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Social inequalities in the impact of falls on health-related quality of life among older adults

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Abstract *The aim of the present study was to determine the association between falls and health-related quality of life (HRQoL) among older adults considering different demographic and socioeconomic characteristics. This study was developed with data from the Household Health Survey conducted in the city of Campinas, Brazil, in 2014 and 2015. HRQoL was investigated using the eight domains and two components of the SF-36 questionnaire. Simple and multiple linear regression analyses were performed with the aid of the Stata 15.0 program to determine the association between falls and HRQoL according to sex, age, income and schooling. Significant declines in the scores of the physical functioning, role physical and bodily pain domains as well as the physical component were found among women (not men) and individuals with a lower income. Among individuals aged 75 years or older and those with less schooling, declines occurred in these same domains as well as in the role emotional and mental health domains. The results reveal that the impact of falls on HRQoL differs depending on the socioeconomic and demographic characteristics of older adults, indicating that specific care strategies should target more vulnerable subgroups, with attention given to emotional aspects.*

Key words *Quality of life, Accident by falls, Elder health*

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Introduction

According to data from the Brazilian Institute of Geography and Statistics, the contingent of older adults increased from 9.8% of the overall population in 2004 to 14.3% in 2015 and this figure is expected to reach 35% by the year 2070[1].

The rapid aging of the population has given rise to discussions on the health problems and factors that exert an impact on the quality of life of older adults[1,2]. Falls are frequent in this age group and therefore constitute a relevant health problem for older adults. The literature reports that such accidents are more prevalent among older women, longer-lived individuals, those with a larger number of morbidities and those who take a larger number of medications[3,4]. Falls that cause injuries, even those that do not place one's life at risk and have no sequelae, can substantially compromise the health status[5,6] and quality of life of older adults[7].

The biological declines that accompany the aging process imply an increase in vulnerabilities of a biological nature that interact with socioeconomic and psychosocial aspects[8], either accelerating or slowing down this process. Considering the influence of one's socioeconomic position and living conditions on the adoption of healthy habits, the prevention of disease and access to both knowledge and health care[9], investigations addressing specific problems, such as the impact of falls on health-related quality of life (HRQoL), need to consider the occurrence of such problems in different socioeconomic strata.

Social inequality is expressed in different health dimensions and events. Regarding the prevalence of falls, studies have not detected any differences among socioeconomic strata[10,11], but few studies have investigated whether the impact of falls affects populations of distinct social positions differently. The association between falls among older adults and HRQoL considering socioeconomic status was only addressed in one Brazilian study[12], which evaluated differences according to schooling. Only three studies have evaluated the impact of falls on HRQoL according to sex, reporting divergent results[12-14]. In a study developed in Taipei, Taiwan, Chang et al.[13] found that falls produced greater declines in the physical and mental components of the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) in women compared to men. In two Brazilian studies, falls were associated with some of the SF-36 domains in men but not in women[12,14]. Regarding age group, the few studies also report divergent results[12-14], with two revealing greater declines associated to falls among individuals at more advanced ages[12,13].

Considering the rapid increase in the older population, the greater vulnerability to falls in this group, the negative impact of falls on HRQoL and the scarcity of population-based studies on this topic, the aim of the present study was to determine the association between falls and HRQoL in older adults according to demographic and socioeconomic strata.

Methods

A population-based, cross-sectional study was conducted with community-dwelling older adults residing in urban areas of the city of Campinas, Brazil. The data were obtained from the 2014-2015 Campinas Household Health Survey, the objective of which was to obtain information on morbidities, health behaviors and the use of health services in three large age groups: adolescents, adults and older adults.

Two-stage, stratified, probabilistic, cluster sampling was performed for the selection of the participants. Seventy census sectors were selected in the first stage. In the second stage, homes were selected using a systematic lottery system applied to the updated list of homes in each of the selected census sectors. The number of individuals to compose the sample was obtained considering the situation corresponding to the maximum variability for the frequency of the events studied ($P = 0.50$), a 95% confidence coefficient for the determination of the confidence intervals ($z = 1.96$), a sampling error of 4 to 5 percentage points and a design effect of 2, leading to 1,000 adolescents (10 to 19 years), 1,400 adults (20 to 59 years) and 1,000 older adults (60 years or older). To reach the sample size for each age group, 3,119, 1,029 and 3,157 homes were independently selected for interviews with adolescents, adults and older adults, respectively, considering the expected rate of losses.

The data were collected using a structured questionnaire organized in to 12 topics and administered in interview format in the respondents' homes by trained, supervised interviewers with the aid of an electronic device (tablet). In the case of older adults unable to answer the questionnaire, assistance from a family member or caregiver was requested to obtain the information.

The dependent variables were the components and domains of the Medical Outcomes

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Study 36-Item Short-Form Health Survey (SF-36), version 2, which is used to measure self-rated health status through 36 items distributed among eight domains: physical functioning, role physical, bodily pain, general health state, vitality, role emotional, social functioning and mental health. The domains are grouped into two components (physical and mental). The SF-26 has been translated and validated for use in Brazil[15,16].

To obtain the SF-36 scores according to the method proposed for the instrument, points were attributed to each item based on the respondent's answer. The scores obtained for each domain were converted to a scale of zero to 100, with higher scores denoting a better health state[17]. The components were standardized with mean scores for the population of the city of Campinas, using a linear transformation with a mean of 50 and standard deviation of 10, as recommended by the SF-36 manual[17].

The independent variable was the occurrence of falls, which was determined through the following question: "Have you suffered any mild or severe falls in the last 12 months?".

The following variables were used for stratification: Sex (male; female); Age group (60 to 74 years; 75 years or older); Schooling (0 to 4 years; 5 years or more); Family income per capital using the Brazilian monthly minimum wage (BMMW) as reference (< 2.5 times the BMMW; ≥ 2.5 times the BMMW).

The number of chronic diseases was used to adjust the analysis. We investigated chronic diseases reported by the respondents as being diagnosed by a physician or other health professional and found on the following checklist: arterial hypertension, diabetes, angina, myocardial infarction, tumor/cancer, arthritis/rheumatism/arthrosis, osteoporosis, asthma/bronchitis/emphysema, rhinitis, sinusitis, tendinitis/repetitive strain injury, varicose veins in lower limbs, stroke, high cholesterol and back problem.

Mean, standard deviation and 95% confidence interval values were calculated for each of the eight scales and two components of the SF-36. The association between HRQoL and falls was tested using simple and multiple linear regression with the estimation of beta coefficients. The regression analyses were adjusted by sex, age and number of chronic diseases and performed with stratification based on sex, age, schooling and income.

All analyses were conducted with the aid of Stata 15.0 (StataCorp, College Station, USA), using the *svy* commands, which incorporate the weights necessary due to the complex sampling design.

The 2014/2015 Campinas Household Health Survey received approval from the Human Research Ethics Committee of Campinas State University as well as the National Ethics Committee via *Plataforma Brasil*.

Results

Among the homes selected for the sample of older adults, the loss rate was 6.8%. Among the 1,168 older adults identified in the selected homes, the refusal rate was 14% and the loss rate for other reasons (selected individual not found at home after three attempts) was 1.5%. Thus, the study population comprised 986 older adults.

The prevalence of falls in the previous year was 17.1% (95% CI: 14.76 to 19.81). The sample was predominantly composed of women (57.5%), individuals between 60 and 74 years of age (71.2%), individuals with up to four years of schooling (57.7%) and an income less than two times the BMMW (71.2%).

In the adjusted analyses, women who suffered a fall had lower scores on the physical functioning, role physical and bodily pain domains as well as the physical component of the SF-36. In contrast, no significant decline in the scores on any of the SF-36 domains was found among the men who suffered falls (Table 1).

Regarding age group, no significant differences in mean SF-36 scores according to falls were found among the individuals aged 60 to 74 years. In contrast, individuals 75 years of age or older who suffered a fall had lower scores on the physical functioning, role physical, role emotional and mental health domains as well as the physical component of the SF-36 (Table 2).

Analyzing the impact of falls on HRQoL according to level of schooling, individuals with less schooling (up to four years) had lower scores on the physical functioning, role physical, bodily pain, role emotional and mental health domains as well as the physical component of the SF-36. In contrast, no significant associations were found among individuals with a higher level of schooling (Table 3).

In the group with a lower income, the impact of falls on HRQoL was evident on the physical functioning, role physical and bodily pain domains as well as the physical component. No significant associations were found among those in the higher income group (Table 4).

Table 1. Mean and standard error values of SF-36 scores and beta coefficients for the occurrence of falls according to sex. 2014/2015 Campinas Household Health Survey, Campinas, São Paulo, Brazil.

Men (n=387)			
SF-36 domains	Did not suffer falls (n=339)	Suffered falls (n=47)	
	Mean (standard error)	β (p-value)	β (p-value)*
Physical functioning	77.1 (1.6)	-6.6 (0.205)	-2.9 (0.470)
Role physical	78.4 (1.9)	-5.4 (0.349)	-3.4 (0.489)
Bodily pain	77.3 (1.6)	-3.5 (0.381)	-2.9 (0.376)
General health	74.9 (1.3)	-6.3 (0.005)	-4.1 (0.070)
Vitality	76.3 (1.6)	-0.9 (0.799)	1.2 (0.649)
Role emotional	87.1 (1.5)	-6.3 (0.241)	-5.6 (0.207)
Social functioning	88.1 (1.5)	-1.0 (0.772)	2.4 (0.467)
Mental health	80.5 (1.1)	-5.6 (0.091)	-3.9 (0.206)
Physical component	46.5 (0.5)	-2.7 (0.123)	-1.6 (0.231)
Mental component	52.1 (0.6)	-1.8 (0.308)	-1.1 (0.501)
Women (n=599)			
SF-36 domains	Did not suffer falls (n=471)	Suffered falls (n=127)	
	Mean (standard error)	β (p-value)	β (p-value)*
Physical functioning	68.0 (1.9)	-12.4 (0.002)	-8.3 (0.006)
Role physical	74.4 (1.8)	-11.3 (0.003)	-8.1 (0.013)
Bodily pain	70.2 (1.7)	-14.2 (0.000)	-10.2 (0.002)
General health	72.2 (1.4)	-2.1 (0.388)	0.5 (0.830)
Vitality	70.2 (1.5)	-5.7 (0.063)	-3.2 (0.305)
Role emotional	81.2 (1.6)	-6.4 (0.049)	-4.2 (0.176)
Social functioning	81.4 (1.2)	-3.4 (0.272)	-1.8 (0.556)
Mental health	73.9 (1.3)	-3.6 (0.119)	-1.5 (0.567)
Physical component	43.9 (0.7)	-5.2 (0.001)	-3.5 (0.004)
Mental component	49.2 (0.6)	-0.4 (0.781)	0.09 (0.949)

*Adjusted by age group and number of chronic diseases.

Discussion

The present study enabled measuring the decline in HRQoL scores associated with the occurrence of falls among older adults in different sociodemographic strata. Among those who suffered falls, men, individuals less than 75 years of age, those in the higher schooling category and those in the higher income category did not experience a significant decline in the scores of the SF-36 domains compared to those who did not suffer falls. In contrast, women and individuals with a lower income who suffered falls had significantly lower mean HRQoL scores compared to those who did not suffer falls with regards to the physical functioning, role physical and bodily pain domains as well as the physical component of the SF-36. Moreover, individuals aged 75 years or older and those with less schooling had significantly lower scores on these same domains as well as the role emotional and mental health domains.

The association between falls and a reduction in HRQoL detected in the present investigation among the women but not the men is in agreement with data described in a study developed in Taiwan with 4,056 older adults, in which falls had a greater impact on women than men regarding the physical and mental components of the SF-36[13]. In contrast, two Brazilian studies found declines in the scores of the SF-36 domains only in men[12,14]; in one of these studies[12], falls constituted the main accident having occurred in the 12 months prior to the interview. This divergence in the results among studies may be due to the characteristics of the populations analyzed (ages, morbidities and vulnerabilities), the instruments used for the collection of data on falls, the variables considered for the adjustment of the analy-

Table 2. Mean and standard error values of SF-36 scores and beta coefficients for the occurrence of falls according to age group. 2014/2015 Campinas Household Health Survey, Campinas, São Paulo, Brazil.

60-74 years (n=664)			
SF-36 domains	Did not suffer falls (n=561)	Suffered falls (n=103)	
	Mean (standard error)	β (p-value)	β (p-value)*
Physical functioning	77.6 (1.3)	-8.1 (0.006)	-4.0 (0.177)
Role physical	79.4 (1.5)	-5.0 (0.179)	-2.0 (0.617)
Bodily pain	72.1 (1.4)	-10.8 (0.003)	-4.2 (0.215)
General health	73.8 (1.2)	-2.6 (0.257)	1.4 (0.562)
Vitality	73.8 (1.4)	-3.6 (0.226)	0.6 (0.847)
Role emotional	85.3 (1.2)	-3.4 (0.279)	-0.4 (0.902)
Social functioning	85.3 (1.1)	-2.1 (0.460)	2.1 (0.480)
Mental health	76.1 (1.1)	-3.5 (0.152)	0.5 (0.858)
Physical component	46.2 (0.5)	-3.5 (0.006)	-1.6 (0.182)
Mental component	50.0 (0.6)	-0.5 (0.704)	1.0 (0.503)
75 years or older (n=322)			
SF-36 domains	Did not suffer falls (n=249)	Suffered falls (n=71)	
	Mean (standard error)	β (p-value)	β (p-value)*
Physical functioning	57.5 (2.2)	-13.2 (0.007)	-9.3 (0.023)
Role physical	67.6 (2.8)	-15.8 (0.002)	-12.3 (0.010)
Bodily pain	76.9 (1.8)	-15.8 (0.001)	-14.1 (0.002)
General health	72.4 (1.7)	-5.4 (0.055)	-3.9 (0.225)
Vitality	70.8 (2.0)	-7.4 (0.024)	-4.8 (0.159)
Role emotional	79.8 (2.7)	-12.4 (0.013)	-10.6 (0.039)
Social functioning	81.8 (2.1)	-5.6 (0.153)	-4.1 (0.321)
Mental health	79.0 (1.3)	-9.0 (0.001)	-7.5 (0.005)
Physical component	42.0 (0.7)	-6.0 (0.002)	-4.5 (0.005)
Mental component	51.8 (0.8)	-2.9 (0.106)	-2.6 (0.157)

*Adjusted by sex and number of chronic diseases.

ses, and other factors. Further studies are needed to gain a better understanding of these aspects. The greater impact of falls on HRQoL in older women may be related to the greater loss of lean mass and muscle strength in females compared to males[18].

The decline in the scores of five domains and the physical component of the SF-36 among individuals aged 75 years or older, with no significant reductions among those aged 60 to 74 years is in agreement with data described by Chang et al.[13], who found an increasing negative impact of falls on the physical component of the SF-36 with the increase in age. As the prevalence of falls increases with age[4,19], it is important to detect whether differences in the impact of falls on HRQoL are found considering different age groups of older adults. In the present investigation, a greater number of domains were affected among individuals aged 75 or older who suffered a fall than the number found in a previous study conducted in the same city[12].

The greater impact of falls on HRQoL with the advance in age is related to progressive structural and functional changes, such as reductions in muscle mass, strength and function, the loss of stability and joint dynamics, and sensory changes. Such changes affect both gait and balance, increasing the risk of falls[20–22] and making the consequences of a fall more serious[17].

With regards to education, we found a negative impact of falls on HRQoL only in the older adults with up to four years of schooling. The only previous study to assess the influence of schooling on the association between falls and HRQoL also found a negative impact among those with less schooling, but only on the role physical and social functioning domains of the

Table 3. Mean and standard error values of SF-36 scores and beta coefficients for the occurrence of falls according to schooling. 2014/2015 Campinas Household Health Survey, Campinas, São Paulo, Brazil.

0 to 4 years (n=604)			
SF-36 domains	Did not suffer falls (n=492)	Suffered falls (n=116)	
	Mean (standard error)	β (p-value)	β (p-value)*
Physical functioning	66.34 (1.5)	-13.4 (0.000)	-6.6 (0.020)
Role physical	72.1 (1.8)	-14.5 (0.001)	-9.8 (0.010)
Bodily pain	71.6 (1.6)	-13.9 (0.000)	-11.3 (0.001)
General health	71.1 (1.3)	-5.9 (0.002)	-3.0 (0.138)
Vitality	71.5 (1.3)	-7.5 (0.024)	-4.4 (0.124)
Role emotional	80.7 (1.4)	-12.3 (0.004)	-9.2 (0.019)
Social functioning	80.8 (1.5)	-5.9 (0.109)	-3.2 (0.347)
Mental health	75.7 (1.2)	-7.5 (0.004)	-5.6 (0.023)
Physical component	43.3 (0.5)	-5.5 (0.000)	-3.3 (0.003)
Mental component	50.0 (0.6)	-3.0 (0.062)	-2.6 (0.099)
5 or more years (n=376)			
SF-36 domains	Did not suffer falls (n=318)	Suffered falls (n=58)	
	Mean (standard error)	β (p-value)	β (p-value)*
Physical functioning	79.9 (1.9)	-8.6 (0.037)	-3.6 (0.341)
Role physical	81.6 (1.8)	-1.8 (0.648)	2.3 (0.582)
Bodily pain	75.6 (1.4)	-8.6 (0.021)	-3.1 (0.397)
General health	76.5 (1.3)	0.2 (0.942)	3.4 (0.168)
Vitality	74.9 (1.7)	-1.2 (0.649)	3.3 (0.282)
Role emotional	87.9 (1.6)	2.0 (0.539)	4.4 (0.222)
Social functioning	89.1 (1.4)	1.0 (0.733)	4.0 (0.204)
Mental health	78.4 (1.3)	-1.1 (0.623)	1.7 (0.576)
Physical component	47.4 (0.6)	-3.4 (0.018)	-1.3 (0.316)
Mental component	51.1 (0.7)	1.7 (0.200)	2.6 (0.099)

*Adjusted by sex, age group and number of chronic diseases.

SF-36[12]. It is important to investigate schooling in an multidimensional evaluation of older adults, as this factor can either facilitate or hinder the understanding of advice regarding risk factors for falls as well as forms of prevention and the implication of falls on quality of life. In individuals with low schooling, it is important to consider the impact of falls on the mental health and emotional aspects of older adults.

Regarding income, declines in the scores of the physical functioning, role physical and bodily pain domains as well as the physical component of the SF-36 were found in older adults with an income of up to 2.5 times the BMMW who suffered falls, whereas no significant decline was found among those with a higher income. Studies involving older adults have identified associations between the prevalence of falls and economic level[3,21,23]. However, we found no studies addressing the impact of falls on quality of life according to income strata, demonstrating an important gap in the medical literature. Income is one of the attributes that strongly influence health and quality of life[24,25].

The findings on the differentiated association between falls and HRQoL according to schooling and income broaden knowledge on the consequences of falls considering the degree of social vulnerability of older adults[26]. The relations between socioeconomic status and health are complex and influenced by political, social and economic factors[27]. Individuals who live in situations of social vulnerability experiencing material deprivation, a higher level of stress, fewer options, a greater probability of health-related risk behaviors and limited access to healthcare services suffer more intense consequences of falls[28].

The score on the bodily pain domain under-

Table 4. Mean and standard error values of SF-36 scores and beta coefficients for the occurrence of falls according to income. 2014/2015 Campinas Household Health Survey, Campinas, São Paulo, Brazil.

> 2.5 x BMMW (n=749)			
SF-36 domains	Did not suffer falls (n=609)	Suffered falls (n=139)	
	Mean (standard error)	β (p-value)	β (p-value)*
Physical functioning	70.3 (1.7)	-13.2 (0.000)	-7.2 (0.004)
Role physical	74.7 (1.8)	-11.3 (0.002)	-6.9 (0.031)
Bodily pain	71.3 (1.4)	-12.1 (0.00)	-8.4 (0.006)
General health	73.1 (1.2)	-5.5 (0.007)	-1.9 (0.324)
Vitality	72.4 (1.4)	-7.8 (0.005)	-4.0 (0.100)
Role emotional	82.5 (1.5)	-8.9 (0.006)	-5.4 (0.067)
Social functioning	82.7 (1.3)	-4.9 (0.085)	-1.0 (0.690)
Mental health	76.0 (1.1)	-6.6 (0.002)	-3.4 (0.122)
Physical component	44.3 (0.6)	-5.0 (0.000)	-2.9 (0.005)
Mental component	50.1 (0.6)	-2.1 (0.070)	-0.9 (0.458)
≥ 2.5 x BMMW (n=237)			
SF-36 domains	Did not suffer falls (n=201)	Suffered falls (n=35)	
	Mean (standard error)	β (p-value)	β (p-value)*
Physical functioning	77.1 (2.0)	-7.8 (0.207)	-2.5 (0.577)
Role physical	80.2 (1.9)	-6.0 (0.348)	-1.9 (0.732)
Bodily pain	78.9 (1.7)	-11.1 (0.046)	-5.4 (0.301)
General health	74.3 (1.7)	1.4 (0.712)	4.3 (0.228)
Vitality	74.5 (2.1)	2.9 (0.382)	6.5 (0.061)
Role emotional	87.3 (1.7)	-1.5 (0.690)	1.5 (0.712)
Social functioning	88.9 (1.6)	0.7 (0.840)	3.0 (0.458)
Mental health	79.1 (1.4)	-0.5 (0.863)	1.0 (0.751)
Physical component	47.1 (0.6)	-4.0 (0.095)	-1.8 (0.267)
Mental component	51.5 (0.7)	1.6 (0.397)	2.1 (0.260)

BMMW - Brazilian monthly minimum wage; *Adjusted by sex, age group and number of chronic diseases.

went the greatest decline among the older adults in the affected sociodemographic segments. Injuries caused by falls may be mild, such as scratches and contusions, or more severe, such as fractures[5], and all generally result in pain that can affect activities of daily living. Moreover, falls can cause injuries with multiple consequences, including pain, that force older adults to face their frailty, constituting a threat to their safety, autonomy and independence in terms of daily and social activities[29].

The role emotional and mental health domains were affected by the occurrence of falls among individuals 75 years of age or older and those in the lower schooling category. The impact on mental health is related to the consequences of the event, such as a fear of falling, which is a predictor of further falls and can lead to a reduction in self-confidence, autonomy and functional capacity as well as an increase on one's perception of frailty and negative feelings[5,14].

This study has some limitations that should be mentioned. The cross-sectional design does not enable the determination of causal relations among the variables studied. The fact that the data were obtained through interviews increases the risk of information bias and fact that the individuals were asked to consider the occurrence of falls in the previous 12 months increases the possibility of recall bias. Moreover, one should bear in mind that quality of life is influenced by diverse factors, besides falls, although the analyses were adjusted for demographic variables (sex and age) and the number of chronic diseases to minimize possible confounding. It is also necessary to consider that several outcomes were ana-

lyzed and the level of significance was set to 5% ($p < 0.05$). However, the p-value was ≤ 00.1 for the majority of associations found. The strengths of the study were the standardized, supervised data collection methods, the representative sample of the population of the city, the stimulation of the memories of the older adults regarding the occurrence of mild and severe falls in the previous 12 months and the administration of the SF-36, which is widely employed and has been validated for use in Brazil[15].

The present study offers novel information on the association between falls and quality of life, detecting socioeconomic inequalities in the impact of falls, as the degree of harm depends on the social and demographic segments to which older adults pertain. This study contributes knowledge on an under-investigated issue and suggests that such aspects need to be considered in public policies directed at elder health in order to diminish the occurrence of falls and minimize the impacts such events have on quality of life, especially in more vulnerable sociodemographic segments.

Collaborations

MM Paiva participated in the data analysis and interpretation, writing and critical review of the manuscript. MG Lima participated in the data interpretation and critical review of the manuscript. MBA Barros participated in the conception and orientation of the study, interpretation of the data and critical review of the manuscript.

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