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Obesity and falls in older people: Mediating effects of disease, sedentary behavior, mood, pain and medication use

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ABSTRACT

Obesity has been associated with an increased risk of falls among older people. However, it is not certain whether factors commonly associated with falls and/or obesity mediate this risk. This research examines whether specific diseases, sedentary behavior, mood, pain, and medication use mediate the association between obesity and falls. A representative sample of community-living individuals aged 65+ years in New South Wales (NSW), Australia were surveyed regarding their experience of falls, height, weight, lifestyle and general health within a 12 month period. Intervening variable effects were examined using Freedman and Schatzkin's difference in coefficients tests and regression analyses were used to estimate relative risks. Obesity was associated with a 25% higher risk (95%confidence interval (CI) 1.11–1.41; $p < 0.0003$) of having fallen in the previous 12 months compared to non-obese individuals. The strongest mediators of the association between obesity and falls were sleeping tablets ($t = -5.452$; $p < 0.0001$), sitting for more than 8 h per day on weekdays ($t = 5.178$; $p < 0.0001$), heart disease/angina ($t = 3.526$; $p < 0.0001$), anti-depressant use ($t = 3.102$; $p = 0.002$), moderate/extreme anxiety or depression ($t = 3.038$; $p = 0.002$), and diabetes ($t = 3.032$; $p = 0.002$). Sedentary behavior, chronic health conditions and medication use were identified as mediators for the association between obesity and falls in community living older people. Interventions aimed at weight reduction and increased activity may have benefits not only for fall prevention, but also for the mediating health, mood and lifestyle factors identified here.

1. Introduction

Internationally, the older adult population (aged 65 years and older) is increasing (United Nations, 2013). It is estimated that 27.3% of the population in the United Kingdom (UK), 22.4% of the population in Australia, and 21.1% of the population in the United States (US) will be aged 65 years and older by 2050 (United Nations, 2013). Around one-third of people aged 65 years and older living in the community will fall each year and many older people fall more than once (Campbell, Borrie, & Spears, 1989; Tinetti, Speechley, & Ginter, 1988). Following a fall, some older people can develop a fear of falling, which often then decreases their level of physical activity as they attempt to prevent further falls (King & Tinetti, 1995).

For older individuals, fall-related injuries are the most common cause of injury-related mortality and injury-related hospitalization (Bradley, 2013; Stevens, Corso, Finkelstein, & Miller, 2006). Fall-related injuries in older individuals represent a substantial cost to health systems (Schuffham, Chaplin, & Legood, 2003; Stevens et al., 2006). Within NSW, Australia's most populous state with approximately 460,000 people aged 65 years and older (Australian Bureau of Statistics, 2012), the annual direct cost of health care following a fall is estimated at $558.5 million (Watson, Clapperton, & Mitchell, 2011).

In many high income countries, the prevalence of obesity in older individuals is increasing (OECD, 2012). In the US, it is estimated that 31% of individuals aged 60 years and older are obese (Body Mass Index: BMI ≥ 30) (Houston, Nicklas, & Zizza, 2009). In Australia, 71% of individuals aged 65–74 years, 60% of those aged 75–84 years and 42% of those aged 85+ years are overweight or

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obese (BMI $\geq$ 25) (Australian Institute of Health and Welfare, 2010). With population aging, the number of obese older individuals is expected to continue to increase (Australian Institute of Health and Welfare, 2002; Elia, 2001; Houston et al., 2009).

For older people, obesity can introduce or exacerbate existing health conditions (such as diabetes, arthritis or cardiovascular disease (Elia, 2001; Houston et al., 2009)), and can adversely affect an individual's ability to perform day-to-day activities (Elia, 2001). In turn, poor health can result in physical inactivity that can influence an individual's weight. Obesity has been associated with an increased risk of falls among older people (Fjeldstad, Fjeldstad, Acree, Nickel, & Gardner, 2008; Kelsey et al., 2010; Mitchell, Lord, Harvey, & Close, 2014). However, it is not certain whether factors commonly associated with falls and/or obesity mediate this risk. A mediator (or intervening variable) is considered to be a factor that plays a part in contributing to the relationship between an independent variable and an outcome (Baron & Kenny, 1986). An assessment of the capacity of a factor to act as a mediator between obesity and falls and the effects that mediation can have on the association between obesity and falls have not been extensively explored. The aim of this research is to examine the extent to which the association between obesity and falls is mediated by related factors including chronic disease, sedentary behavior, mood, pain, and medication use using information obtained from a population-based survey.

2. Method

2.1. Sampling design

The NSW Falls Prevention Baseline Survey was undertaken in 2009 by the NSW Ministry of Health (Centre for Health Advancement and Centre for Epidemiology and Research, 2010). A representative sample of 5681 older people (aged 65+ years) living in the community, with a private telephone, were surveyed across NSW regarding their falls experience, knowledge and perception of falls, participation and awareness of physical activity and health status. The full details concerning the development of the survey and the methods used are described in full elsewhere (Centre for Health Advancement and Centre for Epidemiology and Research, 2010) and summarized below.

A two-stage sampling process was used, with the sample stratified by each of the former eight NSW Area Health Services (AHS). Within each AHS, households were randomly selected using a computer-generated list of telephone numbers. A single respondent was then randomly selected from each household for a computer-assisted telephone interview (CATI). Proxy respondents were chosen for 361 participants who were unable to answer on their own behalf due to various conditions, such as hearing impairments, poor health, dementia or cognitive impairment (Centre for Health Advancement and Centre for Epidemiology and Research, 2010).

Interviews were conducted between March and July 2009. Households selected for a telephone interview that had postal addresses in the electronic phone book were sent a letter describing the aims and methods of the survey two weeks prior to the initial attempts at telephone contact. Interviews were conducted by trained NSW Population Health Survey Program CATI interviewers and by interviewers from McNair Ingenuity Research Ltd. Up to seven call backs were made to establish initial contact with a household and up to five call backs were made to contact a selected respondent. Almost all respondents (96.0%) were interviewed in English (Centre for Health Advancement and Centre for Epidemiology and Research, 2010). The survey response rate was 60.8% (Centre for Health Advancement and Centre for Epidemiology and Research, 2010).

2.2. The survey instrument

During each interview, information obtained from all respondents included demographic information on age, gender, weight, height, health status, doctor-diagnosed physical co-morbidities, physical activity participation, and prescription medication use. Information on fall history and self-rated pain and mood was also obtained. Respondents were asked if in the last 12 months they had suffered a fall (i.e. accidentally lost their balance, tripped or slipped and found themselves on the floor or ground). Questions were field tested prior to use. BMI was classified as underweight (<18.5), healthy weight (18.5–24.9), overweight (25–29.9) and obese (30+). Ethics approval was obtained from the NSW Health's Population and Health Services Research Ethics Committee (2008/12/114; HREC/08/CIPHS/55).

2.3. Data analysis

Analysis was performed using SAS version 9.3 (SAS Institute, 2012). The data were stratified by AHS and a sampling weight was applied to adjust for the probability of selection (i.e. due to the varying number of people living in each household, the number of residential telephone connections for the household, and the varying sampling fraction in each AHS), for differing non-response rates among males and females and different age groups, allowing calculation of prevalence estimates for the NSW population. The SURVEYFREQ procedure was used to calculate prevalence estimates, 95% CIs and Rao-Scott design-adjusted chi-square tests (SAS Institute, 2008).

The hypothesized paths between obesity and falls are outlined in Fig. 1. To examine the significance of the association between obesity and falls and putative mediating factors, a series of Poisson regression analyses with robust variance estimation were conducted (as specified below) as per Baron and Kenny's (1986) three step criteria for mediation. The determination of variable associations for Baron and Kenny's (1986) mediation criteria are conceptually shown in Fig. 2. Putative mediators of certain doctor-diagnosed medical conditions, sedentary behavior, pain, mood, and medication were selected based on the current literature for their association with falls in older people, for their potential for mediation between obesity and falls, and their availability in the survey data collected. Initially, the association between obesity and falls was assessed (Path A: Fig. 2). Each potential mediator was individually assessed for its association with obesity (Path B: Fig. 2), and if this association was significant, then each potential mediator was then assessed for its association with falls (Path C: Fig. 2). If the potential mediator was significantly and independently associated with both falls and obesity, the potential mediator and obesity were both included as independent variables in a regression model to assess their association with falls.

If the three mediating variable conditions were all met in the regression analyses, the intervening variable effect was examined using Freedman and Schatzkin's difference in coefficients test (Freedman & Schatzkin, 1992; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). The Freedman and Schatzkin test of mediation is based on determining the difference in the unstandardized regression coefficients for the association between an independent and dependent variable, unadjusted (β) and adjusted (β^) for the proposed mediator. The significance of the mediating effect was calculated by dividing the difference in coefficients by their standard errors (i.e. SE_{β} and $SE_{\beta^{\wedge}}$) and the correlation between obesity and each potential mediator (i.e. P_{XI}) (Eq. (1)) and, as the survey sample was weighted to the NSW population, comparing the value obtained to the normal distribution for a two tailed significance test.