**Physical activity and loneliness among adults aged ≥50 years in six low- and middle-income**

**Countries**

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**Abstract**

*Introduction*: Loneliness is widespread and associated with deleterious outcomes in middle-aged and

older age people in low- and middle-income countries (LMICs). Physical activity is one potential

psychosocial strategy with the potential to reduce loneliness in this population. Thus, the aim of this

study was to explore associations between physical activity (PA) and loneliness in middle-aged and

older people from 6 LMICs.

*Materials and Methods*: Data from the Study on Global Ageing and Adult Health (SAGE) were analyzed. Self-reported data on loneliness and PA (as assessed by the Global Physical Activity Questionnaire) were collected. Participants were dichotomized into those who do and do not meet the international recommendation of 150 minutes of moderate-to-vigorous PA per week. Associations between loneliness and PA were examined using logistic regressions.

*Results*: Among 34,129 individuals aged ≥50 years, the prevalence of loneliness was higher among

those not meeting the PA guidelines in all countries, although this difference was not significant in

Mexico and South Africa. After full adjustment, not meeting PA guidelines was positively associated

with loneliness in the meta-analysis based on country-wise estimates, with a moderate level of between country heterogeneity being observed (OR=1.31, 95% CI=1.07-1.61, *I2*=48.7%). At an individual country level, statistical significance was only reached in Ghana (OR=1.89; 95%CI=1.44-2.49).

*Discussion*: Our data suggest that physical inactivity and loneliness commonly co-occur in adults aged ≥50 years in LMICs overall but that this association differs by country. Longitudinal studies are required to confirm these findings, and investigate potential mechanisms that may inform future interventions.

**Keywords:** loneliness; physical activity; mental health; physical health; elderly

**Introduction**

Loneliness is defined as a distressing feeling that accompanies the perception that one’s social needs

are not being met in terms of the quantity or especially the quality of one’s social relationships1.

Loneliness is synonymous with perceived, but not objective social isolation. People can live rather

solitary lives but not feel lonely, and conversely, those with a rich social life can still feel lonely 2.

Loneliness can be a transient state, but also a long-lasting perception3 with negative cognitive, mental

and physical health consequences4-6. Several psychobiological processes including neuroendocrine

dysregulation, exaggerated blood pressure and inflammatory reactivity to acute stress7 have been

suggested as underlying mechanisms explaining the association between loneliness and mental and

physical health problems8. It is also possible that poorer health behaviors, such as not meeting

international physical activity recommendations of at least 150 minutes of moderate-to-vigorous

physical activity per week (i.e. physical inactivity), might be central to the association between

loneliness and mental and physical health problems4. The literature exploring the bi-directional

associations between loneliness and physical inactivity is however inconsistent, with some studies

indicating no association9,10, while other studies have shown that physical inactivity is associated with

increased feelings of loneliness11,12. Health and sport psychology research has shown that the context

of physical activity can facilitate, for example, the development of an individual’s social support network, which might reduce feelings of being lonely11. On the other hand, it has been suggested that feelings of loneliness are accompanied by lower levels of self-regulation and incapacity to adequately regulate one’s feelings, emotions and behavior, which in turn can result in a diminished likelihood of performing health enhancing behaviors, such as being sufficiently physically active13.

Associations between loneliness and physical inactivity are increasingly being recognized in

middle-aged (50-64 years) as well as older (≥65 years) people14. These people are at both a higher risk of feeling lonely and of engaging in lower levels of physical activity due to declining physical

capacities15,16. In a cross-sectional analysis of the English Longitudinal Study of Ageing (ELSA)

including 136 men and 131 women aged ≥50 years, loneliness was associated with low levels of

physical activity as assessed by wrist-mounted accelerometers in univariate analyses, but not in

multivariate analyses controlling for poor health, mobility limitations and depressive symptoms17. In a

longitudinal analysis of the ELSA over 10 years in 3,392 men and women aged ≥52 years, only

social isolation but not loneliness was related to low levels of physical activity18. In a random sample of 1663 older Israeli adults aged ≥65 years, loneliness contributed significantly to explaining the self reported level of participation in physical activity in women, but not in men.19 However, to date,

associations between loneliness and physical activity have not been explored in middle-aged and older adults in low- and middle-income countries (LMICs).

Exploring associations between loneliness and physical inactivity in LMICs is important given

(a) different levels of knowledge regarding the benefits of physical activity; (b) different sociocultural

attitudes towards physical activity (e.g., being active as a sign of poverty); (c) differences in availability

and accessibility of community and care facilities for older people, and (d) different environmental

factors (e.g., safety, climate, built environment) in LMICs compared with high-income countries20-22.

Moreover, due to the fact that working-age people often relocate to urban centers in many LMICs to

seek employment, social support networks for older people in rural areas are weakening at a rapid

pace22. Therefore, the aim of the current study was to assess the cross-sectional associations between loneliness and not meeting the international recommendation of at least 150 minutes of moderate-to vigorous intensity physical activity in middle-aged and older people in six LMICs (China, Ghana, India, Mexico, Russia, South Africa), which comprise a large proportion of the world population, and are representative of diverse geographical locations and socioeconomic status. It was hypothesized that not meeting the international physical activity recommendation would be positively related to loneliness.

Factors that might confound any association between physical activity and loneliness were taken into

account. For example, socioeconomic status was considered to be an important confounder for its

association with physical activity levels23 and the fact that it partly explains links between social

isolation/loneliness, disease risk24 and premature mortality25. Health conditions (i.e., chronic physical

conditions, depression) were also adjusted for as poor health may limit the capacity for being physically active26-28 and induce loneliness29. Furthermore, depression can lead to low physical activity, while loneliness is known to be highly prevalent among older people with depression30,31. We also adjusted for setting (i.e., rural or urban) as it is known that older people living in cities are often less physical active32, while urban living may influence loneliness.33-35 Finally, we adjusted for household size (1, 2, ≥3) and social cohesion in the community to assess the independent effect of loneliness regardless of social ties.

**Methods**

***The survey***

Data from the Study on Global Ageing and Adult Health (SAGE) were analyzed. These data are

publically available through http://www.who.int/healthinfo/sage/en/. This survey was undertaken in

China, Ghana, India, Mexico, Russia, and South Africa between 2007 and 2010. Based on the World

Bank classification at the time of the survey, Ghana was the only low-income country, and China and

India were lower middle-income countries although China became an upper middle-income country in

2010. The remaining countries were upper middle-income countries.

Details of the survey methodology have been published elsewhere36. Briefly, in order to obtain

nationally representative samples, a multistage clustered sampling design method was used. The

sample consisted of adults aged ≥18 years with oversampling of those aged ≥50 years. We only used

the data from those aged ≥50 years. Trained interviewers conducted face-to-face interviews using a

standard questionnaire. Standard translation procedures were undertaken to ensure comparability

between countries. The survey response rates were: China 93%; Ghana 81%; India 68%; Mexico 53%; Russia 83%; and South Africa 75%. Sampling weights were constructed to adjust for the population structure as reported by the United Nations Statistical Division. Ethical approval was obtained from the WHO Ethical Review Committee and local ethics research review boards. Written informed consent was obtained from all participants.

***Physical activity (exposure)***

Physical activity levels were assessed with the Global Physical Activity Questionnaire37. The total

amount of moderate-to-vigorous physical activity in a typical week was calculated based on self-report. Those scoring ≥150 minutes of moderate-to-vigorous intensity physical activity were classified as meeting the recommended guidelines (coded=0), and those scoring <150 minutes were classified as not meeting the recommended guidelines (coded=1) (physical inactivity)38.

***Loneliness (outcome)***

Loneliness was assessed with the question “Did you feel lonely for much of the day yesterday?” with

answer options ‘yes’ or ‘no’.

***Covariates***

The selection of the control variables was based on previous literature 17,27 and included age, sex,

wealth quintiles based on country-specific income, highest level of education achieved (primary,

secondary, tertiary), marital status (married/cohabiting, never married, separated/divorced/widowed),

unemployment (engaged in paid work ≥2 days in last 7 days: Y/N), setting (rural, urban), household

size (1, 2, ≥3), number of chronic physical diseases, social cohesion, and depression. The total number of chronic physical conditions (angina, arthritis, asthma, chronic back pain, chronic lung disease, diabetes, edentulism, hearing problems, hypertension, stroke, visual impairment) was summed for each individual. Chronic back pain was defined as having had back pain everyday during the last 30 days. Respondents who answered ‘yes’ to the question “Have you lost all of your natural teeth?” were considered to have edentulism. The participant was considered to have hearing problems if the interviewer observed this condition during the survey. Visual impairment was defined as having extreme difficulty in seeing and recognizing a person that the participant knows across the road 39. Diabetes and stroke were solely based on lifetime self-reported diagnosis. Details on the definitions used for the other chronic conditions can be found in **eTable 1** of the Appendix. As in a previous SAGE publication 40, a social cohesion index was created based on 9 questions on the participant’s involvement in community activities in the past 12 months (e.g., attended religious services, club, society, union etc) with answer options ‘never (coded=1)’, ‘once or twice per year (coded=2)’, ‘once or twice per month (coded=3)’, ‘once or twice per week (coded=4)’, and ‘daily (coded=5)’. The answers to these questions were summed and later converted to a scale ranging from 0-100 with higher scores corresponding to higher levels of social cohesion (Cronbach’s α=0.78). Questions based on the World Mental Health Survey version of the Composite International Diagnostic Interview 41 were used for the endorsement of DSMIV depression.

***Statistical analysis***

The analysis was restricted to those aged ≥50 years. The difference in the prevalence of loneliness by

meeting or not meeting physical activity recommendations was tested by Chi-squared tests.

Multivariable logistic regression analysis was conducted to assess the association between not meeting the physical activity recommendation (exposure) and loneliness (outcome) by country, while adjusting for age, sex, wealth, education, marital status, unemployment, setting, household size, chronic physical diseases, social cohesion index, and depression (fully adjusted model). In order to assess the influence of each covariate used for adjustment in the association between not meeting the physical activity recommendation and loneliness, we also constructed models where each of the covariates were included individually in the model and compared how the estimates change compared with the univariable model. This analysis was not conducted for Mexico and South Africa as the univariable association was not statistically significant. Also, we assessed whether the association between not meeting the physical activity recommendation and loneliness differs by middle-aged (i.e., 50-64 years) and older (i.e., ≥65 years) people by including an interaction term [i.e., age (i.e., 50-64 or ≥65 years) X physical activity] in the fully adjusted model of each country.

Furthermore, in order to assess the between-country heterogeneity that may exist in the

association between not meeting the physical activity recommendation and loneliness, we calculated

the Higgins’s *I*2 based on estimates of the fully adjusted model for each country. The Higgins’s *I*2

represents the degree of heterogeneity that is not explained by sampling error with a value of <40%

often considered as negligible and 40-60% as moderate heterogeneity 42. A pooled estimate was

obtained by random-effect meta-analysis. All variables were included in the models as categorical

variables with the exception of age, number of chronic physical conditions, and the social cohesion

index (continuous variables). The sample weighting and the complex study design were taken into

account in all analyses. Results from the regression analyses are presented as odds ratios (ORs) with

95% confidence intervals (CIs). The level of statistical significance was set at P<0.05.

**Results**

Data for 34,129 individuals aged ≥50 years were available (China 13,175; Ghana 4,305; India 6,560;

Mexico 2,313; Russia 3,938; South Africa 3,838). Values for loneliness were missing from 2.3%, 0.6%, 0.2%, 4.7%, 3.2%, and 5.6% of the individuals from China, Ghana, India, Mexico, Russia, and South Africa, respectively. The corresponding figures for physical activity were 3.7%, 1.4%, 0.2%, 4.5%, 2.1%, and 5.8%, respectively. The sample characteristics of each country are presented in **Table 1**. The average age (years) ranged from 61.5 (India) to 63.9 (Russia), while the percentage of males ranged from 38.9% (Russia) to 52.4% (Ghana). Furthermore, the prevalence of loneliness and not meeting the physical activity recommendation ranged from 5.5% (China) to 17.8% (India) and 20.2% (Russia) to 50.9% (South Africa), respectively. In all countries, the prevalence of loneliness was higher among those not meeting the physical activity recommendation, although this difference was not statistically significant in Mexico and South Africa (**Figure 1**). The association of not meeting the physical activity recommendation and covariates with loneliness estimated by multivariable logistic regression is shown in **Table 2**. After full adjustment, the countrywide meta-analysis found that not meeting the physical activity recommendation was significantly associated with loneliness (with the overall estimate being OR=1.31 (95%CI=1.07-1.61; P=0.010) (**Figure 2**), with a moderate level of heterogeneity between countries (*I2*=48.7%). On an individual country level, all countries except South Africa found trend-level associations between not meeting the physical activity recommendation and loneliness, although statistical significance was only reached in Ghana (OR=1.89; 95%CI=1.44-2.49). There was no significant interaction for the association between not meeting the physical activity recommendation and loneliness by age groups (i.e., 50-64 or ≥65 years) for any of the countries, and the overall OR obtained by meta-analysis for those aged 50-64 and ≥65 years were 1.22 and 1.27, respectively (**eFigure 1** of the Appendix). The change in the estimates for the association between not meeting the physical activity recommendation and loneliness when each covariate was included individually in the unadjusted model is shown in **Table 3**. In China, adjustment for marital status rendered the significant univariable association non-significant, while in India, statistical significance was lost after adjustment for age or chronic physical conditions. In Russia, factors such as age, unemployment, chronic physical conditions, and social cohesion were the most influential factors. Finally, in Ghana, the most influential factor was unemployment.

**Discussion**

***General findings***

To the best of our knowledge, this is the first multi-national study and the first in LMICs to explore

associations between meeting the international physical activity recommendation and loneliness in

community-dwelling middle-aged and old age people. Our study shows that the prevalence of loneliness was significantly higher among those not complying with the international recommendation of at least 150 minutes of moderate-to-vigorous physical activity in a week in all countries with the exception of Mexico and South Africa. Our study demonstrates that even following adjustment for physical and mental co-morbidity, socioeconomic status, setting, household size and social cohesion in the community, a positive association between not meeting the physical activity recommendation and loneliness is observed in all countries except South Africa although statistical significance was only reached in Ghana (OR=1.89; 95%CI=1.44-2.49). There was a moderate level of between-country

heterogeneity with the overall estimate based on a meta-analysis being OR=1.31 (95%CI=1.07-1.61).

One of the reasons why in some countries such as India and Mexico no significant association was

found might be due to the fact that the response rate across these countries was quite low (i.e. 53% in

Mexico and 68% in India). This may have affected the results if lonely people and/or those with

inadequate physical activity levels were less likely to participate. The lack of consistency of our findings and the observed moderate level of between-country heterogeneity emphasize the need to consider potential moderators and mediators in this relationship. Specifically longitudinal research is required to clearly delineate whether loneliness leads to physical inactivity or vice versa and if so, identify the conditions under which physical inactivity leads to feelings of loneliness, and conversely, under which conditions loneliness might result in a lack of physical activity. Some clues that may explain the observed between-country difference were identified in our study. For example, factors such as marital status may be important in this association in China, while key factors in India and Russia may be age and chronic physical conditions.

Marital status has often been considered a factor related with loneliness and inactivity in China

with married older people whose spouses are still alive reporting the lowest level of loneliness and

physical inactivity43,44. Family fragmentation due to migration to large urban centers and emigration of

young people together with the ‘one child’ policy has resulted in the declining number of potential

caregivers and the availability of support for older people45. This may be why marital status was a

particularly strong influential factor in China.

In India and Russia, age and the presence of chronic physical conditions are important factors

that should be considered. It can be hypothesized that differences in access to health care services, in particular for old age people, plays a role. For instance, Mexico has introduced policies which have

resulted in dramatic progress in achieving universal health coverage which increased access to

affordable health care services for older people, while public spending on health care remains low in

India at about 1% of the Gross Domestic Product with only a minority of the population being covered

by any form of social or voluntary health insurance46. High out-of-pocket expenditures for outpatient

visits are observed in India, while hospital visits can also lead to high expenditure in Russia preventing people from seeking aid for their mental and physical health problems46. Moreover, in India, existing public health systems are perceived as overburdened and insensitive towards older people47. The difficulty in accessing affordable mental and physical health care in these countries may lead to a greater level of loneliness.

In Ghana and Russia, unemployment was identified as an important factor. Future research

should explore why unemployment, for example due to retirement, is an influential factor in the

association between physical activity and loneliness in these two countries. At least, it is known that

middle-aged and old age people in LMICs who are employed are more physically active.48,49

Speculatively, employment may offer opportunities for social connection, enhance social functioning

and consequently provide more opportunity to be active, to feel as a meaningful contributor to society

and to feel less lonely 50-52.

Social cohesion was a particularly strong confounder in Russia. In the decades following the

collapse of the Soviet Union, the Russian population has experienced sharp fluctuations in its socioeconomic well-being53. Extensive socioeconomic changes since the 1990s included the removal of many state provided social security entitlements53. Specifically, in an uncertain socio-economic

environment where many of the social safety nets have been removed, and where there is widespread distrust of the state, having a trusted social network within the community has become increasingly important54. It might be hypothesized that older people who feel that they live in a neighborhood where they have a trusted and engaged social network feel safer, and less lonely than elderly people who lack social cohesion55.

***Limitations and future research***

Our findings should be interpreted in the light of several potential limitations. First of all, the study is

cross-sectional, therefore the directionality or causality of the relationships cannot be deduced.

Longitudinal and intervention studies are required to better disentangle the relationships observed. For example, future research should examine the relationships between physical activity-generated

benefits and feelings of loneliness. However, regardless of causality, the mere co-existence of not

complying with the recommended physical activity levels and loneliness in middle-aged and old age

people in LMICs is likely to be deleterious to health as they are both independently associated with

adverse physical and mental health outcomes. Second, physical activity was measured with a self report questionnaire, which, although validated56, is known to be less accurate than objective

assessments57,58. It is well known that self-reported measures can overestimate physical activity

levels59. Accelerometers-inclinometers are available that provide a valid and reliable assessment. Third, the loneliness variable was based on a single-item question but it has been previously reported that single-item questions produce similar findings to multiple-item scales60. Relatedly, our measure on loneliness was only based on ‘yes’ and ‘no’ answer options. Thus, we were unable to assess how

increasing levels of loneliness are associated with physical activity. Fourth, previous research has

shown for example that personality traits such as shyness and introversion are linked to loneliness61.

However, these factors could not be examined in this study due to an absence of data.

**Conclusion**

The current study provides multi-national evidence from LMICs on the relationship between physical

activity levels and loneliness in middle-aged and old age people. Programs focusing on loneliness and inactivity in middle-aged and old age people should consider country-specific factors (e.g., marital

status in China), socio-cultural factors (e.g., social cohesion in the community) and underlying physical and mental health problems.

**Competing interests**

None.

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**Author’s contribution**

AK, EL and DV conceived the study idea, analyzed and interpreted the data, and wrote the main body

of the text. The other authors contributed to the drafting of the manuscript, interpreted the data, and

commented for intellectual content. All authors read and approved the final manuscript.

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**Data availability statement**

Data from the Study on Global Ageing and Adult Health (SAGE) were analyzed. These data are

publically available through <http://www.who.int/healthinfo/sage/en/>.

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