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Association between self-reported visual symptoms (suggesting cataract) and self-reported fall-related injury among adults aged ≥ 65 years from five low- and middle-income countries

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BACKGROUND: Cataracts may increase risk for falls but studies on this topic from low- and middle-income countries (LMICs) are scarce. Therefore, we examined the cross-sectional association between self-reported visual symptoms (suggesting cataract) and self-reported injurious falls in nationally representative samples of adults aged ≥ 65 years from five LMICs (China, Ghana, India, Mexico, and Russia).

METHODS: Data from the WHO Study on global AGEing and adult health (SAGE) were analysed. Self-reported information on past 12-month fall-related injury and cataract based on symptoms were collected. Multivariable logistic regression and meta-analyses were conducted to assess associations.

RESULTS: Data on 13,101 people aged ≥ 65 years were analysed [mean (SD) age 72.5 (11.3) years; 45.2% males]. The overall prevalence of self-reported fall-related injury and visual symptoms (suggesting cataract) were 4.9% and 29.4%, respectively. There was a positive association between self-reported visual symptoms (suggesting cataract) and fall-related injury (i.e., OR > 1) in all five countries but statistical significance was reached in three: China (OR = 1.60; 95% CI = 1.08–2.35), India (OR = 1.96; 95% CI = 1.15–3.35), and Russia (OR = 3.58; 95% CI = 2.06–6.24). The pooled OR including all five countries based on a meta-analysis was OR = 1.88 (95% CI = 1.32–2.68).

CONCLUSIONS: Self-reported visual symptoms (suggesting cataract) were associated with higher odds for self-reported injurious falls among older adults in LMICs. Expanding availability of cataract surgery in LMICs may also have the additional benefit of reducing falls among older people.

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INTRODUCTION

Falls are a major public health issue especially in the older population. The probability of falling increases with age, and each year, a third of community-dwelling older adults fall [1–3]. Falls are responsible for approximately 80% of disability from unintentional injuries in adults aged ≥ 50 years (excluding traffic accidents) [4], while falls are also the main cause of injury-related fatalities in older adults [5]. Moreover, injurious falls pose a significant economic burden. For example, in 2000, the U.S. health care system spent $19 billion on direct medical costs of injurious falls [6]. Indeed, hip fractures, which are commonly associated with falls, cost the U.S. health care system over $8.7 billion per year [7].

Given the rapid ageing of populations globally, and that older adults are at greatest risk of falling, the incidence of falls and fall-related injury are likely to increase substantially in the coming

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years. This is particularly true for low- and middle-income countries (LMICs), where 80% of older people will be living by 2050 [8]. Thus, it is of utmost importance to identify potentially modifiable risk factors of falls or fall-related injury among older adults, especially in the context of LMICs, to establish effective interventions or policies.

While many risk factors of falls have been identified among older adults (e.g., impaired cognition, physical frailty) [9–12], one understudied potentially modifiable risk factor is that of cataract. Cataract refers to a clouding or loss of transparency of the lens in the eye because of tissue breakdown and protein clumping and is an age-related condition. The prevalence of cataract has been reported to be high (17.2%) [13]. Importantly, over 90% of people with visual impairment due to cataract live in LMICs [14], and over 90% of cataract cases are concentrated in individuals aged ≥ 50 years in LMICs [15]. The symptoms of cataract include blurry, misty vision and eventual blindness. Indeed, age-related cataract is one of the leading causes of visual impairment worldwide [16]. Cataracts can potentially increase fall risk via reduced vision increasing one's risk of succumbing to trip hazards [17, 18]. Cataracts can be cured via surgical procedures, and in a meta-analysis on the effects of cataract surgery on falls, based on six quasi-experimental studies, a reduction in the frequency of falls was observed (RR = 0.68; 95% CI = 0.48–0.96), while one randomised controlled trial reported a risk reduction of 34% (RR = 0.66; 95% CI = 0.45–0.96) [19].

Currently, several studies mainly from high-income countries exist on the association between cataracts and falls among community-dwelling adults. For example, one study from Australia including 3299 adults aged ≥ 49 years found that the presence of posterior subcapsular cataract had a statistically significant association with two or more falls (prevalence ratio 2.1; 95% CI = 1.0–4.3), while another study from Australia including 2594 adults aged ≥ 40 years found that nuclear cataract was significantly related to self-reported falls at home in the past month (OR = 2.87, 95% CI = 1.78–4.67) [20, 21].

The few community-based studies from LMICs have found higher odds for falls among people with cataracts in Brazil [22], Indonesia (only men) [23], and China [24]. However, these studies from LMICs have important limitations; they were mostly of a small sample size, some were not designed to specifically investigate the association between cataracts and falls, and all were single country studies.

It is clear that there is the need to conduct more robust studies on this topic from LMICs as the majority of people with visual impairment due to cataract live in such settings, where access to cataract surgery is often restricted by a limited number of eye care facilities, poor awareness of services, and high user fees and costs of transport [14]. Furthermore, it is possible for the association in LMICs to differ from that of high-income countries, since known risk factors for falls such as low levels of education and wealth, poor housing conditions, poor lighting, and uneven sidewalks are more common in LMICs [25, 26]. Moreover, multi-country studies are needed as they allow for the comparison of standardised estimates across countries and can thus inform targeted intervention and policy.

Given this background, the aim of the present study was to examine the cross-sectional association between self-reported visual symptoms (suggesting cataract) and self-reported injurious falls in 13,101 people aged ≥ 65 years from five LMICs (China, Ghana, India, Mexico, and Russia).

METHODS

The survey

Secondary data analysis of the Study on Global Ageing and Adult Health (SAGE) was conducted. The main aim of the survey was to obtain valid and comparable information on health and wellbeing among the adult population. This survey was conducted in China, Ghana, India, Mexico, Russia, and South Africa between the years 2007 and 2010. These countries represent different geographical regions as well as economic development, and demographic and health transition. Furthermore, two of the most populous countries in the world were included (i.e., China and India). Based on the World Bank classification at the time of the survey, Ghana and India were a low-income country and a lower middle-income country, respectively, while Mexico, Russia, and South Africa were all upper middle-income countries. China was a lower middle-income country at the beginning of the survey but became an upper middle-income country in 2010. Details of the survey methodology have been published elsewhere [27]. In brief, to obtain nationally representative samples, a multistage clustered sampling design method was employed. The sample consisted of adults aged ≥ 18 years with oversampling of people aged ≥ 50 years. Trained interviewers conducted face-to-face interviews using a standard questionnaire. Standard translation procedures were undertaken to ensure comparability between countries. Computer-assisted personal interviews (CAPI) were conducted in half of the interviews in China, and the other half was completed using paper and pencil. Mexico used only CAPI, while the other four countries used paper and pencil format for all interviews. 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.

Self-reported fall-related injury

The variable on self-reported fall-related injury was derived from questions of the WHO guidelines on injuries [28]. First, the participant was asked "In the past 12 months, have you had any other event (other than a road traffic accident) where you suffered from bodily injury?" Those who answered affirmatively were prompted to the next question "What was the cause of the injury?" If there were multiple injuries, the respondent was instructed to refer to the most recent injury. If the respondent answered "Fall", then he or she was considered to have had a fall-related injury in the past year.

Self-reported visual symptoms (suggesting cataract)

In accordance with a previous SAGE publication [29], self-reported visual symptoms (suggesting cataract) was defined as answering affirmatively to the following two questions: "In the last 12 months, have you experienced cloudy or blurry vision?" and "In the last 12 months, have you experienced vision problems with light such as glare from bright lights, or halos around lights?"

Control variables

The control variables were selected based on past literature [28, 30], and included age, sex, highest level of education achieved (< or ≥ secondary), wealth quintiles based on income, marital status (married/cohabiting or else), setting (urban or rural), alcohol consumption in the past 30 days (yes or no), obesity, and number of chronic physical conditions (apart from cataract). Obesity was defined as a body mass index of ≥ 30 kg/m^2 based on measured weight and height. The total number of chronic physical conditions was calculated (angina, arthritis, asthma, stroke, diabetes, chronic lung disease, hypertension, chronic back pain, or hearing problems) and classified as 0, 1, and ≥ 2. The details on the diagnosis of these conditions are provided in Table S1 (Appendix).

Statistical analysis

The statistical analysis was done with Stata 14.2 (Stata Corp LP, College station, Texas). The analysis was restricted to those aged ≥65 years. Although data for South Africa was available, due to the very low prevalence of self-reported fall-related injuries in this country, stable estimates could not be obtained. Thus, South Africa was omitted from the analysis. The difference in sample characteristics between those with and without self-reported visual symptoms (suggesting cataract) was calculated with Chi-squared tests, except for age (Student's *t*-test), which was a continuous variable. Country-wise multivariable logistic regression analysis [31] was conducted to assess the association between self-reported visual symptoms (suggesting cataract) (exposure) and self-reported fall-related injury (outcome), while adjusting for age, sex, education, wealth,

Table 1. Sample characteristics (overall and by self-reported visual symptoms (suggesting cataract)).

			Self-reported visual symptoms (suggesting cataract)		
Characteristic		**Overall**	**No**	**Yes**	***P*-value[a]**
Age (years)	Mean (SD)	72.5 (11.3)	72.2 (11.0)	73.2 (11.6)	0.001
Sex	Male	45.2	47.6	39.4	<0.001
Education	<Secondary	63.3	58.5	73.9	<0.001
	≥ Secondary	36.7	41.5	26.1	
Wealth	Poorest	21.7	20.3	24.8	0.016
	Poorer	21.1	20.8	21.7	
	Middle	20.5	20.3	20.9	
	Richer	17.4	18.7	14.4	
	Richest	19.2	19.9	18.2	
Married/cohabiting	Yes	61.4	65.5	52.0	<0.001
Setting	Rural	49.8	44.8	61.3	<0.001
	Urban	50.2	55.2	38.7	
Alcohol consumption	Yes	14.0	15.7	9.7	<0.001
Obesity	Yes	9.3	9.1	9.9	0.634
No. of chronic	0	19.7	19.8	19.5	0.021
physical conditions	1	31.5	33.1	27.7	
	≥ 2	48.8	47.1	52.9	

SD Standard deviation.
Data are % unless otherwise stated.
[a]*P*-value was calculated by Chi-squared tests except for age (Student's *t*-test).

marital status, setting, alcohol consumption, obesity, and number of physical chronic conditions. Overall estimates were obtained based on country-wise estimates by meta-analysis with random effects. In order to assess the degree of between-country heterogeneity in the association between self-reported visual symptoms (suggesting cataract) and self-reported fall-related injury, we calculated the Higgin's I^2 based on country-wise estimates. This represents the degree of heterogeneity that is not explained by sampling error with values of 25%, 50%, and 75% often being considered as low, moderate, and high levels of heterogeneity [32]. 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 two-sided $P < 0.05$.

RESULTS

A total of 13,101 people aged ≥ 65 years from five countries were included in the analysis. The sample size of each country were: China $n = 5360$; Ghana $n = 1975$; India $n = 2441$; Mexico $n = 1375$; Russia $n = 1950$. The overall prevalence of self-reported fall-related injury and self-reported visual symptoms (suggesting cataract) were 4.9% and 29.4%, respectively. The sample characteristics based on the overall sample are provided in Table 1. The mean (SD) age was 72.5 (11.3) years and 45.2% were males. Those with self-reported visual symptoms (suggesting cataract) were significantly more likely to be older, be females, have lower levels of education and wealth, and be from a rural setting, while they were also significantly less likely to consume alcohol and be married/cohabiting. Furthermore, they were significantly more likely to have multiple chronic physical conditions. The sample characteristics by country are shown in Table 2. The prevalence of self-reported injurious falls ranged from 2.3% in Russia to 7.2% in India, while that of self-reported visual symptoms (suggesting cataract) ranged from 14.5% in China to 50.8% in India. Overall, the prevalence of self-reported fall-related injury among those with and without self-reported visual symptoms (suggesting cataract) was 8.4% and 3.5%, respectively. The corresponding figures by country are provided in Fig. 1. The prevalence of self-reported injurious falls was higher in those with self-reported visual symptoms (suggesting cataract) compared to those without this condition. Particularly strong contrasts were observed in countries such as Russia (5.4% vs. 1.5%) and India (9.8% vs. 4.6%). The results of the country-wise association between self-reported visual symptoms (suggesting cataract) and self-reported fall-related injury estimated by multivariable logistic regression are shown in Fig. 2. There was a positive association between self-reported visual symptoms (suggesting cataract) and self-reported fall-related injury in all countries (i.e., OR > 1). Statistical significance was reached in China, India, and Russia where the ORs ranged from 1.60 to 3.58. The overall estimate based on a meta-analysis was OR = 1.88 (95% CI = 1.32–2.68) with a moderate level of between-country heterogeneity being observed ($I^2 = 47.8\%$).

DISCUSSION

Main findings

In our study including a large nationally representative sample of adults aged ≥ 65 years, nearly a third of the population had symptoms compatible with cataracts, while almost 5% had a self-reported injurious fall in the past year. Overall, the prevalence of self-reported fall-related injury among those with self-reported visual symptoms (suggesting cataract) was much higher than in those without (8.4% vs. 3.5%). Country-wise estimates adjusted for potential confounders showed that self-reported visual symptoms (suggesting cataract) are positively associated with self-reported fall-related injury in all countries (i.e., OR > 1), with a particularly strong association being observed in Russia (OR = 3.58; 95% CI = 2.06–6.24). Overall, self-reported visual symptoms (suggesting cataract) were associated with a nearly two-fold higher odds for self-reported fall-related injury (OR = 1.88; 95% CI = 1.32–2.68), with a moderate level of between-country heterogeneity being observed ($I^2 = 47.8\%$). To the best of our

Table 2. Sample characteristics by country.

Characteristic		China	Ghana	India	Mexico	Russia
Injurious falls	Yes	4.4	3.1	7.2	4.6	2.3
Self-reported visual symptoms (suggesting cataract)	Yes	14.5	22.7	50.8	21.8	22.5
Age (years)	Mean (SD)	72.3 (11.0)	74.1 (14.1)	71.6 (10.0)	74.7 (15.9)	74.2 (10.4)
Sex	Male	46.6	52.0	52.0	45.1	31.8
Education	<Secondary	72.6	85.3	82.4	87.1	16.5
	≥ Secondary	27.4	14.7	17.6	12.9	83.5
Married/cohabiting	Yes	73.4	50.8	60.9	54.2	42.1
Setting	Rural	45.1	59.5	70.5	21.4	26.0
	Urban	54.9	40.5	29.5	78.6	74.0
Alcohol consumption	Yes	17.1	26.6	5.5	11.4	20.7
Obesity	Yes	5.4	7.2	2.2	23.2	28.8
No. of chronic	0	16.3	22.5	30.3	13.3	8.9
physical conditions	1	37.7	45.5	32.5	44.5	18.6
	≥ 2	46.0	32.0	37.2	42.2	72.5

SD Standard deviation.
Data are % unless otherwise stated.

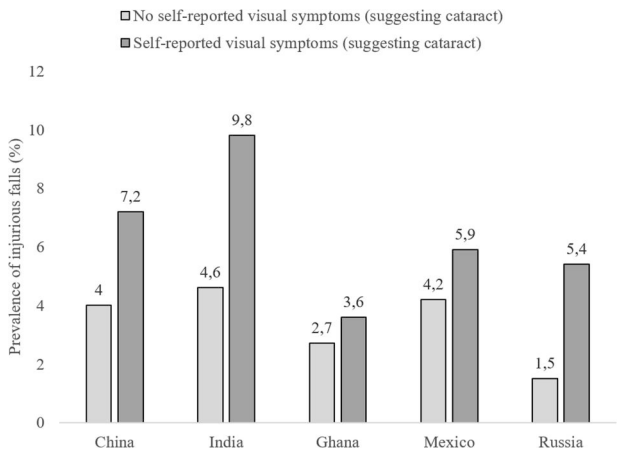

Fig. 1 Prevalence of fall-related injury by presence or absence of self-reported visual symptoms (suggesting cataract) (by country).

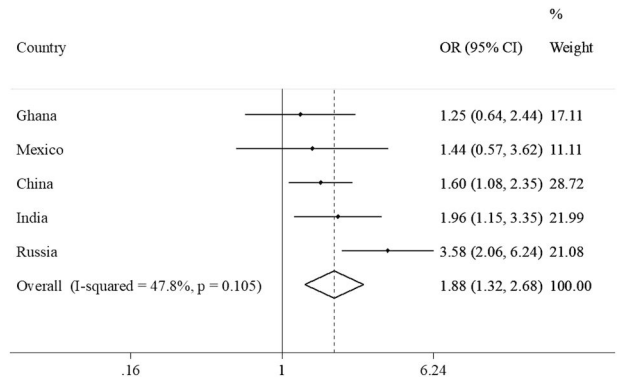

Fig. 2 Country-wise association between self-reported visual symptoms (suggesting cataract) and fall-related injury (outcome) estimated by multivariable logistic regression. OR Odds ratio, CI Confidence interval. Models are adjusted for age, sex, education, wealth, marital status, setting, alcohol consumption, obesity, and number of physical chronic conditions. Overall estimate was based on meta-analysis with random effects.

knowledge, this is one of the first studies on this topic using nationally representative data from LMICs, as well as one of the few that focuses on self-reported fall-related injury (and not any falls), while it is also the first multi-country study on this topic.

Interpretation of findings

Findings from the present study both support and add to existing literature. Findings support existing studies from single high-income countries and mainly small studies from LMICs using community-based data through further identifying a positive association between cataract and falls or injurious falls [20–24]. Importantly, in the present study, individuals with self-reported visual symptoms (suggesting cataract) had 1.88 times higher odds for injurious falls compared to those without these symptoms. This effect size is similar to that observed in previous studies. For example, in a sample of older men from Indonesia, those with cataract were much more likely to experience a single injurious fall (RRR = 1.53; 95% CI = 1.05–2.2) and multiple injurious falls (AOR = 2.02; 95% CI = 1.28–3.19) compared to those without cataract [23]. Furthermore, the findings add to this literature by demonstrating that such an association holds in large nationally representative samples of older adults from multiple LMICs. There are several plausible pathways that likely explain the increased odds in falls among those with cataracts. Firstly, as previously discussed, cataracts affect multiple aspects of one's vision, and thus, those with cataracts are more likely to succumb to trip hazards owing to the ground surface being more difficult to visualise [33]. Next, sleep complications are common among those with cataracts [34], possibly owing to decreases in transmission of light to the retina, while sleep complications per se are associated with an increased risk of falls [35] potentially via impaired cognition and balance [35]. Another explanation may be related with frailty. Indeed, literature has shown an association between cataract and frailty. For example, in a sample of 2370 US adults, cataract was associated with some measures of physical frailty independent of visual acuity and systemic comorbidities [36]. Importantly, physical frailty has been found to be a key risk factor for falls likely owing to an impairment in physical and mental health performance [37]. Finally, chronic inflammation could be a shared risk factor for both cataracts and falls [38–40].

It is worth noting that there was a moderate level of between-country heterogeneity in the association between self-reported

visual symptoms (suggesting cataract) and self-reported injurious falls, with Russia showing a particularly pronounced association. The exact reasons behind this heterogeneity are elusive, but this could be related to factors such as difference in severity of cataracts in each country as well as environmental trip hazards (e.g., quality of footpaths, presence of handrails, poor lighting, slippery floors). The particularly high OR observed in Russia could be related to the climate where streets could be frozen, or other factors such as larger number of chronic physical conditions observed in our study. It is possible that these conditions, when compounded by cataract results in a particularly high risk for falls. However, all factors mentioned above are speculative, and thus, future research (e.g., of qualitative nature) are warranted to understand potential between-country differences.

Implication of study findings

Findings from the present study suggest that interventions are required to reduce the risk for injurious falls among those with cataracts. The most pressing issue in LMICs would be to advocate for better treatment for cataracts. Indeed, literature has demonstrated a reduction in fall risk from before to after cataract surgery [41]. However, such a change would require strong government buy in, and is a particular challenge in the context of LMICs due to lack of resources including surgeons who can conduct this surgical procedure [42]. Recommendations specifically for LMICs include reduction/elimination of patient direct and indirect costs; surgical awareness campaigns; use of successfully operated persons as exemplars; and routine community outreach [43]. However, it is acknowledged that there is limited literature on improving uptake of cataract surgery in LMICs and further research using an experimental design is required [44]. Additionally, in LMICs, addressing the risk factors of cataract (e.g. smoking [45], alcohol use [46], physical inactivity [47], obesity [48], and sun light exposure [49]) especially from a younger age is important, given that gold standard treatment for cataract such as phacoemulsification surgery is often not available.

Strengths and limitations

The large representative samples of older adults from five LMICs are clear strengths of the present study. However, findings must be interpreted in light of the study's limitations. First, the study was cross-sectional in nature, and therefore, temporal associations or causality cannot be established. However, it is unlikely that injurious falls lead to cataract development. Second, the majority of the variables used in this study were self-reported. This can potentially introduce recall and social desirability bias into the findings. Third, cataract was not diagnosed by a medical practitioner. However, based on the BMJ Best Practice, the symptoms assessed in our study (i.e., cloudy/blurry vision and vision problems with light) are the most important diagnostic factors for cataract, and this is the reason why these questions were chosen to diagnose this condition in the SAGE survey. Next, information on severity of cataract was not available. Future research should assess how severity of cataract relates to risk for fall-related injury. Finally, there may be variability in the interpretation of survey questions between countries when questions are translated and back-translated, potentially introducing some level of error into the findings.

CONCLUSION

In the present study including large representative samples of adults aged ≥ 65 years from five LMICs, overall, self-reported visual symptoms (suggesting cataract) were associated with a nearly two-fold increased odds for self-reported fall-related injury. The results of our study suggest that improvement in cataract care in LMICs by making cataract surgery more widely available may also aid in the prevention of falls.

SUMMARY

What was known before:

Cataracts may increase risk for falls.
Studies on this topic from low- and middle-income countries (LMICs) are scarce.

What this study adds:

Cataract was associated with higher odds for injurious falls among older adults in LMICs.
Expanding availability of cataract surgery in LMICs may also have the additional benefit of reducing falls among older people.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding authors upon reasonable request.

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