Body mass index and health service utilisation in the older population: results from The Irish Longitudinal Study on Ageing

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Abstract

Background: obesity is associated with higher healthcare costs in older people; however, estimates are predominantly based on the use of primary and secondary services. Our objective was to estimate the effect of overweight and obesity on the use and cost of allied health services among middle-aged and older people.

Methods: the study used data from The Irish Longitudinal Study of Ageing (TILDA), a nationally representative study of adults aged ≥50 sampled using multistage stratified clustered sampling, which included objective measures of height and weight. Body mass index was categorised as normal (18.5–24.99 kg/m²), overweight (25.00–29.99 kg/m²), moderate obesity (30.00–34.99 kg/m²), severe obesity (35.00–39.99 kg/m²) or morbid obesity (≥40 kg/m²). Participants were asked about a range of allied health services including dietetic services, public health nurse visits, chiropody and home help. Adjusted seemingly unrelated biprobit models were used to account for unobserved heterogeneity associated with the use of services.

Results: among 5,841 participants, 77.6% (95% CI = 76–79%) were overweight or obese (n = 4,534). All classes of obesity were significantly associated with higher general practitioner service use (P < 0.05). Moderate and severe obesity were associated with increased use of out-patient services, while only moderate obesity was associated with increased hospital admissions (P < 0.05). Moderate and severe obesity were significantly associated with chiropody service use (P < 0.05) with an estimated annual cost of €919,662. Morbid obesity was associated with dietetic service use (P < 0.001) with an annual cost of €580,013.

Conclusion: given these costs and improvements in life expectancy, an increasingly obese older population presents new challenges for healthcare delivery.

Keywords: obesity, healthcare utilisation, population-based study, older people, costs

Background

The relationship between body mass index (BMI) and adverse health outcomes becomes more complicated with age. A recent meta-analysis found that the association between BMI and mortality weakens with age, adjusting for confounding factors such as pre-existing illness and smoking [1]. However, there is also evidence demonstrating the impact of overweight and obesity on morbidity, physical function and quality of life [2]. Results from the US Health and Retirement Study (HRS) suggest that rising obesity may reduce or reverse declines in disability seen in the older population in recent years [3]. Obesity is also associated with higher healthcare costs [4, 5]. It is a risk factor for a number of chronic conditions [6] that contribute to increased health service utilisation. However, studies have shown that the association between obesity and health service use is only partially explained by chronic illness [4, 7], leading to the suggestion that the adverse effects of obesity itself, and not just the demands of chronic illness, may result in increased health service utilisation [7].

The prevalence of obesity is expected to rise in the older population. In the United States, Arterburn et al. [8] estimated that the prevalence of obesity among older people would increase by 5.4% between 2000 and 2010, equating to ~20.9 million categorised as obese by 2010. In Ireland, three in four people over 50 are either overweight or obese [9]. In 2009, the direct and indirect costs of overweight and obesity were estimated to be €1.13 billion [10].
To date, studies on the impact of overweight and obesity on health services, both national [11] and international [4, 7, 8, 12–15], have focused on the use of general practice and hospital services, leading to tentative estimates of the cost of obesity. Few studies have examined the impact of excess body weight on allied health services such as dietetic services, community-based services such as public health nurses and social care services such as home help. The aim of this study was to examine the association between overweight and obesity and the use of health services including allied health services in a nationally representative sample of middle-aged and older adults from The Irish Longitudinal Study on Ageing (TILDA) to examine the wider burden of increasing BMI on the health system.

Methods

Study population
Data from the first wave of The Irish Longitudinal Study on Ageing (TILDA) were analysed. Using a multistage stratified sampling design, a nationally representative random sample of community-dwelling adults aged ≥50 in the Republic of Ireland were invited to participate. A response rate of 62% was achieved (6,279 households), and a total of 8,504 participants were recruited (8,175 aged ≥50 and 329 younger partners of eligible individuals). Ethical approval was obtained from Trinity College Dublin Research Ethics Committee and written informed consent was sought from each participant. Details of the study methodology are described in detail elsewhere [16].

Data collection
Data were collected between October 2009 and February 2011. The main questionnaire was administered using computer-assisted personal interviewing (CAPI) and included questions on socio-demographics, physical and mental health including self-reported doctor-diagnosed chronic conditions, employment/retirement and health service use. Respondents also completed a Self-Completed Questionnaire (SCQ) and were invited to participate in a detailed health assessment. A total of 5,897 participants completed the health assessment carried out by trained research nurses (72% of the overall sample). Assessments took place in a health centre (85.4%) or at participants’ homes (15.6%), and included anthropometric measurements that were used to calculate BMI [17]. A single measure of height was taken using a wall-mounted measuring rod while a single measure of weight was taken using an electronic floor scale [18].

Measures
BMI is defined as a person’s weight in kilograms divided by the square of his/her height in metres (kg/m²). Participants were grouped into five BMI categories: normal weight (BMI: 18.5–24.99 kg/m²), overweight (BMI: 25.00–29.99 kg/m²), moderately obese (class I: 30.00–34.99 kg/m²), severely obese (class II: 35.00–39.99 kg/m²) and morbidly obese (class III: ≥40 kg/m²), based on the WHO classification [19].

The outcome was self-reported health service use in the 12 months preceding the survey. Participants were asked about the use of in-patient and out-patient hospital services, general practitioner (GP) services, allied health services (dietitians, public health or community nurses, chiropody and physiotherapy) and social care services (home help services). Psychological and counselling services, personal care attendance services and meals-on-wheels services were also examined, but the uptake rates were too low to allow for comparison across BMI categories.

Statistical analysis
Analysis was restricted to those who participated in the health assessment and had a valid BMI measurement (n = 5,873, 99.6% of health assessment sample). We excluded those who were underweight <18.5 kg/m² (n = 32), resulting in a final sample for analysis of 5,841 participants.

Health service utilisation was compared across BMI categories using χ² statistics. A seemingly unrelated probit regression model was used to take into account the potential for correlated errors between health services. Underlying factors that drive an individual to use one service could also influence their use of another health service [20], particularly as the use of allied health services may involve GP referral. Regression models were adjusted for socio-demographic characteristics including age, sex, marital status (married yes/no) and education (primary or none/secondary/third level). Analyses were also adjusted for medical card status (means-tested public health insurance scheme entitling the holder to free access to healthcare), self-rated health (excellent/good/very good versus fair/poor), depressive symptomology measured by the Center for Epidemiologic Studies Depression Scale (CES-D) (score ≥16 indicative of clinically significant symptoms) [21] and self-reported doctor diagnosis of obesity-related chronic conditions (angina, stroke, chronic heart failure, myocardial infarction, diabetes, arthritis, cancer, chronic obstructive pulmonary disease, asthma, emotional or psychological issues including anxiety and depression). Average marginal effect was estimated representing the predicted probability of attending a service for each BMI category in comparison to the normal weight category (reference category in each model), holding all other co-variates equal.

Further analysis was conducted to separate out the impact of health status on health service utilisation from the impact related to BMI. Using an approach previously applied by Doherty et al. [11], the impact of BMI on health service use was examined after removing the impact of BMI on the number of chronic conditions (chronic condition residual). The residual term was calculated by modelling the effect of BMI category on the number of chronic conditions. The same co-variates listed above were included in regression.
analysis for each service under consideration. Analyses were weighted to reflect the complex sampling design and were carried out using Stata 12.

Direct healthcare costs were estimated using the population-weighted marginal effects from the regression analysis. Costs were estimated for significant marginal effects only. Average unit costs of €50 for a GP visit, €160 for an out-patient department visit (OPD) and €5,030 for a hospital in-patient visit have recently been estimated for Ireland [22], and were used in this analysis. The average unit cost for a hospital in-patient stay takes into account the average number of nights spent in hospital. The unit cost of hospital outpatient visits was €33.50 and €32.40 for community podiatry/chiropody services using estimates from the NHS [23], adjusted for Purchasing Power Parity levels for 2013 [24].

The unit cost of each service was multiplied by the relevant marginal effects (the probability of additional visits), and the average number of visits undertaken by the BMI group concerned (for GP visits, hospital admissions and out-patient visits) or the increased probability of attending a service in each BMI group (for allied health services as there were no data available on the frequency of visits to these services). This gave an estimate of the additional cost per person associated with overweight and obesity in this sample, i.e. the expected additional cost per person. This estimate was extrapolated for the number of people in the population in the relevant BMI category based on population estimates from the Central Statistics Office (CSO).

**Results**

Of the 5,841 participants included in the analysis, 40.1% (95% CI = 39–41%) were ≥65 years old (n = 2,338) and 53.9% (95% CI = 53–55%) were female (n = 3,150). 22.4% (95% CI = 21–23%) were classified as normal weight (n = 1,307), 43.2% (95% CI = 42–44%) as overweight (n = 2,521), 25.3% (95% CI = 23–26%) as moderately obese (n = 2,013), 7.5% (95% CI = 7–8%) as severely obese (n = 435) and 2.6% (95% CI = 2–3%) as morbidly obese (n = 149). There were a number of significant associations between demographic characteristics, health status and BMI category (Table 1). There was higher service use among individuals in obese categories compared with normal and overweight categories (Figure 1). Less than 1% (95% CI = 0.4–1.0%) of overweight individuals had consulted a dietician in the previous 12 months compared with 2% (95% CI = 1.2–4.8) of severely obese individuals and 9% (95% CI = 5–15%) of morbidly obese individuals (P < 0.001). (Supplementary data, Appendix 1 available in Age and Aging online).

Appendix 2 available as Supplementary data in Age and Aging online presents the predicted probability of attending a service in a given BMI category. Group 1 models were adjusted for socio-demographic variables, each chronic condition, depressive symptomology and self-rated health (Group 1 models). There were significant positive associations between BMI category and the use of GP services, hospital admissions and chiropody services. The predicted probability of having a hospital admission was 3% points higher in moderately obese individuals compared with normal weight individuals (P < 0.05).

Given the causal link between a number of chronic conditions and obesity, it is difficult to separate the impact of BMI from the impact of chronic illness on service use when each condition is entered separately into the model. Hence, further analysis was conducted to remove this collinearity effect by adjusting for the residual term from a model where the number of conditions was predicted based on BMI, in addition to adjusting for socio-demographic characteristics and depressive symptoms (Group 2 models). The impact of moderate and severe obesity on the use

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<tr>
<th>Table 1. Socio-demographic characteristics, health status and health service use according to BMI category</th>
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<tr>
<td>Female</td>
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<td>65–74</td>
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<tr>
<td>75+</td>
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<td>Rural residence</td>
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<tr>
<td>Married</td>
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<td>Education</td>
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<tr>
<td>None/primary</td>
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<tr>
<td>Secondary</td>
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<td>Third level</td>
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<tr>
<td>Medical card</td>
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<tr>
<td>Private health insurance</td>
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<td>Fair/poor self-rated health</td>
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Proportions and 95% CI adjusted for complex survey design (weights applied).

*P ≤ 0.05.

**P ≤ 0.001.
of chiropody services remained statistically significant ($P < 0.05$). The probability of attending dietetic services was significantly higher among those who were morbidly obese compared with normal weight individuals (average marginal effect of 0.06 or 6% points, $P < 0.05$). When stratified by age, sex and the presence of at least one chronic condition, the impact of BMI varied across health services (Supplementary data, Appendix 3 available in Age and Ageing online).

Table 2 presents population-based estimates of the incremental cost in terms of the health service use of overweight and obesity relative to normal weight. Estimates were based on the adjusted statistically significant marginal effects from models that included the residual chronic conditions term (Supplementary data, Appendix 2 available in Age and Ageing online).

**Discussion**

This study is among the first studies worldwide to analyse the impact of overweight and obesity on the use of allied health services among middle-aged and older people, including dietetic services, public health nurse visits and home help services. The results suggest that in addition to GP and hospital services, overweight and obesity are associated with increased use of allied health services, adjusting for socio-demographic and chronic disease factors. Moderate and severe obesity were associated with increased use of chiropody services, and morbid obesity was associated with increased use of dietetic services.

Health service utilisation varied according to BMI category. Individuals who were obese were more likely to have used services compared with normal weight individuals, but no significant difference was observed between overweight and normal weight individuals. The small number of studies that examined health service use across obesity categories found similar variation in results [11, 15], and it has been suggested that individuals who are severely or morbidly obese represent a different subgroup to those who are overweight or moderately obese [15].

Our findings support previous research on the increased use of GP services associated with overweight and obesity, and the inconsistent impact on hospital service use [7, 11, 14]. The difference between GP and hospital service use may be due to the strong gatekeeping role of GPs in the Irish health system. Our estimates suggest that the cost of overweight and obesity-related allied health services was approximately €1.5 million per annum. Few studies have included allied health services such as those examined in this article. A study of health service use using data from the Survey of Healthy Ageing and Retirement in Europe (SHARE) examined the use of home health care and domestic help in Europe, and found no significant association with overweight and obesity following adjustment for socio-economic status, lifestyle, chronic conditions and country [7]. Similarly, in this study, there was no statistically significant association between BMI and the use of home help services after adjustment for co-variates. This is unsurprising given the low levels (<5%) of state-provided home help services received by the older population in Ireland where the vast majority of caregivers for community-dwelling older people are unpaid [9].

Increased BMI is a major risk factor for a number of conditions including cardiovascular disease and diabetes [6], which are likely to lead to a greater need for and use of health services. However, previous studies have suggested that the association between overweight and obesity and health service use is only partially explained by the presence of chronic health conditions [4, 7]. Hence, obesity may represent an independent need factor within the health system. We applied the approach used by Doherty *et al.* [11] to disentangle the direct impact of BMI on health service use from
Table 2. Estimated additional costs of health services due to overweight and obesity among adults aged ≥50

<table>
<thead>
<tr>
<th>Model with residual on chronic conditions</th>
<th>Hospital admissions</th>
<th>GP visits</th>
<th>OPD visits</th>
<th>Chiropody</th>
<th>Dietician</th>
</tr>
</thead>
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<tr>
<td>Overweight (25.00–29.99 kg/m²)</td>
<td>€4,560,070</td>
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<tr>
<td>Moderately obese (30.00–34.99 kg/m²)</td>
<td>€17,886,100</td>
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<tr>
<td>Severely obese (35.00–39.99 kg/m²)</td>
<td>€825,992</td>
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<td></td>
</tr>
<tr>
<td>Morbidly obese (≥40 kg/m²)</td>
<td>€667,015</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>€17,886,100</td>
<td>€12,400,135</td>
<td>€8,403,688</td>
<td>€919,662</td>
<td>€667,015</td>
</tr>
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Confidence intervals are based on the marginal effects reported in Supplementary data, Appendix 2 available in Age and Ageing online.

Estimates adjusted for complex survey design (weights applied).

In conclusion, we found that overweight and obesity were associated with increased use of GP, hospital and dietetic and chiropody services among middle-aged and older adults, and that increased use of GP and hospital services was almost €1.5 million per annum. Given the growing costs associated with obesity, and improvements in life expectancy, an increasingly obese older population presents new challenges for health service delivery [8], the indirect impact through chronic conditions. Having removed the BMI-related impact on chronic conditions including psychological disorders, we found that overweight and obesity were associated with increased use of services. An Australian study found that co-morbid major depression explained most of the excess health service use among those who were underweight, overweight and obese, independent of other chronic conditions [25]. Depression was one of the chronic conditions included in our analysis; however, data were based on self-reported doctor diagnosis of any emotional, nervous or psychiatric problems so the effect of major depression may have been underestimated. We also included clinically significant depressive symptomology based on CES-D scores; however, this did not alter the independent effect of BMI on health service utilisation.

It has been suggested that the treatment of obesity itself and not the related chronic conditions may be driving service utilisation [7]. The increased use of dietetic services among those classified as morbidly obese found in this study may reflect multidisciplinary management in severe cases, although a multidisciplinary approach is recommended across all levels of obesity according to the NICE guidelines for the prevention and management of overweight and obesity [26]. Whether obesity represents an independent need factor within the health system remains controversial. The American Medical Association recently voted to recognise obesity as a disease requiring medical intervention for treatment and prevention [27]. Although cited as a way to improve the management of obesity by healthcare professionals, several concerns have been raised including the problems with defining obesity based on BMI and the impact it will have on individual responsibility [28].

We analysed data from a large nationally representative random sample of middle-aged and older adults. The majority of TILDA participants underwent a detailed health assessment. However, health assessment participants were younger, more likely to have private health insurance and engaged in healthier lifestyles [17, 18]. Hence, the estimates of service use in this study may be conservative for the older old with higher levels of illness and disability. Standardised objective measures of height and weight were used to calculate BMI. Previous studies have relied on self-reported height and weight to calculate BMI [7, 13], which may underestimate the prevalence of obesity [29]. As this is a cross-sectional study, it is not possible to infer causality; higher use of GP services among overweight and obese individuals may reflect active management of the problem in primary care.

In conclusion, we found that overweight and obesity were associated with increased use of GP, hospital and dietetic and chiropody services among middle-aged and older adults, taking socio-demographic factors and chronic disease status into consideration. The estimated incremental cost of overweight- and obesity-related allied health services was almost €1.5 million per annum. Given the growing costs associated with obesity, and improvements in life expectancy, an increasingly obese older population presents new challenges for health service delivery [8],...
particularly given the underdeveloped primary care infrastructure in Ireland.

**Key points**

- Few studies have examined the use and cost of allied health services associated with overweight and obesity in the older population.
- We analysed data from a nationally representative random sample of people aged 50+, recruited to The Irish Longitudinal Study of Ageing.
- In addition to the increased use of GP and hospital services, overweight and obesity were associated with increased use of dietetic and chiropody services, with an estimated cost of almost €1.5 million euro per annum.

**Conflicts of interest**

None declared.

**Funding**

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**Supplementary data**

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

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Survival in elderly men in relation to midlife and current BMI

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Abstract

Background: The relationship between BMI and mortality is U-shaped in the elderly but may be modified by midlife BMI and change in weight.

Objective: To elucidate mortality prediction by BMI trajectory in older men.

Subjects: The Oslo cohort of men born in 1923–32 were screened for BMI and cardiovascular risk in 1972–73. Survivors were rescreened at ages of 68–77 years, and all-cause mortality was followed from 2000 to 2011.

Methods: We calculated Cox regression proportional hazards for 11-year mortality rates in relation to BMI change among 5,240 men with no reported disease in 1972–73 and complete data. Models were adjusted for demographics, medications and disease. Men with BMI < 25 kg/m² in midlife (1972–73) and in 2000 were the reference group.

Results: Men whose BMI changed from <25 kg/m² in midlife to 25–29.9 kg/m² in 2000 carried the lowest mortality risk (hazard ratio [HR] 0.84; 95% confidence interval [CI] 0.75–0.94). Men with BMI ≥ 30 kg/m² in midlife were at highest risk (HR 1.79; 95% CI 1.12–2.88 if reclassified to 25–29.9 kg/m² in 2000 and HR 1.39; 95% CI 1.05–1.85 if BMI remained ≥30 kg/m² in 2000). Men with BMI 25–29.9 kg/m² in midlife that reclassified to <25 kg/m² in 2000 had increased risk. Findings were similar when percentage change in BMI was the outcome.

Conclusion: Survival in older men with normal weight at midlife was associated with BMI gain after midlife while midlife obesity increased risk regardless of subsequent change.

Keywords: BMI, mortality, ageing, older people