Afr. J. Med. Med. Sci. (2017) **46,** 19-29

Contributions of chronic diseases to measured disability in older adults living in Low/middle income countries: a systematic review with syntheses

A Ojagbemi
World Health Organization (WHO) Collaborating Centre for Research and Training in Mental Health, Neuroscience, and Substance Abuse, Department of Psychiatry, College of Medicine, University of Ibadan, Nigeria

Abstract
Background: Due to rapid socio-economic transition and demographic aging, the number of older persons living with chronic diseases is set to increase in low and middle income countries (LMICs). The identification of conditions that may be associated with greater disability burden may help in the prioritization of health policies and allocation of limited resources. However, existing information about the contributions of chronic diseases to disability in older persons living in many LMICs is based on projections from studies conducted in mostly higher income countries. The present systematic review aims to determine the relative contribution of chronic diseases to directly-measured disability in older persons living in LMICs.
Methods: The present systematic review used a simple methodology to estimate the proportions of community-dwelling older persons with a specific chronic disease-disability among all persons with the relevant disease who were participants in studies drawn across LMICs wherein disability was directly measured, rather than implied. Records in the African Journals Online, Medline, EMBASE, PsychINFO, and the Cumulative Index to Nursing and Allied health Literature were searched for relevant citations, and the Pubmed for in-process articles.
Results: Seven cross-sectional surveys including a total of 42,581 community-dwelling older persons met criteria for syntheses. None of the identified studies was based on samples derived from countries in sub-Saharan Africa. Observations are made suggesting that implicit data derived from a global pool of studies may have the potential to mask the true state of the experience of older persons living with chronic diseases in countries with lower research mileages.
Conclusion: Recommendations are made for future designs of studies investigating the impact of chronic diseases on directly-measured disability in LMICs, especially those in sub-Saharan Africa.

Keywords: *Global burden of disease; Population attributable prevalence fractions; Disability adjusted life years; Developing countries*

Résumé
Contexte: En raison de la transition socioéconomique rapide et du vieillissement démographique, le nombre de personnes âgées vivant avec des maladies chroniques devrait augmenter dans les pays à revenu faible ou intermédiaire (PRFI). L'identification des conditions qui peuvent être associées à une plus grande charge d'infirmité peut aider à établir des priorités dans les politiques de santé et à allouer des ressources limitées. Cependant, les informations existantes sur les contributions des maladies chroniques aux handicaps chez les personnes âgées vivant dans de nombreux pays à revenu faible sont basées sur des projections d'études menées dans des pays à revenu plus élevé. La présente étude systématique vise à déterminer la contribution relative des maladies chroniques au handicap mesuré directement chez les personnes âgées vivant dans des pays à faible revenu.
Méthodes: La présente revue systématique a utilisé une méthodologie simple pour estimer les proportions de personnes âgées vivant dans la communauté atteintes d'une maladie-handicap chronique spécifique parmi toutes les personnes atteintes de la maladie concernée qui ont participé aux études menées dans les pays à faible revenu où l'incapacité était mesurée directement plutôt que implicite. Les registres des Revues Africaines en Ligne, Medline, EMBASE, PsychINFO et l'Index Cumulatif de la Littérature sur les soins Infirmiers et connexes ont été recherché pour des citations pertinentes et le Pubmed pour les articles en cours.
Résultats: Sept sondages transversaux, dont un total de 42.581 personnes âgées vivant en communauté, ont satisfait aux critères de synthèse. Aucune des études identifiées n'a été basée sur des échantillons

Correspondence:: Dr. Akin Ojagbemi, Department of Psychiatry, College of Medicine, University of Ibadan, Ibadan Nigeria. E-mail: akin.ojagbemi@kelalumni.net.

provenant de pays d'Afrique subsaharienne. Des observations font ressortir que les données implicites tirées d'une série d'études mondiales risquent de masquer l'état réel de l'expérience des personnes âgées vivant avec des maladies chroniques dans les pays à moindres cadences de recherche.
Conclusion: Des recommandations sont formulées pour la conception future d'études sur l'impact des maladies chroniques sur la déficience mesurée directement dans les pays à faible revenu, en particulier en Afrique subsaharienne.

Mots-clés: *Charge mondiale de maladie; Fractions de prévalence attribuables à la population; Années de vie ajustées d'handicap; Pays en voie de développement*

Introduction

Projections from the World Health Organisation (WHO) Global Burden of Disease (GBD) studies [1-3] suggest that an older person living in Low and Middle Income Countries (LMICs) can expect to spend about half of their remaining life in disability. A substantial portion of this disability will result from chronic diseases such as sensory impairments (vision and hearing), dementia, depression, and many causes of musculoskeletal pain [4].

Currently, demographic aging is increasing rapidly in LMICs. For example, it is estimated that by 2050 the population older than 60 years in countries in the region is expected to have increased from approximately 490 million to nearly 1.6 billion persons [5-7]. The estimated population growth may be explained in part by the global increase in life expectancy and decrease in mortality [8]. In Nigeria, as an example, estimates suggest that despite an average life expectancy at birth of about 52 years [9], the population surviving to the age of 65 years in the country may have the prospect of an additional 15 years of life [10, 11]. As rates of chronic diseases are known to increase with aging [12], the expectation is that the number of persons living with these conditions in LMICs will increase in the coming few years.

Compared with more developed countries, rates of many chronic diseases may also be higher in less developed regions of the world. As an example, age specific stroke rates in a country like Tanzania have been estimated to reach nearly six times the rates in some countries in Western Europe [13]. Perhaps, this is a reflection of differences in access to quality healthcare. Even within LMICs, access to quality healthcare is generally known to be dictated by levels of financial resources [14].

Globally, an important approach to reduce the disability engendered by chronic diseases is the development of effective strategies for their prevention. In this regard, the identification of chronic diseases that may be more associated with disability in older adults is a logical step in the effort at reducing overall burden. This approach may also help in the prioritization of health policies, planning, and allocation of available resource. This is especially important in LMICs where resources for healthcare are limited. However, currently available information about the contributions of chronic diseases to disability in older persons living in LMICs have been based on data extrapolated from a global pool of studies collated in the WHO GBD collaborations.

The GBD estimates are implied, rather than measured, disability indicators extrapolated mostly from studies of incidence and duration of the relevant diseases from across many countries [1]. In the GBD methodology, expert judgements about the global and regional impact of several chronic diseases on disability were made by allocating disorder-specific disability weights, also called the 'implicit societal weighting', to each chronic disease after an 'in-depth' review of all available epidemiological studies of the relevant disease. In this way, projections about the impact of the diseases from higher income countries or those with higher volumes of relevant research are extrapolated to other countries. Not accounted for in these projections are factors such as the rapid epidemiological transition in many developing LMICs relative to more stable dynamics in higher income countries. Also, the natural trajectory of onset and course of some chronic diseases, for example cardiovascular diseases, may differ between developed and less developed countries [13]. The GBD estimates are also limited by the assignment of disability portions to individual chronic diseases independently, and without accounting for the effect of co-occuring conditions. Where as co-morbidities are generally commoner in old age [12].

The present systematic review aims to determine the relative contribution of several chronic diseases to directly-measured, rather than implied, disability in older persons living in LMICs. The review uses a simple methodology of proportions of older persons with a specific chronic disease-disability among all persons with the relevant disease who were participants in studies where disability was directly measured, rather than implied or self-reported.

Materials and methods

Search strategy

This review followed conventional recommendations for the methodology and reporting of systematic reviews [15, 16]. A systematic search of the Medline (Ovid SP-1946-25th November 2015), PsychInfo (Ovid SP 1806-7th October, 2015) EMBASE (Ovid SP 1974-25TH November, 2015), and CINHAL (EBSCO host, 7th October, 2015) databases was conducted using the following keywords with the .mp. and explode operators: 'old age'/ elderly/ aged and 'Chronic diseases'/ 'chronic conditions' and disability/ 'Activities of daily living'/ 'daily life activities'.

Inclusion criteria

Studies were included if; 1), they were peer reviewed, 2), reporting on participants who were 60 years or older, 3), participants were drawn from a country grouped as belonging to LMICs in the WHO and World Bank income categories [17], and 4), included a validated measurement of disability. For the purpose of inclusion, disability was defined as the inability to cope with activities of daily life without assistance.

Exclusion criteria

Studies were excluded if they relied on participants' self-report of disability. An additional exclusion criterion was failure to provide data on the association between individual chronic conditions and disability.

A search of the Pubmed database (1966-2nd October, 2015, repeated for updates on the 4th of January, 2015) was also conducted to retrieve 'in-process' and 'ahead of print' citations. For this, the following key words were combined: ('old age' or elderly or aged) and ('Chronic diseases' or 'chronic conditions') and (disability or 'Activities of daily living' or 'daily life activities'). The same key words were entered into 'advanced search' in the African Journals Online (AJOL) database on the 10th of September, 2016. The database searches were limited to English language and human literature. Limits on publication dates were not imposed. The search strategies for the databases are available from the author.

Ascertainment of risk of bias

A standard framework for assessing biases in studies showing associations between variables [15, 18] was used for judgements about the risk of bias in the selected trials. All 5 steps in the modified Graphical Appraisal Tool for Epidemiologic Studies (GATE) [15, 18] were used for the determination of the risk of bias in each of the identified studies. Step 1 in the modified GATE criteria seeks to determine the external validity of the selected study. For this, key characteristics of the eligible sample in the relevant studies were assessed to determine the level of representativeness of the source population. Steps 2 to 4 of the modified GATE criteria seek to determine the internal validity of the selected study. An assessment of the methods of selection of exposure, outcome measurements, and analytical strategies was conducted. These steps were undertaken to ensure that the associations identified by the respective studies are valid and are not due to unidentified factors that may be related to both exposure and outcome.

Risk of bias was classified as low, unclear/ unknown, and high [15]. Points were allocated to each component of the study as follows: 2 points when the risk of bias was low, 1 point when this was unclear /unknown and no points when the risk of bias was clearly high. Modified GATE step 5 ascertains the overall risk of bias in the selected study. For this, the average risk of bias for a particular study was calculated by summing up the total points accrued by that study and dividing the result by the total number of components assessed. Finally, we classified the overall risk of bias for a particular study as high (when the average risk of bias scores for that study is less than 1), moderate (when this is between 1 and 1.5), and low (when the score is greater than 1.5).

Quantitative syntheses

Previous studies, for example Sousa and colleagues [4], have used the method of Population Attributed Prevalence Fractions (PAPF) or meta-analyses in quantifying disability attributable to individual chronic diseases. These methods rely on the availability of outcome data in both the exposed and unexposed. In the present study, the disability-outcome data for unexposed (i.e., participants not reporting the relevant chronic diseases) were not available from the studies under review. This limitation prevented the calculation of PAPFs of disability by individual chronic disease, or the overall quantitative effect of individual chronic diseases on disability as synthesised across included studies (i.e., those investigating such diseases) using meta-analysis. Given the limitations around the quality of available data, judgement about the contributions of individual chronic disease to disability was made using the proportion of participants with the relevant disease-disability in studies providing data for that disease. Data on the number of participants with individual chronic diseases-disability were first extracted for each study. The proportion of participants who had a named chronic disease-disability was then calculated by dividing the total number of participants with the relevant disease-disability across the relevant studies by the total number of participants with disability, also across

studies. These proportions are presented along with PAPFs generated in a previous study conducted across 7 LMIC [4].

Results

Search results

The combined database searches identified a total of 3,260 records. Notably, the keywords search of the AJOL database produced 'no results'. After removing duplicates in either databases (N=2,101 articles), the titles and abstract of 1,159 articles were screened. A total of 19 articles that might have contained relevant information were retrieved. After reading through their full texts, a further 12 articles were excluded. Four studies [14, 19-21] relied on self report, rather than direct measurement of disability as required for inclusion. The study by Tyrovolas *et al* [22] used a general population sample older than 18 years, rather than 60 years or older as required for inclusion. The remaining 7 studies [10, 23-28] were excluded because they failed to provide appropriate data for the association of individual chronic diseases on disability. Details of included and excluded studies are shown on the flow chart in Figure 1 [16].

Appraisal of studies meeting inclusion criteria

In all, 7 studies [4, 29-34] met criteria for syntheses. The studies were drawn from across 8 LMICs. They included a total of 42,581 mostly female participants with an average age of 73 years (Table 1).

Key information about the studies is presented in Table 2. They were all cross-sectional surveys. In studies where a variety of conditions were investigated in the same survey [4, 29, 30, 32], self report of clinician diagnoses was used in the ascertainment of the presence of a chronic disease. Dementia and depression were often measured using validated tools, rather than self report. All studies in the present review relied on standardized measurements of disability using a variety of methods.

The studies clearly described the source population and sampling frame. Appropriate analytical techniques were used. Most studies derived relative risks or odds ratios for associations between the chronic diseases and disability. However, the study by Hairi et al [31] derived prevalence ratios. That study [31] also made judgements about functional disability relying on a measure of gait and balance [35]. Overall, the combined risk of bias as assessed using the modified GATE criteria was low.

Figure 1: Flow chart for included and excluded studies

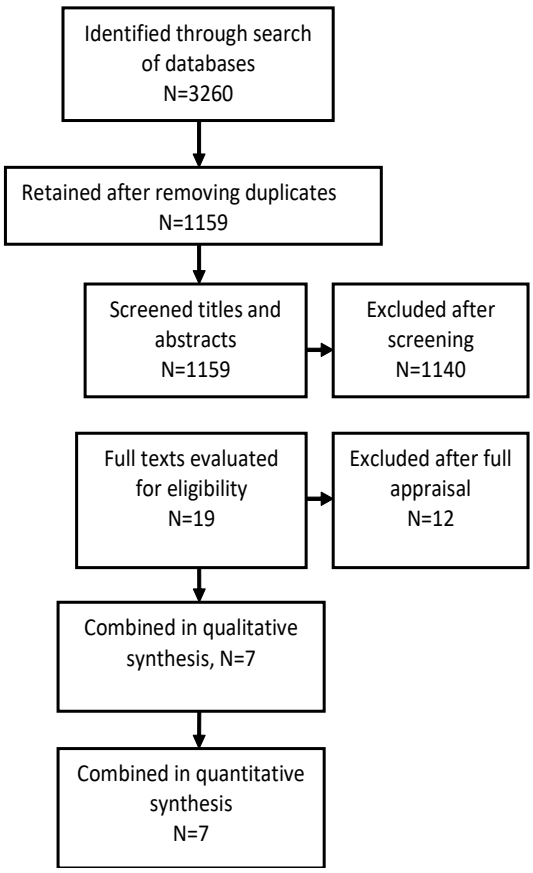

Table 1: Participant characteristics

Reference	Sample sizes	Country	Setting	Female (%)	Average ages
Patel *et al* 2006	15,186	Mexico	Community	54.7	73.0
Sousa et al 2009	15,022	China, India, Cuba, Dominican republic, Venezuela, Mexico, Peru	Community	59.5	73.3
Acosta *et al* 2010	2,111	Dominican republic	Community	65.9	74*
Hairi *et al* 2011	765	Malaysia	Community	62.6	74
Llibre-Rodriguez *et al*, 2011	2,944	Cuba	Community	64.7	74
Duba *et al* 2012	1,000	Rural India	Community	54.6	72.5
Arias-Merino *et al* 2012	5,553	Mexico	Community	61.2	71.6

**Median*

Quantitative estimates of the contributions of chronic diseases to disability in LMICs

The relative contributions of individual chronic disease to directly-measured disability in LMICs as assessed using the proportion of participants who had a named chronic disease-disability is presented in table 3 along with PAPFs calculated for disability due to several diseases in a previous study conducted across 7 LMICs [4]. Also presented in Table 3 are the projected contributions of individual chronic disease to disability according to the GBD estimations [1-3].

Some chronic diseases that were ranked as disability-associated by the GBD estimates, for example malignancies [odds ratio=1.5, 95% C.I=0.9-2.6 [29]] and hypertension [relative risk= 1.0, 95% C.I=0.9-1.1 [30, 32] and relative risk=1.0, 95% C.I=1.0-1.1 [4]] were not found to be statistically associated with functional disability when considering relevant studies using direct measurements. However, there was a consensus on the impact of eye disease and dementia as the highest ranking disability-associated chronic diseases, while cerebrovascular (mostly stroke) and respiratory diseases were lower ranking disability-associated diseases according to direct measurements in studies reporting on samples from LMICs (Table 3).

Discussion

In reviewing existing evidence for the relative contributions of chronic diseases to directly-measured disability in LMICs, some important observations have been made. First, none of the studies meeting inclusion criteria of the present review was based on samples derived from countries or regions in sub-Saharan Africa. It is important to note that two studies from Nigeria [14, 20] were excluded from the final syntheses because they relied on self-report of disability, rather than direct measurement as indicated in the criteria for the present study. The second observation is that some chronic diseases ranked as disability-associated by the GBD estimates were not found to be statistically associated with functional disability when considering relevant studies using direct measurements. Third, there was consensus across studies about the impact of many diseases on disability in older persons living in LMICs. For example, and as estimated by the GBD studies, sensory impairments (especially eye diseases) and dementia were found to be among the highest ranked disability-associated chronic diseases according to direct measurements in studies reporting on samples from the region. Also, across methods (direct measurements or GBD estimations), cerebrovascular (mostly stroke) and respiratory diseases appear to be lower ranking disability-associated diseases in the region.

The first and second observations in the present systematic review would suggest that implicit data derived from a global pool of studies may have the potential to mask the true state of the experience of older persons living with chronic diseases in countries with lower research mileages. In line with this idea, improved data in 2012 [2] and 2014 [36] suggest that the global and regional impact of some conditions on disability in older adults, for example dementia, may have been underestimated previously by the GBD studies. Another important example of the limitation of implicit data in the context of LMICs is the ranking of depression in the GBD studies compared with the status when considering studies

Table 2: Study characteristics

Reference	Study types	Chronic diseases investigated	Outcome measure	Measure of study effect	Strongest association with disability
Patel *et al* 2006	Cross-sectional	Self report of physician diagnoses: Diabetes, cancer, respiratory diseases, heart attack, stroke, and arthritis.	Activities of Daily living (Katz index)	Odds ratio	Stroke
Sousa *et al* 2009	Cross-sectional	Self report of clinician diagnoses: and hearing impairments, arthritis, respiratory, and skin diseases; dementia (DSM IV), depression (ICD-10), Hypertension (sphygmomanometer)	WHO Disability diabetes, stroke, heart disease, vision (WHO-DAS 2.0)	Relative risk	Angina, Dementia assessment schedule
Acosta *et al* 2010	Cross-sectional	Self report of physician diagnoses: Dementia, stroke, myocardial infarction, angina, hypertension, COPD, depression	WHO Disability assessment schedule (WHO-DAS 2.0)	Relative risk	Dementia
Hairi *et al* 2011	Cross-sectional	Depression (Geriatric depression scale)	Tinetti performance oriented mobility assessment tool	Prevalence ratio	Depression*
Llibre-Rodriguez *et al*, 2011	Cross-sectional	Self report of clinician diagnoses of stroke, heart disease, and diabetes. Dementia (Community screening interview for dementia), and Hypertension (sphygmomanometer)	WHO Disability assessment schedule (WHO-DAS 2.0)	Relative risk	Dementia
Duba *et al* 2012	Cross-sectional	Self report of clinician diagnoses of respiratory diseases, hypertension, diabetes, heart diseases, arthritis, vision impairment, stroke, hearing impairments, and skin diseases. DSM IV Dementia, and depression using computer algorithm	WHO Disability assessment schedule (WHO-DAS 2.0)	Odds ratio	Arthritis
Arias-Merino et al 2012	Cross-sectional	Depression (The geriatric depression state)	Activities of Daily living (Katz index)	Odds ratio	Depression*

*COPD= Chronic obstructive pulmonary diseases, WHO= World health organization, DSM IV= Fourth edition of the Diagnostic and Statistical manual of mental disorders, I CD 10= 10TH revision of the International Classification of diseases, *No other chronic condition was investigated*

Table 3: Quantitative syntheses- contributions of chronic diseases to disability in LMICs

Diseases	Proportions with measured-disability among study participants with disease (%)	Ranks	PAPF of disease-disability from 7 LMICs (%)	Ranks	GBD estimates of contributions to total chronic disease-disability (%)	Ranks
Angina	1.2[ab]	Not applicable	Not assessed	Not applicable	Not applicable	Not applicable
Musculoskeletal	33.1	2	9.9	3	8.9	4
Cancers	2.9[ab]	Not applicable	Not assessed	Not applicable	1.1	12
Dementia	11.3	6	25.1	1	10.2	3
Depression	22.5	3	8.3	4	7.3	6
Diabetes	22.5	3	4.1	7	2.6	10
Hearing impairment	13.5	4	2.2	9	11.3	2
Heart disease	11.8	5	0.8	11	7.6	5
Hypertension	74.2[b]	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Respiratory diseases	9.9	7	3.3	8	5.3	7
Cerebrovascular	9.1	8	11.4	2	4.3	8
Eye diseases	39.6[a]	1	6.8	5	33.9	1

PAPF= Population attributable Prevalence Fraction, GBD= Global burden of disease, [a]Reported by one study, [b]Not statistically associated with disability

including samples drawn directly from the region. While primary data suggests that depression may be among the top 3 or 4 disability-associated chronic conditions in LMICs, the ranking in the GBD estimation is 6th. Other studies have also found that some of the highest rates of late-life depression in the world can be found in a countries like Nigeria [37]. In one of the two Nigerian studies excluded from our final syntheses, participants with depression reported themselves as having the most severe disability. It is important to note that in the context of depression people are more likely to have a negative self-perception, and therefore likely to report themselves as having the worse forms of impairments in daily life activities. In the present systematic review, we have focused on studies using directly-measured, rather than self-reported, disability.

Lower ranking diseases (i.e., by relative contributions to directly-measured disability) and conditions not statistically associated with disability in individual studies included in the present systematic review were observed to be those reported to be associated with higher mortality burden in LMICs. Stroke and malignancies, as examples, are known to be associated with relatively higher levels of mortality in LMICs compared with higher income countries [38-40]. Similarly, systemic hypertension which is now one of the leading causes of disease in LMICs [41] has been associated with a high global and regional mortality burden [42]. In circumstances of diseases with relatively high mortality weights, it can be expected that only those with less severe disease, which may or may not be associated with high levels of functional disability, may be available to provide self report of such diseases in surveys conducted in LMICs.

The observations in the present review are made within limitations of the quality of available data. Judgments about the quantitative contributions of the different diseases to disability using the proportion of participants with the relevant disease-disability is unlikely to be as accurate as those derived from more sophisticated methodologies, for example meta-analysis or PAPFs. However, because data for unexposed participants were not provided by individual studies, a formal meta-analysis or the calculation of PAPFs based on each chronic disease could not be implemented. Nevertheless, the qualitative similarities in the overall judgments of the relative contributions of a majority of the diseases to disability across methods of ranking would provide some measure of validity to the simple methodology based on proportion of disease-disability. Similar to the GBD estimates, portions of disability has been allocated to different chronic diseases in the present systematic review without factoring the effect of comorbidities. Whereas the number of co-occuring chronic diseases can be expected to increase with ageing [12]. This can be expected to have additional impact on functional disability over time [43]. Also, while the GBD estimates assume disability occurring overtime all the studies identified for the present systematic review relied on cross-sectional methodologies. Cross-sectional analyses are inadequate in providing strong evidence for the direction of associations between events occurring overtime. The plausible effect of reverse causality between depression and disability, as an example, in cross-sectional surveys may result in larger sizes of association between the two conditions. Similarly, the impact of conditions which may be associated with cummulative disability overtime, for example systemic hypertension, may be under-estimated in cross-sectional analyses. Furthermore, short term relapse and remitting disability, which occurs in some categories of depression [44], may be qualitatively different from the chronically unremitting disability that may be associated with many types of musculoskeletal diseases. In this way, longitudinal investigations of measured disability, conducted in multiple waves may better provide a measure of disease-disability that is qualitatively similar to the conceptual framework of 'years lived with disability' as approximated in the GBD studies.

The present systematic review has strengths and limitations. The search strategy had been designed to be meaningfully sensitive. In this regard, the searches have focused on some of the largest repository of biomedical literature with additional strategy to cover recent citations that might not have been included in the Medline and EMBASE databases, as well as citations of African studies in the AJOL database. On the other hand, manual searches of the references of the appraised articles were not undertaken. An additional limitation of the present review is that the search strategy did not cover grey literature which may be another valuable source of materials dealing with the specific review question.

In concluding, health care resources are limited in many LMICs, especially those in sub-Saharan Africa. Accurate information about the contribution of chronic diseases to disability will help in the planning and prioritization of policies and allocation of scarce resources. Therefore, epidemiological studies estimating the impact of several chronic diseases on directly-measured disability in the older person living in resource poor

countries, such as those located in most of sub-Saharan Africa are urgently needed. Cross-sectional surveys are important. However, the plausible effect of reverse causality between some of the chronic diseases and disability in cross-sectional analyses may result in inaccurate estimates of the impact of the diseases investigated. Thus, longitudinal investigations of the impact of chronic diseases on measured disability will provide better information about the contributions of the conditions to disability in the older person living in LMICs. Apart from the impact of these diseases on incident disability, the possibility of investigating persistence of disability engendered by the different conditions may enable the identification of diseases which may be directly associated with a longer duration of disability, in years. Such longitudinal studies should also investigate the impact of co-occuring chronic diseases on disability over time.

Acknowledgements
The author acknowledges support from the advanced care in dementia programme of the department of Old age Psychiatry, Kings College London.

References

1. Murray C. and A. Lopez The global burden of disease: A comprehensive assessment of Mortality and Disability from diseases, injuries, and risk facotors in 1990 and projected to 2020. 1996, Cambridge MA: Harvard School of Public Health.
2. Murray C.J., Vos T, Lozano R. *et al*., Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet, 2012. 380(9859): p. 2197-223.
3. Global Burden of Disease Study 2013 Collaborators, Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet, 2015. Jun 7. pii: S0140-6736(15)60692-4 [Epub ahead of print].
4. Sousa R.M. Ferri C.P. Acosta D,, *et al*., Contribution of chronic diseases to disability in elderly people in countries with low and middle incomes: a 10/66 Dementia Research Group population-based survey. Lancet, 2009. 374(9704): p. 1821-1830.
5. Strong K., Matherws C, Leeder S, *et al.*, Preventing chronic diseases: how many lives can we save? Lancet, 2005. 366(9496): p. 1578-1582.
6. Velkoff, V.A. and P.R. Kowal, Population aging in sub-Saharan Africa: Demo-graphic dimensions 2006. In: U.S. Census Bureau, ed. Current Population Reports. 2007, Washington, DC: U.S. Government Printing Office.
7. World Health Organisation, 2008-2013 action plan for the Global strategy for the Prevention and Control of Non-communicable diseases. 2008, World Health Organisation: Geneva. p. 42.
8. Wang H., Dwyer-Lindgren L, Lofgren K.T., *et al*., Age-specific and sex-specific mortality in 187 countries, 1970-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet, 2012. **380**(9859): p. 2071-2094.
9. United Nations International Children's Emergency Fund, Country Statistics. 2008.
10. Gureje O., Ogunbiyi A, Kola L. *et al*., Functional disability in elderly Nigerians: Results from the Ibadan Study of Aging. J Am Geriatr Soc, 2006. **54**(11): p. 1784-1789.
11. World Health Organisation, The World Health Report 2008: primary health care- now or never. 2008, World Health Organisation: Geneva.
12. Stenholm S., Westerlund H, Head J., *et al*., Comorbidity and functional trajectories from midlife to old age: the Health and Retirement Study. J Gerontol A Biol Sci Med Sci, 2015. 70(3): p. 332-338.
13. Lawes C.M., Vander Hoorn S, Rodgers A. *et al*., Global burden of blood-pressure-related disease, 2001. Lancet, 2008. 371(9623): p. 1513-1518.
14. Uwakwe R., Ibeh CC, Modebe A.L. *et al*., The epidemiology of dependence in older people in Nigeria: prevalence, determinants, informal care, and health service utilization. A 10/66 dementia research group cross-sectional survey. J Am Geriatr Soc, 2009. 57(9): p. 1620-1627.
15. National Institute for health and Care Excellence, The guidelines manual: process and method guide. 2012, National Institute for health and Care Excellence,: London.
16. Moher D., Liberati A, Tetzlarff JS *et al*., Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. Open Med, 2009. **3**(3): p. e123-30.
17. World Health Organisation, World Health Statistics. 2015, World health Organization: Geneva, Switzerland.
18. Jackson R., Ameratunga S, Broad J. *et al*., The GATE frame: critical appraisal with pictures. Evid Based Med, 2006. 11(2): p. 35-38.

19. Chen H., Wang H, Crimmins E.M. *et al*., The contributions of diseases to disability burden among the elderly population in China. J Aging Health, 2014. 26(2): p. 261-282.
20. Gureje, O., A. Ademola, and B.O. Olley, Depression and disability: comparisons with common physical conditions in the Ibadan study of aging. J Am Geriatr Soc, 2008. 56(11): p. 2033-2038.
21. Mandal P.K., Chakrabarti D, Gosh P. *et al*., Geriatric Disability and Associated Risk Factors: A Community Based Study in a Rural Area of West Bengal, India. India Journal of Medical Sciences, 2010. 35(1).
22. Tyrovolas S., Koyanagi A, Garin N. *et al*., Diabetes mellitus and its association with central obesity and disability among older adults: a global perspective. Exp Gerontol, 2015. 64: p. 70-77.
23. Basu S. and A.C. King, Disability and chronic disease among older adults in India: detecting vulnerable populations through the WHO SAGE Study. Am J Epidemiol, 2013. 178(11): p. 1620-1628.
24. Ferri C.P., Schoenborn C, Kalra I, *et al*., Prevalence of stroke and related burden among older people living in Latin America, India and China. J Neurol Neurosurg Psychiatry, 2011. 82(10): p. 1074-1082.
25. Gupta P., Mani K, Rai S.K, *et al.*, Functional disability among elderly persons in a rural area of Haryana. Indian J Public Health, 2014. 58(1): p. 11-16.
26. Medhi G.K., Hazarika N.C. Borah P.K. *et al*., Health Problems and Disability of Elderly Individuals in Two Population Groups from Same Geographical Location. Journal of the Association of Physicians of India, 2006. 54(7): p. 539-554.
27. Costa e Silva Mdo D., Guimaraes H.A, trindade Fi;ho E.M. *et al.*, Factors associated with functional loss in the elderly living in the city of Maceio, Northeastern Brazil. Rev Saude Publica, 2011. 45(6): p. 1137-1144.
28. Yount K.M., J. Hoddinott, and A.D. Stein, Disability and self-rated health among older women and men in rural Guatemala: the role of obesity and chronic conditions. Soc Sci Med, 2010. 71(8): p. 1418-1427.
29. Patel K.V., Peek M.K. Wong, R, *et al*., Comorbidity and disability in elderly Mexican and Mexican American adults: findings from Mexico and the southwestern United States. J Aging Health, 2006. 18(2): p. 315-329.
30. Acosta D., Rottbeck R. Rodriguez J.G *et al*., The prevalence and social patterning of chronic diseases among older people in a population undergoing health transition. A 10/66 Group cross-sectional population-based survey in the Dominican Republic. BMC Public Health, 2010. 10: p. 344.
31. Hairi N.N., Bulgiba A, Mudla I. *et al*., Chronic diseases, depressive symptoms and functional limitation amongst older people in rural Malaysia, a middle income developing country. Prev Med, 2011. 53(4-5): p. 343-346.
32. Llibre Jde, J., Valhuerdi A, Calvo M. *et al*., Dementia and other chronic diseases in older adults in Havana and Matanzas: the 10/66 study in Cuba. MEDICC Rev, 2011. 13(4): p. 30-37.
33. Arias-Merino, E.D., Mendoza=Ruvalecaba N.M, Ortiz G.G. *et al*., Physical function and associated factors in community-dwelling elderly people in Jalisco, Mexico. Arch Gerontol Geriatr, 2012. 54(3): p. e271-278.
34. Duba A.S., Rajkumar A.P., Prince M. *et al*., Determinants of disability among the elderly population in a rural south Indian community: the need to study local issues and contexts. Int Psychogeriatr, 2012. 24(2): p. 333-341.
35. Tinetti, M.E., Performance-oriented assessment of mobility problems in elderly patients. J Am Geriatr Soc, 1986. 34(2): p. 119-126.
36. GBD 2013 Mortality and Causes of Death Collaborators, Global, regional, and national age–sex specifi c all-cause and cause-specifi c mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet, 2014. Volume 385(9963): p. 117–171.
37. Gureje, O., B. Oladeji, and T. Abiona, Incidence and risk factors for late-life depression in the Ibadan Study of Ageing. Psychol Med, 2011. 41(9): p. 1897-1906.
38. Owolabi M.O., Akarolo-Anthony S, Akinyemi R. *et al.*, The burden of stroke in Africa: a glance at the present and a glimpse into the future. Cardiovasc J Afr, 2015. 26(2 Suppl 1): p. S27-38.
39. Fernandes T.G., Bando D.H. Alencar A.P., *et al*., Income inequalities and stroke mortality trends in Sao Paulo, Brazil, 1996-2011. Int J Stroke, 2015. 10 Suppl A100: p. 34-37.
40. Torre L.A., Siegel R.L., Ward F.M., *et al.*, Global Cancer Incidence and Mortality Rates and Trends-An Update. Cancer Epidemiol Biomarkers Prev, 2015.

41. Norman R., Gaziano T, Laubscher R., *et al*., Estimating the burden of disease attributable to high blood pressure in South Africa in 2000. S Afr Med J, 2007. 97(8 Pt 2): p. 692-698.
42. WangY., Nie X, Chen L. *et al*., Burden of hypertension in China over the past decades: Systematic analysis of prevalence, treatment and control of hypertension. Eur J Prev Cardiol, 2015.
43. Marengoni A., Angleman S., Melis R., *et al*., Aging with multimorbidity: a systematic review of the literature. Ageing Res Rev, 2011. 10(4): p. 430-409.
44. Nuevo R., Leighton C., Dunn G., *et al.*, Impact of severity and type of depression on quality of life in cases identified in the community. Psychol Med, 2010. 40(12): p. 2069-2077.