2096
R ²	0.42	0.44	0.38	0.42	0.49

Panel B: Arellano-Bover Estimates

	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
Lagged ADL	0.048 (0.06) [0.427]	0.038 (0.06) [0.427]	0.119* (0.07) [0.195]	0.209** (0.08) [0.071]	0.058 (0.06) [0.427]
Observations	1267	1267	1267	1267	1267
R ²	0.40	0.41	0.41	0.44	0.45
F-statistic from first-stage regression	1392.55	928.24	266.01	163.46	402.65
m1 statistic (p-value)	-8.84 (0.00)	-7.80 (0.00)	-5.40 (0.00)	-4.63 (0.00)	-6.90 (0.00)
m2 statistic (p-value)	-1.05 (0.29)	-1.35 (0.18)	-0.68 (0.50)	0.33 (0.74)	-1.47 (0.14)

Notes: Robust standard errors adjusted for clustering at the village level reported in parentheses. The FDR adjusted q-values are reported in square brackets. Controls include time dummies, village-by-time dummies, age and age squared, indicators for primary and secondary schooling completion, indicator for currently married, and dummy variables for religion, ethnicity, and presence of a metal roof. p-value <0.01***, p-value<0.05**, p-value<0.10*. First-stage regressions are reported in Appendix Table A2. Note that the F statistic on the excluded instruments is the Kleibergen–Paap Wald rk F statistic.

Table 3: Path dependence in ADL limitations: Females**Panel A: OLS Estimates**

	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
Lagged ADL	0.171*** (0.02) [0.001]	0.192*** (0.02) [0.001]	0.235*** (0.04) [0.001]	0.277*** (0.05) [0.001]	0.268*** (0.03) [0.001]
Observations	2836	2836	2836	2836	2836
R ²	0.32	0.34	0.32	0.34	0.39

Panel B: Arellano-Bover Estimates

	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
Lagged ADL	-0.011 (0.04) [1.00]	0.020 (0.04) [1.00]	0.041 (0.06) [1.00]	0.051 (0.06) [1.00]	0.030 (0.05) [1.00]
Observations	1673	1673	1673	1673	1673
R ²	0.30	0.31	0.31	0.32	0.34
F-statistic from first-stage regression	3998.78	2812.32	899.35	642.37	1811.67
m1 statistic (p-value)	-10.58 (0.00)	-10.12 (0.00)	-6.93 (0.00)	-6.11 (0.00)	-9.01 (0.00)
m2 statistic (p-value)	0.42 (0.68)	-0.02 (0.99)	0.68 (0.50)	0.38 (0.70)	0.19 (0.85)

Notes: Robust standard errors adjusted for clustering at the village level reported in parentheses. The FDR adjusted q-values are reported in square brackets. p-value <0.01***, p-value<0.05**, p-value<0.10*. See notes in Table 2 for details on control variables. First-stage regressions are reported in Appendix Table A3.

Table 4: Pathways of ADL limitations: Males and Females

Panel A: Males					
	Help received due to poor health (1)	Agricultural work (2)	Expenditure on health (3)	Hours spent on domestic duties (4)	Hours spent on unpaid household farm work (5)
Lagged any ADL	0.019*** (0.01)	-0.054* (0.03)	500.088** (233.53)	-0.217 (0.72)	-1.488 (1.16)
N	1182	1695	2215	1520	1515
Lagged severe	0.027	-0.095	-160.885	-0.857	-5.068***

ADL					
	(0.02)	(0.06)	(665.06)	(1.21)	(1.60)
N	1182	1695	2215	1520	1515
Panel B: Females					
	Help received due to poor health (1)	Agricultural work (2)	Expenditure on health (3)	Hours spent on domestic duties (4)	Hours spent on unpaid household farm work (5)
Lagged any ADL	0.001	-0.000	166.314*	-1.244*	-0.379
	(0.00)	(0.02)	(98.08)	(0.69)	(0.56)
N	1534	2234	2934	2053	2052
Lagged severe ADL	0.003	-0.087**	-116.370	-2.661***	-3.376***
	(0.01)	(0.04)	(176.60)	(0.91)	(1.04)
N	1534	2234	2934	2053	2052

Notes: Every cell contains partial effects from a separate regression of the dependent variable (listed in the 5 columns) on either lagged any ADL or lagged any severe ADL, estimated separately for males and females. These regressions also control for the full set of demographic characteristics: time dummies, village-by-time dummies, age and age squared, indicators for primary and secondary schooling completion, indicator for currently married, and dummy variables for religion, ethnicity, and presence of a metal roof.

Table 5: Sample attrition

Panel A: Males					
	Attrition (1)	Attrition (2)	Attrition (3)	Attrition (4)	Attrition (5)
Any ADL	0.137 (0.14)				
No. of any ADLs		0.075 (0.10)			
Severe ADL			0.453 (0.40)		
No. of severe ADLs				0.353 (0.31)	
ADL score					0.337 (0.34)
Observations	731	731	731	731	731
Panel B: Females					
	Attrition (1)	Attrition (2)	Attrition (3)	Attrition (4)	Attrition (5)
Any ADL	0.036 (0.14)				
No. of any ADLs		0.022 (0.08)			
Severe ADL			0.665 ^{***} (0.23)		
No. of severe ADLs				0.480 ^{***} (0.17)	
ADL score					0.295 (0.25)
Observations	811	811	811	811	811

Notes: Attrition is a dummy that takes value 1 if an individual is not present in at least three consecutive waves and zero otherwise. All ADL measures are from baseline, that is, when the respondent appears for the first time in the analysis panel sample. Robust standard errors adjusted for clustering at the village level reported in parentheses. Controls include village dummies, age, indicators for primary and secondary schooling completion, indicator for Muslim and Christian, indicator for married, and dummy variables for ethnicity, indicator for last two waves and presence of a metal roof. p-value<0.01^{***}, p-value<0.05^{**}, p-value<0.10^{*}.

Appendix Tables

Table A1: Disability among 30+ in Malawi, stratified by gender

Type of Disability	Males		Females		
	Severity of Disability	Incidence of severity	Type of Disability	Severity of Disability	Incidence of severity
Seeing (40.80%)			Seeing (37.60%)		
	Some difficulty with glasses	32.2		Some difficulty with glasses	32.7
	A lot of difficulty with glasses	4.9		A lot of difficulty with glasses	5
	Cannot see at all with glasses	1.4		Cannot see at all with glasses	1.1
Hearing (13.20%)			Hearing (12.9%)		
	Some difficulty with hearing aid	30.5		Some difficulty with hearing aid	33.3
	A lot of difficulty with hearing aid	5.2		A lot of difficulty with hearing aid	6
	Cannot hear at all with hearing aid	1.5		Cannot hear at all with hearing aid	1.2
Walking (19.90%)			Walking (26.4%)		
	Some difficulty	82.7		Some difficulty	84.7
	A lot of difficulty	14.5		A lot of difficulty	13
	Cannot walk	2.8		Cannot walk	2.3
Speaking (4.70%)			Speaking (3.1%)		
	Some difficulty speaking	81.7		Some difficulty speaking	79.9
	A lot of difficulty speaking	11.6		A lot of difficulty speaking	13.3
	Cannot speak	6.7		Cannot speak	6.8
Intellectual (7.70%)			Intellectual (9.8%)		
	Some difficulty	83.1		Some difficulty	83.8
	A lot of difficulty	11.7		A lot of difficulty	11.3
	Cannot do at all	5.2		Cannot do at all	4.9
Self-Care (3.00%)			Self-Care (3%)		
	Some difficulty	69.8		Some difficulty	71.4
	A lot of difficulty	18.7		A lot of difficulty	17.1
	Cannot do at all	11.5		Cannot do at all	11.5

Notes: Author's calculations based on the 2018 Malawi Population and Housing Census. Severity of disability also has other categories under seeing and hearing. For instance, seeing also includes – never used glasses and no difficulty with glasses.

Table A2: First-stage regression results – Males

	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
First-difference in lagged any ADL	0.488*** (0.0131)				
First-difference in lagged number of any ADLs		0.501*** (0.0165)			
First-difference in lagged severe ADL			0.519*** (0.0318)		
First-difference in lagged number of severe ADLs				0.548*** (0.0428)	
First-difference in lagged ADL score					0.511*** (0.0255)
Age	-0.016 (0.0135)	-0.039* (0.0232)	-0.017* (0.0088)	-0.035** (0.0154)	-0.019** (0.0081)
Age squared	0.000** (0.0001)	0.000** (0.0002)	0.000** (0.0001)	0.000** (0.0001)	0.000*** (0.0001)
Primary	-0.068 (0.0425)	-0.125 (0.0771)	-0.040 (0.0302)	-0.061 (0.0484)	-0.046* (0.0266)
Secondary	-0.076 (0.0672)	-0.132 (0.1186)	-0.078** (0.0390)	-0.114** (0.0548)	-0.061 (0.0377)
Married	-0.135 (0.0913)	-0.165 (0.1547)	-0.077 (0.0554)	-0.108 (0.0816)	-0.068 (0.0539)
Wealth indicator: House has metal/tiled roof	-0.004	-0.047	0.008	0.006	-0.010
Constant	0.704 (0.4557)	1.479* (0.7744)	0.470* (0.2632)	0.998** (0.4618)	0.629** (0.2494)
F-statistic	1392.55	928.24	266.01	163.46	402.65
Observations	1267	1267	1267	1267	1267

Notes: Robust standard errors adjusted for clustering at the village level reported in parenthesis. P<0.01***, p<0.05***, p<0.10*. See notes in Table 2 for details.

Table A3: First-stage regression results – Females

	Any ADL (1)	Number of Any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
First-difference in lagged any ADL	0.498*** (0.0079)				
First-difference in lagged number of any ADLs		0.514*** (0.0097)			
First-difference in lagged severe ADL			0.523*** (0.0174)		
First-difference in lagged number of severe ADLs				0.544*** (0.0215)	
First-difference in lagged ADL score					0.526*** (0.0123)
Age	0.020* (0.0109)	0.027 (0.0189)	-0.006 (0.0075)	-0.008 (0.0117)	0.005 (0.0071)
Age square	-0.000 (0.0001)	-0.000 (0.0002)	0.000* (0.0001)	0.000 (0.0001)	0.000 (0.0001)
Primary	-0.037 (0.0312)	-0.067 (0.0580)	0.004 (0.0276)	-0.012 (0.0411)	-0.020 (0.0210)
Secondary	0.028 (0.0774)	0.013 (0.1372)	-0.009 (0.0512)	-0.028 (0.0637)	-0.004 (0.0430)
Married	-0.060* (0.0319)	-0.112** (0.0557)	-0.045* (0.0232)	-0.078** (0.0330)	-0.047** (0.0191)
Wealth indicator: House has metal/tiled roof	0.049 (0.0325)	0.091* (0.0544)	0.020 (0.0190)	0.020 (0.0265)	0.028 (0.0185)
Constant	-0.611* (0.3677)	-0.716 (0.6343)	0.183 (0.2203)	0.208 (0.3408)	-0.130 (0.2213)
F-statistic	3998.78	2812.32	899.35	642.37	1811.67
Observations	1673	1673	1673	1673	1673

Notes: Robust standard errors adjusted for clustering at the village level reported in parentheses. p-value <0.01***, p-value<0.05**, p-value<0.10*. See notes in Table 3 for details.

Table A4: Path dependence in ADL limitations for males and females (45+ years old)

Panel A: OLS estimates for Males					
	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
Coefficient on lagged ADL	0.230*** (0.05)	0.237*** (0.04)	0.225*** (0.05)	0.269*** (0.07)	0.289*** (0.05)
Observations	1770	1770	1770	1770	1770
R ²	0.43	0.45	0.40	0.43	0.50
Panel B: Arellano-Bover estimates for Males					
	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
Coefficient on lagged ADL	0.030 (0.06)	0.030 (0.06)	0.132* (0.07)	0.223** (0.09)	0.059 (0.06)
Observations	1214	1214	1214	1214	1214
R ²	0.40	0.42	0.42	0.45	0.46
F-statistic from first-stage regression	1491.03	1127.42	237.89	143.89	382.07
m1 statistic (p-value)	-8.07 (0.00)	-7.25 (0.00)	-5.02 (0.00)	-4.40 (0.00)	-6.23 (0.00)
m2 statistic (p-value)	-0.30 (0.76)	-0.72 (0.47)	-0.35 (0.72)	0.49 (0.62)	-0.94 (0.34)
Panel C: OLS estimates for Females					
	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number of Severe ADLs (4)	ADL Score (5)
Coefficient on lagged ADL	0.143*** (0.03)	0.180*** (0.03)	0.251*** (0.04)	0.291*** (0.05)	0.270*** (0.03)
Observations	2177	2177	2177	2177	2177
R ²	0.33	0.34	0.35	0.36	0.39
Panel D: Arellano-Bover estimates for Females					
	Any ADL (1)	Number of any ADLs (2)	Severe ADL (3)	Number Severe ADLs (4)	ADL Score (5)
Coefficient on lagged ADL	-0.026 (0.05)	0.004 (0.04)	0.045 (0.06)	0.048 (0.06)	0.015 (0.05)
Observations	1538	1538	1538	1538	1538
R ²	0.31	0.32	0.33	0.33	0.35
F-statistic from first-stage regression	3459.51	2325.72	807.26	534.87	1445.94
m1 statistic (p-value)	-8.68 (0.00)	-8.38 (0.00)	-6.36 (0.00)	-5.51 (0.00)	-7.37 (0.00)
m2 statistic (p-value)	-0.53 (0.59)	-0.066 (0.95)	1.17 (0.24)	1.15 (0.25)	0.85 (0.39)

Notes: Robust standard errors adjusted for clustering at the village level reported in parentheses. p-value <0.01***, p-value<0.05**, p-value<0.10*. See notes in Table 2 for details on control variables.

