

**Title:** Anxiety symptoms among informal caregivers in 47 low- and middle-income countries: a cross-sectional analysis of community-based surveys

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## **ABSTRACT**

**Background:** There are no multi-country studies on the association between informal caregiving and anxiety from low- and middle-income countries (LMICs). Therefore, we investigated this relationship in a large predominantly nationally representative sample from 47 LMICs.

**Methods:** Cross sectional data from the World Health Survey were analyzed. Anxiety symptoms referred to severe or extreme problems with worries or anxiety in the past 30 days. Information on caregiving in the past 12 months was obtained. Multivariable logistic regression analysis adjusting for age, sex, marital status, education, household size, employment, disability, and country was conducted. Data on 237,952 individuals aged  $\geq 18$  years [mean (SD) age 38.4 (16.0) years; 50.8% female] were analyzed.

**Results:** After adjustment for potential confounders, caregiving was positively associated with anxiety symptoms (OR=1.52; 95%CI=1.40, 1.65). Greater number of caregiving activities was associated with higher odds for anxiety symptoms dose-dependently, with the OR (95%CI) for engagement in 5 activities (vs. no caregiving) being 2.19 (1.86-2.58).

**Conclusion:** Caregiving is associated with higher odds for anxiety symptoms among adults in LMICs. Given the increasing importance of informal caregivers in long-term care provision and the fact that good health of caregivers is vital to sustain this system, interventions to address mental health of caregivers in LMICs are urgently needed.

**Keywords:** anxiety, caregivers, low- and middle-income countries, epidemiology.

## INTRODUCTION

The global population is ageing at an unprecedented rapid pace. Specifically, between 2015 and 2050, the proportion of the world's population over 60 years is projected to nearly double from 12% to 22%, and 80% of older people will be residing in low- and middle-income countries (LMICs) in 2050 (World Health Organization, 2018). Furthermore, largely as the result of medical advances, people often now live longer than before, but many live with disabilities (Emerson, et al, 2014). High-income countries (HICs), have well-established and often highly functional healthcare systems that can adapt to the health care needs of an increasing ageing population. However, population ageing is also occurring in LMICs (World Health Organization, 2018), where health care systems can be under-resourced, fragmented, and suboptimal (Bitton, et al, 2019).

Globally, older adults and people living with long-term illness or disabilities are often provided informal care. Informal care may be defined as the unpaid care provided to older and dependent persons by a person with whom they have a social relationship, such as a spouse, parent, child, other relative, neighbor, friend or other non-kin (INTERLINKS, 2021). It is possible that there is a particularly heavy reliance on informal care in the context of LMICs as health systems and welfare systems are often not as developed as in HICs (Prince 2004). Thus, it is of vital importance to understand the health conditions of informal caregivers, as the system of caregiving would not be sustainable without the good health of the caregivers, especially in the context of LMICs (Jacob, et al, 2020; Lambert, et al, 2017). For example, previous studies have shown that caregiver ill health may lead to the institutionalization of the care recipients, harmful caregiving behavior, or that caregiving strain may lead to premature mortality of the caregiver (Beach, et al, 2005; Colerick and George, 1986; Lin and Giles, 2013; Schulz and Beach, 1999). Caregiver ill health may arise,

for example, owing to a high need for providing hands-on care that may affect caregiver health through physical strain, changes in health habits, psychological distress, and physiological changes (Pinquart and Sörensen, 2007).

Studies from HICs have shown that caregiving activities are associated with increased risk of mental health problems (Geng, et al, 2018; Loh, et al, 2017; Sallim, et al, 2015) including anxiety (del-Pino-Casado, et al, 2021). Anxiety is often defined as an unpleasant mood characterized by thoughts of worry, and is an adaptive response to perceived threats that can develop into a maladaptive anxiety disorder if it becomes severe and chronic (Barlow, 2004). It is associated with adverse physical health outcomes such as cardiovascular disease (Celano, et al, 2016), sleep disorders (Sleep Foundation, 2020), and premature mortality (Archer, et al, 2020). Caregiving activities may increase risk for anxiety via, for example, physical and psychological strain over extended periods of time accompanied by high levels of unpredictability and uncontrollability (Schulz and Sherwood, 2008), as well as sleep loss and stigma (Koyanagi, et al, 2018; Su and Chang, 2020). With more women joining the working force, and shifts away from institutional care in some countries without adequate community care being provided, it is possible that caregiving is becoming more stressful than before, causing increased anxiety among caregivers. However, while mental health in caregivers such as sleep problems, depression, and perceived stress has been examined in multiple LMICs (Koyanagi, et al, 2018), there are currently no multi-country studies of the general LMIC population on the association between caregiving and anxiety. Community-based studies are important as most previous studies on caregiving and anxiety have only focused on care recipients with a certain disease (e.g., dementia) and this may limit generalizability (del-Pino-Casado, et al, 2021). Furthermore, multi-country studies using standardized methodology across countries are important as contextual factors such as

difference in disease profiles of the care recipient, household size, or availability of social welfare are likely to largely influence anxiety levels among caregivers, and these studies may provide important information for context-specific targeted interventions. Given this background, the aim of the present study was to investigate the relationship between informal caregiving and anxiety symptoms in a community-based sample of 237,952 individuals aged  $\geq 18$  years from 47 LMICs.

## **METHODS**

### *The survey*

The World Health Survey (WHS) was a cross-sectional survey conducted in 70 countries in 2002-2004. Survey details are available elsewhere (Üstün, et al, 2003). Briefly, single-stage random sampling was carried out in 10 countries, while the remaining 60 countries used stratified multi-stage random cluster sampling. All adults aged  $\geq 18$  years with a valid home address were assigned a non-zero chance of inclusion. Standard translation procedures for the survey questionnaire were followed to ensure comparability across countries. Face-to-face interviews and telephone interviews were conducted by trained interviewers. Individual level response rates were over 82%. Post-stratification corrections were made to sampling weights to adjust for non-response and the population distribution reported by the United Nations Statistical Division. Ethical boards at each study site provided ethical approval for the survey with all participants providing informed consent.

Data were publicly available for 69 countries. Of these, 10 countries were excluded due to a lack of sampling information. Furthermore, 10 high-income countries were excluded to focus on LMICs. Moreover, Turkey was deleted due to lack of data on caregiving, while Morocco was deleted due to lack of data on anxiety symptoms. Thus, the final sample consisted of 47 LMICs according to the World Bank classification at the time of the survey (2003). The data were nationally representative for all countries, except for China, Comoros, the Republic of Congo, Ivory Coast, India, and Russia. The list of included countries and their sample sizes can be found in **Table S1** (Appendix).

### ***Caregiving (Exposure variable)***

Those who answered affirmatively to the question “During the past year, did you provide help to a relative or friend (adult or child), because this person has a long-term physical or mental illness or disability, or is getting old and weak?” were considered to be caregivers (Hosseinpoor, et al, 2013). This question is comparable to those used in previous surveys to identify caregivers (Smith, et al, 2014). Furthermore, questions on five types of caregiving activities (personal care, medical care, household activities, supervision, transport/mobility) with “Yes” and “No” answer options were asked to caregivers (See **Table S2** of the Appendix for actual questions). The number of caregiving activities was summed. Non-caregivers were assigned a score of 0.

### ***Anxiety symptoms (Outcome variable)***

Anxiety symptoms were assessed by the question “Overall in the past 30 days, how much of a problem did you have with worry or anxiety?” with answer options being none, mild, moderate, severe, and extreme. In accordance with previous WHS publications, those who answered “severe” and “extreme” were considered to have anxiety symptoms (Koyanagi and Stickley, 2015; Wong, et al, 2013).

### ***Control variables***

The selection of the control variables used in this analysis was based on past literature and included age, sex, marital status (married/cohabiting, never married, separated/divorced/widowed), highest education attained (no formal education, primary education, secondary or high school completed, and tertiary education completed), household size (1, 2, 3-5,  $\geq 6$ ), employment status (not working for pay or currently in paid employment), and disability (Hosseinpoor, et al, 2013; Smith, et al, 2014). Individuals who

had severe/extreme difficulty in either moving around, performing self-care, concentrating/remembering things, or seeing and recognizing a person across the road in the past 30 days were considered to have disability (Mitra and Sambamoorthi, 2014).

### ***Statistical analysis***

Statistical analyses were performed with Stata 14.2 (Stata Corp LP, College station, Texas). The difference in sample characteristics by caregiving status was tested by Student's *t*-test for continuous variables, and Chi-squared test for categorical variables. The associations between the presence of caregiving or the number of caregiving activities (exposures) and anxiety symptoms (dichotomous outcome) were estimated by multivariable logistic regression. The analysis on the presence of caregiving and anxiety symptoms was also stratified by age groups (i.e., 18-44, 45-64,  $\geq 65$  years), sex, and country income levels. We also tested whether there is effect modification by unemployment and education in the association between the presence of caregiving and anxiety symptoms by including product terms of unemployment X caregiving and education X caregiving in the model. These regression analyses were adjusted for age, sex, marital status, education, household size, employment status, disability, and country, except for the sex-stratified analysis which was not adjusted for sex. Adjustment for country was done by including dummy variables for each country as in previous WHS publications (Koyanagi and Stickley, 2015; Koyanagi, et al, 2017).

Next, to assess whether there is between-country heterogeneity in the association between caregiving and anxiety symptoms, we conducted country-wise analysis adjusting for sex and age. The Higgins's  $I^2$  statistic was calculated, which represents the degree of heterogeneity that is not explained by sampling error with values of 25%, 50%, and 75% often being

considered low, moderate, and high level of heterogeneity, respectively (Higgins, et al, 2003). The sample weighting and the complex study design were considered in all analyses. Results from the logistic regression models are presented as odds ratios (ORs) with 95% confidence intervals (CIs). The level of statistical significance was set at  $P < 0.05$ .

## RESULTS

A total of 237,952 individuals aged  $\geq 18$  years [mean (SD) age 38.4 (16.0) years; 50.8% female] were included in the analysis. Overall, the prevalence (95%CI) of caregiving and anxiety symptoms was 19.1% (18.6%, 19.6%) and 11.5% (11.1%, 11.9%), respectively. The sample characteristics are provided in **Table 1**. Compared to non-caregivers, the prevalence of anxiety symptoms, female sex, higher levels of education, having an employment, and disability was higher among caregivers, while they were also slightly younger and more likely to be from middle-sized households. The prevalence of anxiety symptoms increased with increasing number of caregiving activities (**Figure 1**). Specifically, the prevalence of anxiety symptoms in non-caregivers was 10.4% but this increased to 21.4% among those who engage in five caregiving activities. After adjustment for potential confounders, compared to non-caregivers, caregivers had 1.52 (95%CI=1.40-1.65) times higher odds for anxiety symptoms in the overall sample (**Table 2**). No significant effect modifications were observed for education and unemployment in the association between caregiving and anxiety symptoms. The association was similar across all age groups and both sexes. In terms of country income levels, the association was more pronounced in upper middle-income countries than in low-income countries and lower middle-income countries. Compared to engaging in no caregiving activities, a greater number of caregiving activities was associated with significantly higher odds for anxiety symptoms in the adjusted models in a near linear fashion (OR 1.25-2.19) (**Figure 2**). Finally, country-wise analysis showed that caregiving is

positively associated with anxiety symptoms (i.e., OR >1) in the vast majority of countries included in the study although statistical significance was not reached in all countries (**Figure 3**). There was a moderate level of between-country heterogeneity ( $I^2=63.7\%$ ).

## **DISCUSSION**

### ***Main findings***

In this large sample of adults from 47 LMICs, after adjustment for potential confounders, compared to non-caregivers, caregivers had a 1.52 (95%CI=1.40, 1.65) times higher odds of reporting anxiety symptoms in the overall sample. Similar associations were found for different age groups and sex. Upper middle-income countries showed higher odds (OR=1.93) compared to low-income countries (OR=1.48) and lower middle-income countries (OR=1.54). Moreover, importantly, compared to engaging in no caregiving activities, a greater number of caregiving activities was associated with significantly higher odds for anxiety symptoms in a linear fashion. For example, compared to not engaging in any caregiving activities, engagement in five caregiving activities was associated with more than double the odds for anxiety symptoms (OR: 2.19; 95%CI=1.86, 2.58), which was much higher than engagement in only one caregiving activity (OR: 1.25; 95% CI: 1.08, 1.45). Finally, although caregiving was positively associated with anxiety symptoms in the majority of the countries included in our study, a moderate level of between-country heterogeneity was observed.

### ***Interpretation of the findings***

Findings from the present study both support and add to previous literature. They support previous literature, predominantly carried out in single HICs (del-Pino-Casado, et al, 2021), through confirming that a positive association exists between informal caregiving and anxiety

symptoms, and add to this by showing that such an association holds in a very large community-based sample of adults from multiple LMICs. There are several plausible pathways that likely explain a high level of anxiety symptoms among informal caregivers. First, informal caregivers may face financial difficulties, as in many countries, particularly LMICs, little financial support is available. Financial losses may also arise from loss of working hours, and this has been reported to be more severe in caregivers of LMICs compared to HICs (Viana, et al, 2013). Indeed, financial concerns have been reported as a key risk factor for anxiety *per se* (Sun, et al, 2009). Second, caregivers likely experience high levels of psychological distress. Indeed, caregiving creates physical and psychological strain over extended periods of time and is accompanied by high levels of unpredictability and uncontrollability. Caregiving also has the capacity to create secondary stress in multiple life domains (e.g., work and family relationships), and frequently requires high levels of vigilance. Such distress can subsequently increase levels of anxiety (Schulz and Sherwood, 2008). Third, research has shown that informal caregivers are in general more likely to allocate less time to physical activity, hobbies, and their social lives (Rokicka and Zajkowska, 2020). Such a reduction in discretionary leisure time will likely increase risk of anxiety. For example, physical activity may promote neurogenesis, potentially reducing hyperactivity of the sympathetic nervous system affecting abnormalities in the fear conditioning processing. Physical activity also tends to activate anti-inflammatory mechanisms to diminish oxidative stress (Meira Jr, et al, 2020). Moreover, caregiving may impinge on the caregiver's ability to socialize with others, and social interactions in social activities have been shown to aid in the reduction and management of anxiety (Rebar, et al, 2015). Finally, the uncertainty in terms of the outcome of the care receiver's illness and duration of care is likely to induce anxiety in the caregiver.

In our study, we found that caregiving was positively associated with anxiety symptoms in almost all the countries included in our study, but a moderate degree of heterogeneity was found. Although the reasons for this between-country heterogeneity are unknown, it can be related to differences in factors such as the underlying illness of the care recipient, the relation of the caregiver with the care recipients (child or spouse), number of siblings to share caregiving tasks, availability and quality of welfare, and duration/intensity of caregiving activities, which may differ between countries, and may explain this heterogeneity. For example, kinship status has been shown to affect caregiving burden (Viana, et al, 2013), while some illnesses (e.g., dementia) are known to be associated with higher levels of caregiver strain than others (Ory, et al, 1999). In our study, the association between caregiving and anxiety was more pronounced in upper middle-income countries compared to countries with lower income levels, and this suggests that country income may partly explain the between-country heterogeneity observed. Previous studies have also found that caregiving in higher income countries is associated with higher levels of distress (Viana, et al, 2013). This may be related to factors such as fewer siblings to share the caregiving task, and more intense caregiving, or more long-term caregiving due to longer life lived but with disabilities of the care recipient. However, future studies that examine the reasons for the between-country heterogeneity are needed.

### ***Implication of the study findings***

Findings from the present study suggest that informal caregivers residing in LMICs are at high risk of anxiety symptoms. It is important to address anxiety in informal caregivers as poor mental health may result in inability to care, while informal caregivers are essential to maintain adequate health care needs in such settings. It may be prudent to introduce programmes to prevent and manage anxiety among informal caregivers. Importantly, some

randomized controlled trials have shown that interventions may be effective in LMICs for caregivers. For example, the 10/66 Dementia Research Group's 'Helping Carers to care' intervention implemented in India was found to relieve carer strain and/or reduce psychological morbidity. Briefly, this was a community-based intervention provided by a team consisting of Home Care Advisors who were supervised by a counselor and a psychiatrist, focusing on supporting the caregiver through information on dementia, guidance on behavior management, a single psychiatric assessment and psychotropic medication if needed (Dias, et al, 2008). Moreover, programmes to address anxiety among carers may incorporate mind-body exercises that have been shown to be highly beneficial for preventing and managing anxiety (Tsai, et al, 2003). Indeed, such exercises have been found to be feasible for informal caregivers and can be performed with those who are being cared for, thus potentially overcoming discretionary time as a barrier to such activities (Barrado-Martín, et al, 2019). Direct benefits and financial compensation (e.g., state-funded salaries or reimbursements through the health care system) may also alleviate some of the strain of informal caregiving, particularly for those with lower incomes (Rabarison, et al, 2018). Furthermore, it would also be prudent to carry out future research that identifies possible solutions that can be employed to address informal caregiver burden in terms of workload (e.g., shared caregiving roles between family members).

### ***Strength and limitations***

The large sample size and the inclusion of multiple LMICs are clear strengths of the present study. However, findings must be interpreted in light of the study's limitations. First, data were self-reported potentially introducing social desirability and recall bias into the findings. Second, we lacked information on some characteristics of caregiving (e.g., intensity, duration), financial loss associated with caregiving, or the characteristic of the care recipient.

Thus, our estimate for anxiety may be conservative as individuals with very little involvement in caregiving may have been considered to be caregivers. Third, anxiety symptoms were assessed by a single non-validated question in our study. However, the use of extreme categories (i.e., severe and extreme) is likely to have improved specificity. Next, data collection was conducted in 2002-2004. Thus, it is possible for the data to not reflect the current situation. With lowering fertility rates and less family members to share caregiving tasks, increasing life expectancy, and increase in the proportion of women in the work force, it is possible that the association between caregiving and anxiety is now more pronounced. Finally, temporal associations and causality cannot be inferred from our study as the study had a cross-sectional design.

### ***Conclusion***

In our large sample of adults from LMICs, we found that caregiving is associated with higher odds for anxiety symptoms, and that engaging in many caregiving activities is associated with particularly high odds for anxiety symptoms. Given the rapid pace of population ageing in LMICs, the number of caregivers is likely to increase drastically in the coming years in this setting. Thus, more studies to identify effective strategies to reduce caregiving burden and its associated mental health problems in LMICs are needed. This is particularly important given that the system of informal caregiving is not sustainable if the health of caregivers is neglected.

## REFERENCES

- Archer, G., Kuh, D., Hotopf, M., Stafford, M., Richards, M., 2020. Association between lifetime affective symptoms and premature mortality. *JAMA psychiatry*. 77, 806-813.
- Barlow, D.H., 2004. *Anxiety and its Disorders: The Nature and Treatment of Anxiety and Panic*. Guilford press.
- Barrado-Martín, Y., Heward, M., Polman, R., Nyman, S.R., 2019. Acceptability of a dyadic Tai Chi intervention for older people living with dementia and their informal carers. *J. Aging Phys. Act.* 27, 166-183.
- Beach, S.R., Schulz, R., Williamson, G.M., Miller, L.S., Weiner, M.F., Lance, C.E., 2005. Risk factors for potentially harmful informal caregiver behavior. *J. Am. Geriatr. Soc.* 53, 255-261.
- Bitton, A., Fifield, J., Ratcliffe, H., Karlage, A., Wang, H., Veillard, J.H., Schwarz, D., Hirschhorn, L.R., 2019. Primary healthcare system performance in low-income and middle-income countries: a scoping review of the evidence from 2010 to 2017. *BMJ global health*. 4, e001551.
- Celano, C.M., Daunis, D.J., Lokko, H.N., Campbell, K.A., Huffman, J.C., 2016. Anxiety disorders and cardiovascular disease. *Curr. Psychiatry Rep.* 18, 1-11.
- Colerick, E.J. and George, L.K., 1986. Predictors of institutionalization among caregivers of patients with Alzheimer's disease. *J. Am. Geriatr. Soc.* 34, 493-498.
- del-Pino-Casado, R., Priego-Cubero, E., López-Martínez, C., Orgeta, V., 2021. Subjective caregiver burden and anxiety in informal caregivers: A systematic review and meta-analysis. *PloS one*. 16, e0247143.
- Dias, A., Dewey, M.E., D'Souza, J., Dhume, R., Motghare, D.D., Shaji, K.S., Menon, R., Prince, M., Patel, V., 2008. The effectiveness of a home care program for supporting caregivers of persons with dementia in developing countries: a randomised controlled trial from Goa, India. *PloS one*. 3, e2333.
- Emerson, E., Glover, G., Hatton, C., Wolstenholme, J., 2014. Trends in age-standardised mortality rates and life expectancy of people with learning disabilities in Sheffield over a 33-year period. *Tizard Learning Disability Review*.
- Geng, H., Chuang, D., Yang, F., Yang, Y., Liu, W., Liu, L., Tian, H., 2018. Prevalence and determinants of depression in caregivers of cancer patients: A systematic review and meta-analysis. *Medicine*. 97.
- Higgins, J.P., Thompson, S.G., Deeks, J.J., Altman, D.G., 2003. Measuring inconsistency in meta-analyses. *BMJ*. 327, 557-560.
- Hosseinpoor, A.R., Bergen, N., Chatterji, S., 2013. Socio-demographic determinants of caregiving in older adults of low-and middle-income countries. *Age Ageing*. 42, 330-338.

INTERLINKS, 2021. INTERLINKS - A Europe-wide resource that aims to improve long-term care for older people. 2021.

Jacob, L., Smith, L., Jackson, S.E., Shin, J.I., Haro, J.M., Vancampfort, D., Stubbs, B., Koyanagi, A., 2020. Informal caregiving and physical activity among 204,315 adults in 38 low-and middle-income countries: A cross-sectional study. *Prev. Med.* 132, 106007.

Koyanagi, A. and Stickley, A., 2015. The association between sleep problems and psychotic symptoms in the general population: a global perspective. *Sleep.* 38, 1875-1885.

Koyanagi, A., Vancampfort, D., Carvalho, A.F., DeVylder, J.E., Haro, J.M., Pizzol, D., Veronese, N., Stubbs, B., 2017. Depression comorbid with tuberculosis and its impact on health status: cross-sectional analysis of community-based data from 48 low-and middle-income countries. *BMC medicine.* 15, 209.

Koyanagi, A., DeVylder, J.E., Stubbs, B., Carvalho, A.F., Veronese, N., Haro, J.M., Santini, Z.I., 2018. Depression, sleep problems, and perceived stress among informal caregivers in 58 low-, middle-, and high-income countries: a cross-sectional analysis of community-based surveys. *J. Psychiatr. Res.* 96, 115-123.

Lambert, S.D., Bowe, S.J., Livingston, P.M., Heckel, L., Cook, S., Kowal, P., Orellana, L., 2017. Impact of informal caregiving on older adults' physical and mental health in low-income and middle-income countries: a cross-sectional, secondary analysis based on the WHO's Study on global AGEing and adult health (SAGE). *BMJ open.* 7, e017236.

Lin, M. and Giles, H., 2013. The dark side of family communication: a communication model of elder abuse and neglect. *International psychogeriatrics.* 25, 1275-1290.

Loh, A.Z., Tan, J.S., Zhang, M.W., Ho, R.C., 2017. The global prevalence of anxiety and depressive symptoms among caregivers of stroke survivors. *Journal of the American Medical Directors Association.* 18, 111-116.

Meira Jr, C.M., Meneguelli, K.S., Leopoldo, M.P., Florindo, A.A., 2020. Anxiety and Leisure-Domain Physical Activity Frequency, Duration, and Intensity During Covid-19 Pandemic. *Frontiers in Psychology.* 11, 3758.

Mitra, S. and Sambamoorthi, U., 2014. Disability prevalence among adults: estimates for 54 countries and progress toward a global estimate. *Disabil. Rehabil.* 36, 940-947.

Ory, M.G., Hoffman III, R.R., Yee, J.L., Tennstedt, S., Schulz, R., 1999. Prevalence and impact of caregiving: A detailed comparison between dementia and nondementia caregivers. *Gerontologist.* 39, 177-186.

Pinquart, M. and Sörensen, S., 2007. Correlates of physical health of informal caregivers: a meta-analysis. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences.* 62, P126-P137.

Rabbarison, K.M., Bouldin, E.D., Bish, C.L., McGuire, L.C., Taylor, C.A., Greenlund, K.J., 2018. The economic value of informal caregiving for persons with dementia: Results from 38

states, the District of Columbia, and Puerto Rico, 2015 and 2016 BRFSS. *Am. J. Public Health.* 108, 1370-1377.

Rebar, A.L., Stanton, R., Geard, D., Short, C., Duncan, M.J., Vandelanotte, C., 2015. A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. *Health psychology review.* 9, 366-378.

Rokicka, M. and Zajkowska, O., 2020. Informal Elderly Caregiving and Time Spent on Leisure: Evidence from Time Use Survey. *Ageing Int.* 45, 393-410.

Sallim, A.B., Sayampanathan, A.A., Cuttilan, A., Ho, R.C., 2015. Prevalence of mental health disorders among caregivers of patients with Alzheimer disease. *Journal of the American Medical Directors Association.* 16, 1034-1041.

Schulz, R. and Beach, S.R., 1999. Caregiving as a risk factor for mortality: the Caregiver Health Effects Study. *JAMA.* 282, 2215-2219.

Schulz, R. and Sherwood, P.R., 2008. Physical and mental health effects of family caregiving. *Journal of Social Work Education.* 44, 105-113.

Sleep Foundation, 2020. *Anxiety and Sleep.* 2021.

Smith, L., Onwumere, J., Craig, T., McManus, S., Bebbington, P., Kuipers, E., 2014. Mental and physical illness in caregivers: results from an English national survey sample. *The British Journal of Psychiatry.* 205, 197-203.

Su, J. and Chang, C., 2020. Association between family caregiver burden and affiliate stigma in the families of people with dementia. *International journal of environmental research and public health.* 17, 2772.

Sun, F., Hilgeman, M.M., Durkin, D.W., Allen, R.S., Burgio, L.D., 2009. Perceived income inadequacy as a predictor of psychological distress in Alzheimer's caregivers. *Psychol. Aging.* 24, 177.

Tsai, J., Wang, W., Chan, P., Lin, L., Wang, C., Tomlinson, B., Hsieh, M., Yang, H., Liu, J., 2003. The beneficial effects of Tai Chi Chuan on blood pressure and lipid profile and anxiety status in a randomized controlled trial. *The Journal of Alternative & Complementary Medicine.* 9, 747-754.

Üstün, T.B., Chatterji, S., Mechbal, A., Murray, C.J., WHS Collaborating Groups, 2003. The world health surveys [chapter 58]. In: Murray, C. and Evans, D.B. (Eds.), *Health Systems Performance Assessment: Debates, Methods and Empiricism.* World Health Organization, Geneva, Switzerland, pp. 115-126.

Viana, M.C., Gruber, M.J., Shahly, V., Alhamzawi, A., Alonso, J., Andrade, L.H., Angermeyer, M.C., Benjet, C., Bruffaerts, R., Caldas-de-Almeida, J.M., 2013. Family burden related to mental and physical disorders in the world: results from the WHO World Mental Health (WMH) surveys. *Brazilian Journal of Psychiatry.* 35, 115-125.

Wong, K.O., Hunter Rowe, B., Douwes, J., Senthilselvan, A., 2013. Asthma and wheezing are associated with depression and anxiety in adults: an analysis from 54 countries. *Pulmonary medicine*. 2013.

World Health Organization, 2018. *Ageing and health*. 2021.

## **TABLES AND FIGURES**

**Table 1** Sample characteristics (overall and by caregiving)

Characteristic		Overall	Caregiving		P-value <sup>a</sup>
			No	Yes	
Anxiety symptoms	No	88.5	89.6	84.4	<0.001
	Yes	11.5	10.4	15.6	
Age (years)	Mean (SD)	38.4 (16.0)	38.5 (16.4)	38.1 (14.4)	0.036
Sex	Male	49.2	49.6	47.4	<0.001
	Female	50.8	50.4	52.6	
Marital status	Married/cohabiting	66.3	66.1	67.0	0.136
	Never married	23.4	23.4	23.2	
	Separated/divorced/widowed	10.3	10.4	9.8	
Education	No formal	26.1	28.0	16.7	<0.001
	Primary	31.0	30.4	33.8	
	Secondary	33.7	33.0	37.5	
	Tertiary	9.2	8.6	12.0	
Household size	1	3.5	3.6	3.1	<0.001
	2	7.7	7.6	8.6	
	3-5	43.6	43.1	46.4	
	≥6	45.2	45.7	41.9	
Employment	Employed	57.5	57.1	59.3	0.001
	Unemployed	42.5	42.9	40.7	
Disability	No	86.8	87.2	85.3	<0.001
	Yes	13.2	12.8	14.7	

Abbreviation: SD Standard deviation

Data are % unless otherwise stated.

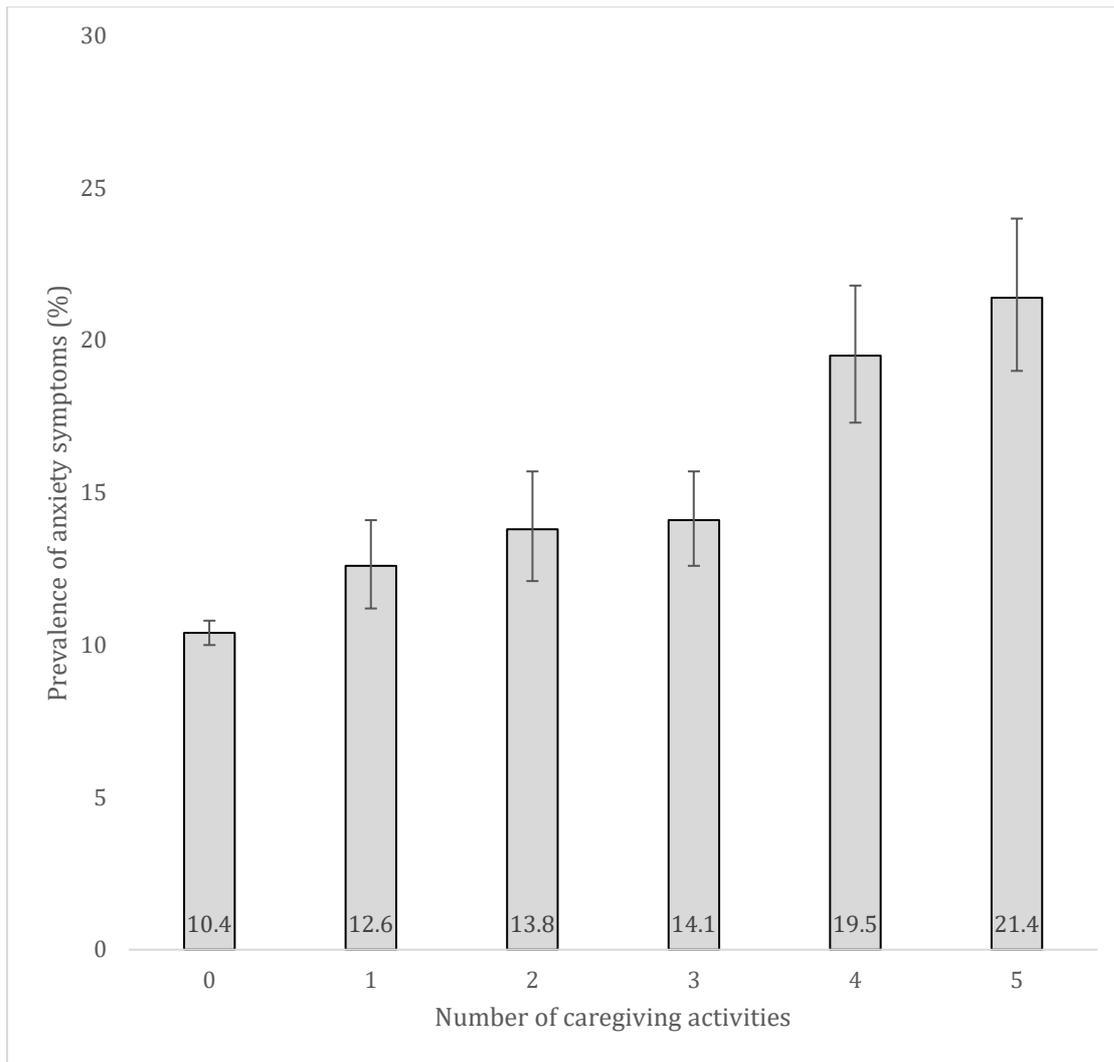
<sup>a</sup>P-value was calculated based on Student's *t*-test for age and on Chi-squared tests for other variables.

**Table 2** Association between caregiving (exposure) and anxiety symptoms (outcome) estimated by multivariable logistic regression

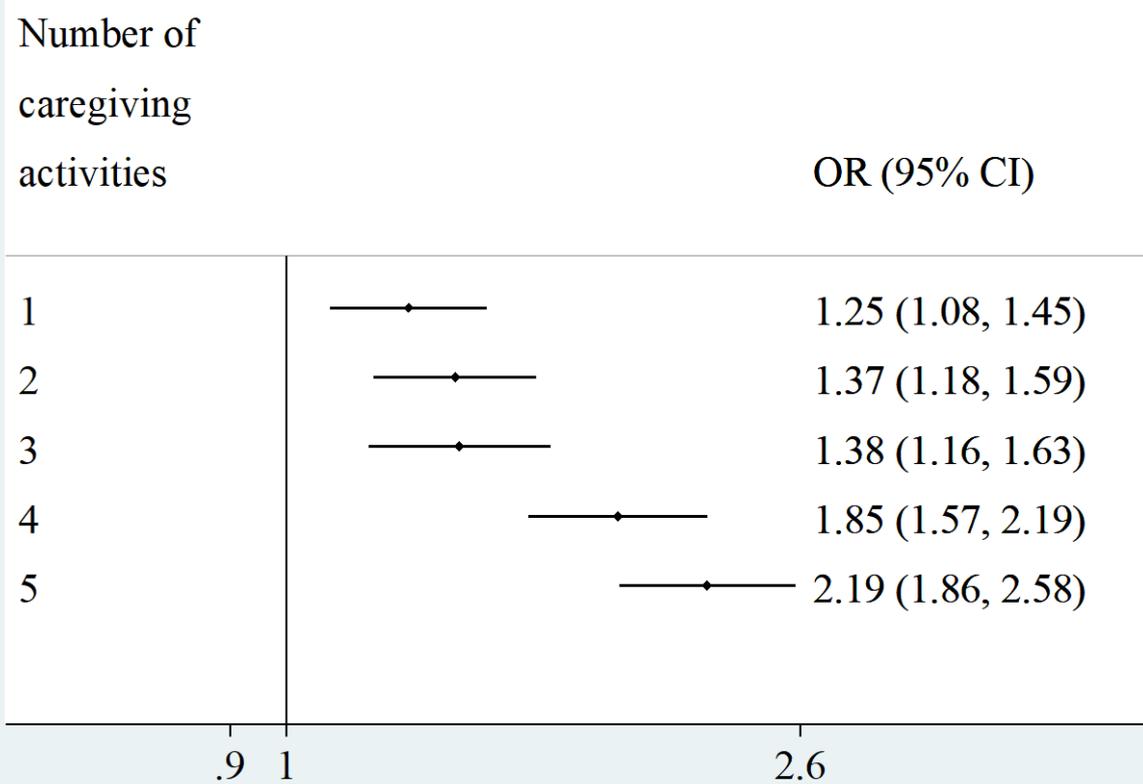
Sample		OR	95%CI	P-value
Overall		1.52	[1.40,1.65]	<0.001
Age (years)	18-44	1.35	[1.21,1.51]	<0.001
	45-64	1.50	[1.21,1.84]	<0.001
	≥65	1.52	[1.23,1.89]	<0.001
Sex	Male	1.49	[1.31,1.69]	<0.001
	Female	1.52	[1.38,1.68]	<0.001
Country income level	Low-income countries	1.48	[1.32,1.66]	<0.001
	Lower middle-income countries	1.54	[1.37,1.74]	<0.001
	Upper middle-income countries	1.93	[1.67,2.23]	<0.001

Abbreviation: OR Odds ratio; CI Confidence interval

Models are adjusted for age, sex, marital status, education, household size, employment status, disability, and country, with the exception of the sex-stratified analysis which was not adjusted for sex.



**Figure 1** Prevalence of anxiety symptoms by number of caregiving activities  
Bars denote 95% confidence interval.



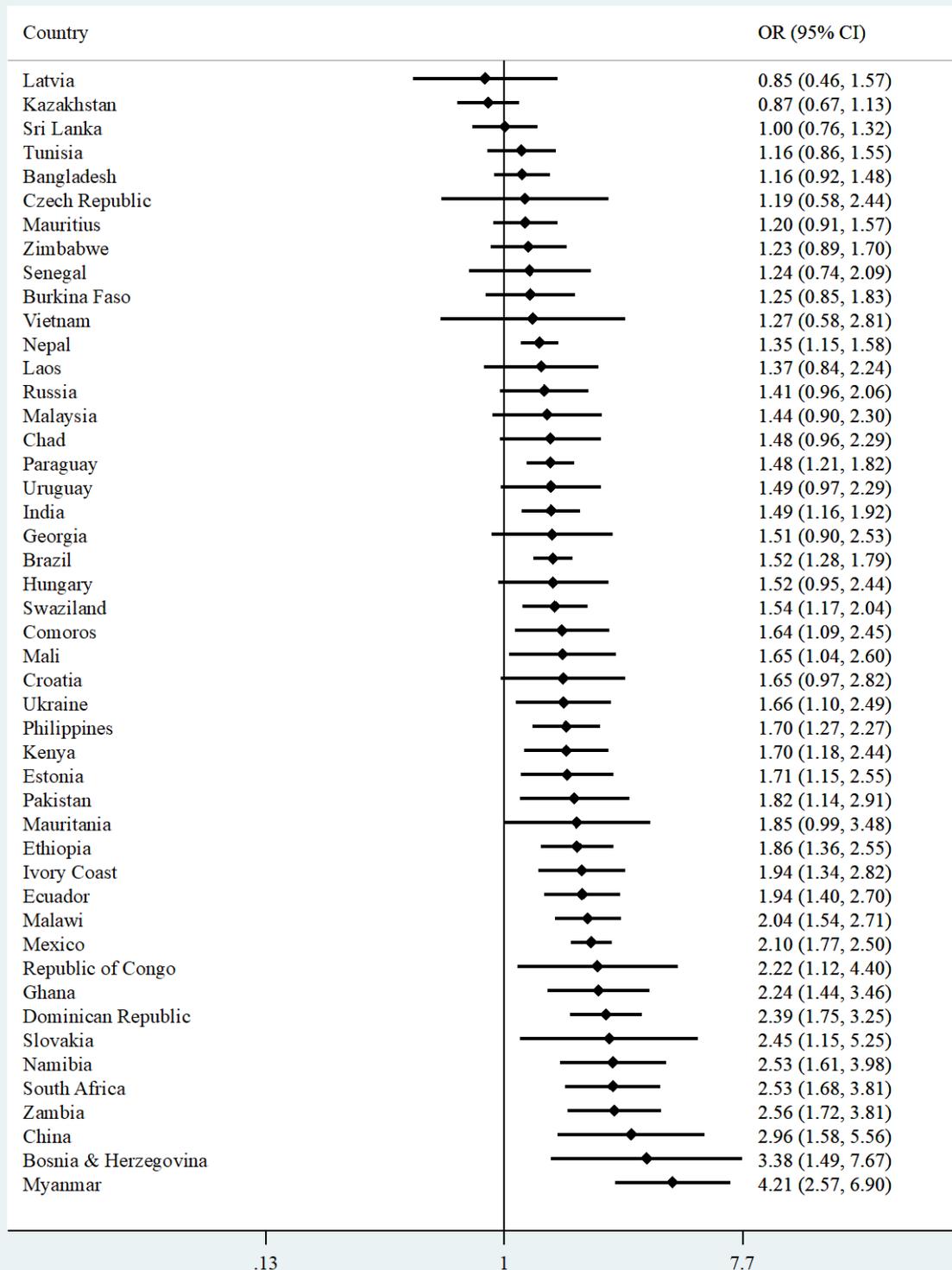
**Figure 2** Association between number of caregiving activities (exposure) and anxiety symptoms (outcome) estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval

Reference category is no caregiving activities.

Model is adjusted for age, sex, marital status, education, household size, employment status, disability, and country.

Chart



**Figure 3** Country-wise association between caregiving (exposure) and anxiety symptoms (outcome) estimated by multivariable logistic regression adjusted for sex and age  
 Abbreviation: OR Odds ratio; CI Confidence interval  
 Overall estimate was obtained by meta-analysis with random effects.

## APPENDIX

**Table S1** Countries included in the study and sample size

Country-income level	Country	N
Low-income countries	Bangladesh	5,942
	Burkina Faso	4,948
	Chad	4,870
	Comoros	1,836
	Ethiopia	5,089
	Ghana	4,165
	India	10,687
	Ivory Coast	3,251
	Kenya	4,640
	Laos	4,988
	Malawi	5,551
	Mali	4,886
	Mauritania	3,902
	Myanmar	6,045
	Nepal	8,820
	Pakistan	6,501
	Republic of Congo	3,075
	Senegal	3,461
	Vietnam	4,174
	Zambia	4,165
Zimbabwe	4,290	
Lower middle-income countries	Bosnia & Herzegovina	1,031
	Brazil	5,000
	China	3,994
	Dominican Republic	5,027
	Ecuador	5,675
	Georgia	2,950
	Kazakhstan	4,499
	Namibia	4,379
	Paraguay	5,288
	Philippines	10,083
	Russia	4,427
	South Africa	2,629
	Sri Lanka	6,805
	Swaziland	3,117
	Tunisia	5,202
	Ukraine	2,860
	Upper middle-income countries	Croatia
Czech Republic		949
Estonia		1,020
Hungary		1,419
Latvia		929
Malaysia		6,145
Mauritius		3,968
Mexico		38,746
Slovakia		2,535
Uruguay		2,996

**Table S2** Questions used to assess type of caregiving

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Please tell me the kind of care you provided (yes/no)

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- (1) You helped with personal care, such as going to the toilet, washing, getting dressed, or eating
  - (2) You helped with medical care, like changing bandages and giving medicines
  - (3) You helped with household activities, such as meal preparation, shopping, cleaning, laundry
  - (4) You watched over them since their behavior can be upsetting or dangerous to themselves or others
  - (5) You helped them to get around outside the home
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