Obesity History as a Predictor of Walking Limitation at Old Age

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Abstract

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Objective: To study whether walking limitation at old age is determined by obesity history.

Research Methods and Procedures: In a retrospective longitudinal study based on a representative sample of the Finnish population of 55 years and older (2055 women and 1337 men), maximal walking speed, body mass, and body height were measured in a health examination. Walking limitation was defined as walking speed <1.2 m/s or difficulty in walking 0.5 km. Recalled height at 20 years of age and recalled weight at 20, 30, 40, and 50 years of age were recorded.

Results: Subjects who had been obese at the age of 30, 40, or 50 years had almost a 4-fold higher risk of walking limitation compared to non-obese. Obesity duration increased the age- and gender-adjusted risk of walking limitation among those who had been obese since the age of 50 (odds ratio, 4.33; 95% confidence interval, 2.59 to 7.23, $n = 114$), among the obese since the age of 40 [6.01 (2.55 to 14.14), $n = 39$], and among the obese since the age of 30 [8.97 (3.06 to 26.29), $n = 14$]. The risk remained elevated even among those who had previously been obese but lost weight during their midlife or late adulthood [3.15 (1.63 to 6.11), $n = 71$].

Discussion: Early onset of obesity and obesity duration increased the risk of walking limitation, and the effect was only partially mediated through current BMI and higher risk of obesity-related diseases. Preventing excess weight gain throughout one's life course is an important goal in order to promote good health and functioning in older age.

Key words: obesity duration, BMI, mobility, chronic disease, older people

Introduction

Obesity is a significant and growing health problem in industrialized societies and an important risk factor for a number of chronic conditions including type 2 diabetes, hypertension, cardiovascular diseases, osteoarthritis, and certain cancers (1,2). Furthermore, obesity increases the risk for functional disability and mobility limitation (3–8), and these limitations, in turn, decrease the independence and quality of life among older people (9,10).

An association between obesity and mobility limitation has been proven in cross-sectional (4,11–13) and prospective studies (3,14–17). There is also evidence that high BMI, both past and current, and long-term weight change are associated with greater risk for self-reported functional limitation (3,18). However, to our knowledge, no earlier studies have analyzed the effects of early vs. late onset of obesity or obesity duration on mobility limitation among older people.

It is possible that a history of obesity influences mobility through obesity-related diseases, such as diabetes and osteoarthritis, which are also well-known risk factors for functional limitation (6,19). It has been shown that the duration of obesity is associated with type 2 diabetes (20–23) and the metabolic syndrome (21). The effects of obesity duration on hypertension have been studied to a lesser extent, and the results are still unclear (24). In addition, several studies have shown that the magnitude of obesity increases the risk for osteoarthritis (25–28). Therefore, it is assumed that obesity duration may also be associated with osteoarthritis. The aim of this study was to investigate whether walking

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limitation is determined by early onset of obesity and obesity duration during life course in a representative sample of the Finnish population 55 years or older.

Research Methods and Procedures

Study Design and Subjects

The study is based on the Health 2000 Survey, a comprehensive nationwide health interview and examination survey carried out in Finland from 2000 to 2001 (29). The two-stage stratified cluster sample comprised 8028 adults 30 years or older, living in mainland Finland either in the community or in institutions. Subjects 80 years or older were oversampled (2:1) in relation to their proportion in the population. The sample for the present study was limited to subjects 55 years or older ($n = 3392$), 2055 women and 1337 men.

The data were collected in two phases. First, a structured health interview (mean duration, 90 minutes) was completed at the participant's home by a trained interviewer for 3186 subjects (94% of the sample). A health examination was carried out for 2572 subjects (76% of the sample) by trained professionals in a nearby study center. In addition, 306 subjects (9% of the sample) not able or willing to participate in the study center examinations took part in an abbreviated health examination at their place of living. A questionnaire, asking about, e.g., previous weights, was completed by 2639 persons (78% of the sample). A complete weight history was obtained from 2153 subjects (63% of the sample). All participants signed informed written consent forms approved by the Ethics Committee for epidemiology and public health in the hospital district of Helsinki and Uusimaa in Finland.

Measurements

Walking Limitation. Maximal walking speed was measured over a distance of 6.1 m (30) using a stopwatch. Subjects were instructed to "walk to the end of the course as fast as you can," starting from a standstill. Walking aids were allowed if the person normally used them when walking. The reliability of the walking speed test, measured with the intraclass correlation coefficient, was moderately good ($r = 0.77$).

Self-reported walking difficulty was assessed using the question: "Are you able to walk about one-half a kilometer without resting?" The four response options were: without difficulty, with minor difficulties, with major difficulties, and not at all.

Participants were considered to have walking limitation if their walking speed was <1.2 m/s ($n = 388$) or they were unable to finish the test ($n = 45$). Speed of 1.2 m/s was chosen as a proxy for the ability to cross a street safely at traffic lights (31). For those who did not participate in the walking test ($n = 32$), self-reported difficulty walking 500 m was considered to indicate walking limitation. Of all persons with both measured and self-reported information on walking limitations, 78% of persons reporting difficulty in walking 500 m had walking speed <1.2 m/s.

Obesity History. Current weight to the nearest 100 grams and standing height to the nearest 0.5 cm were measured at the health examination, with subjects wearing light clothing and no shoes. In the questionnaire, subjects were asked to recall their height at the age of 20 and weight at the ages of 20, 30, 40, and 50 years.

BMI was subsequently calculated as weight (kilograms) divided by the square of height (meters squared). BMI at ages 20, 30, 40, and 50 years was calculated on the basis of the recalled weight at each of the given ages and height at the age of 20 years. Based on previous studies, it was assumed that body height had not changed substantially between the ages of 20 and 50 years (32,33). In addition, subjects were asked whether they had gained or lost weight during the last 12 months and whether the weight change was intentional or unintentional. Subjects who had unintentionally lost 5 kg or more during the past year were excluded from the analyses ($n = 134$ persons), as were those who were currently underweight ($n = 10$).

Based on BMI at the given ages, subjects were classified into non-obese (<30 kg/m^2) and obese (≥ 30 kg/m^2) according to the criteria of the World Health Organization (2). Subjects were then categorized according to the duration of obesity: never obese; previously obese, but currently non-obese; currently obese, but non-obese at the ages of 20 to 50 years; obese since the age of 50 years; obese since the age of 40 years; and obese since the age of 30 years. Those who had been obese since the age of 20 years ($n = 3$) were merged with the last category. Those 11 persons with a history of weight cycling (i.e., obese at the age of 30 or 40, non-obese at the age of 50, and currently obese) were excluded from the analyses. Thus, the final sample for this study consisted of 2034 subjects.

Covariates. The health status of those who attended the study center health examination was ascertained by a specially trained physician using structured, uniform diagnostic criteria based on current clinical practice. Those who did not attend the health examination gave a self-report of diseases diagnosed by a physician. The subjects were asked about 42 medical conditions: "Has a doctor ever told you that you have. . . ?" Information on diabetes, hypertension, heart failure, and knee and hip osteoarthritis was taken into account when adjusting for the medical covariates.

Smoking status was based on self-reports, and the subjects were categorized into three groups: never smokers, former smokers, and current smokers. Never smokers included those who had smoked for less than 1 year of their life. Former smokers were defined as persons who had quit smoking at least a month prior. Alcohol use was measured as the average weekly consumption (grams per week) dur-

Table 1. Descriptive characteristics of the study sample by obesity history categories ($n = 2034$)

	Never obese ($n = 1360$)	Previously obese ($n = 71$)	Currently obese ($n = 436$)	Obese since 50 years of age ($n = 114$)	Obese since 40 years of age ($n = 39$)	Obese since 30 years of age ($n = 14$)	p
Age (years)	65.9 ± 8.1	65.5 ± 9.0	67.0 ± 8.1	62.4 ± 6.5	63.5 ± 7.5	61.5 ± 8.1	<0.0001
Current BMI (kg/m^2)	25.6 ± 2.7	27.3 ± 2.0	32.6 ± 2.5	34.5 ± 3.8	37.1 ± 5.3	35.3 ± 5.8	<0.0001
Women (%)	53	42	64	57	52	29	0.0003
Users of walking aids (%)	6	16	14	12	16	16	<0.0001
Physically inactive (%)	20	30	35	29	44	35	<0.0001
Poor self-rated health (%)	15	24	20	24	26	33	<0.0001
Diabetes (%)	4	26	11	16	32	15	<0.0001
Hypertension (%)	29	45	43	47	61	56	<0.0001
Heart failure (%)	3	9	6	2	7	7	0.005
Knee osteoarthritis (%)	9	21	21	18	33	30	<0.0001
Hip osteoarthritis (%)	8	18	14	9	3	7	<0.0001
Smoking (%)							0.12
Current	15	27	12	13	19	15	
Former	26	28	27	32	29	41	
Never	59	45	61	56	52	44	
Alcohol consumption (%)							0.01
Heavy	6	6	4	7	8	7	
Moderate	56	46	47	42	47	63	
No alcohol	39	48	49	50	45	30	
Education (%)							<0.0001
Basic (0 to 9 years)	24	22	33	38	39	26	
Intermediate (10 to 12 years)	49	56	51	49	49	66	
Higher (≥13 years)	26	22	16	13	13	8	

Means and standard deviations are presented for continuous variables and proportions for categorical variables.

ing the past month, based on self-reported consumption of different drink types; the categories were no alcohol use, moderate use, and heavy use. The limit for heavy use was set at 280 g/wk in men and 140 g/wk in women according to currently valid Finnish guidelines (34,35). The level of education was based on the highest completed degree reported in the interview and classified as basic education (0 to 9 years), intermediate education (10 to 12 years), and higher education (13 years or more).

According to literature, all of the above covariates are associated with walking limitation (6). The association between covariates and obesity history was ascertained before the analyses (Table 1).

Statistical Analysis

Differences in group characteristics (Table 1) were compared using one-way ANOVA for continuous variables, whereas χ^2 test was used for categorical variables. Differences in walking limitation prevalence (Table 2) within and between groups were calculated with χ^2 and Cochran-Mantel-Haenszel tests, respectively.

A hierarchical set of logistic regression analyses was used to examine the associations between obesity duration and walking limitation (Table 3). Subjects who had never been obese served as the reference group. Model 1 was adjusted for age and gender. In Model 2, in addition to age and gender, socioeconomic and health behavioral factors were examined, whereas Model 3 included also obesity-related chronic diseases. To study the effect of obesity duration on walking limitation beyond the effect of current obesity, a subgroup analysis for obese persons was carried out with logistic regression analysis. The linearity of the association between obesity duration and walking limitation was tested with the SAS-GLM procedure.

Table 2. Prevalence of walking limitation in obesity history categories and among the currently obese persons (%)

	Men* (n = 877)	Women* (n = 1157)	<70 years† (n = 1321)	≥70 years† (n = 713)	Total*† (n = 2034)
Obesity history					
Never obese	15	23	9	41	19
Previously obese, currently non-obese	26	48	21	74	37
Currently obese but non-obese at 20 to 50 years of age	24	37	20	58	31
Obese since 50 years of age	26	54	27	70	43
Obese since 40 years of age	37	59	37	57	49
Obese since 30 years of age	44	70	35	100	57
p Value within group	‡	§	§	§	§
p Value between groups	§		§		
Currently obese	26	41	23	59	35
p Value between groups	§		§		

* Adjusted for age.
† Adjusted for gender.
‡ p Values for within- and between-group differences: $p < 0.05$.
§ p Values for within- and between-group differences: $p < 0.0001$.

Statistical analyses were completed using SAS version 9.1 (SAS Institute, Inc., Cary, NC). For the analyses, the data were weighted to reduce the bias due to non-response and to correct for the oversampling in the age group of 80 years and older. The complex sampling design was taken into account by using SUDAAN procedures version 9.0 (SUDAAN Language Manual, RTI International, Research Triangle Park, NC).

Results

The mean age of the subjects was 68 years (range, 55 to 99 years). A total of 30% of them were currently obese (BMI ≥ 30 kg/m^2). Of the obese subjects, 72% had not been obese at the ages of 20, 30, 40, or 50 years, 19% had been obese since the age of 50 years, 6% since the age of 40 years, and 2% since the age of 30 years. The majority of obese persons were women, except in the group of those who had been obese since the age of 30 years (29% women). Those with the longest obesity duration more frequently rated their health poor and were physically more inactive, as compared with those who had never been obese (Table 1). Table 1 shows the detailed descriptive characteristics of the study subjects in the various obesity duration categories.

Subjects who had been obese at the age of 30, 40, or 50 years had more walking limitation than those who had not been obese. The age- and gender-adjusted risk of walking limitation for those groups were odds ratio (OR),[1] 3.61 [95% confidence interval (CI), 1.47 to 8.88]; OR, 4.02 (95% CI, 2.29 to 7.08); and OR, 3.76 (95% CI, 2.57 to 5.48), respectively. In addition to negative effect of obesity at young adulthood and midlife, obesity duration increased the risk for walking limitation. The highest prevalence of walking limitation was found among those who had been obese ever since the ages of 30 and 40 years, 57% and 49%, respectively (Table 2). Moreover, walking limitation was more common among women than men ($p < 0.0001$) and among subjects 70 years and older than among their younger peers ($p < 0.0001$) in each obesity duration category. However, there was no significant interaction between gender and obesity duration in walking limitation ($p = 0.12$) nor between age and obesity duration ($p = 0.09$). Therefore, further analyses were conducted with the total study population.

Figure 1 indicates that the longer subjects had been obese, the higher the risk for walking limitation. Subjects who had been obese since the age of 30 years had a 9 times higher risk for walking limitation, as compared with those who had never been obese. Test for linear trend (excluding group of previously obese) was statistically significant ($p < 0.0001$).

Table 3 shows the results from the hierarchical set of logistic regression analyses. Model 1 examined the age-

[1] Nonstandard abbreviations: OR, odds ratio; CI, confidence interval.

Table 3. Risk (OR) for walking limitation by obesity history categories and the mediating factors

	Model 1		Model 2		Model 3	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Obesity history						
Never obese	1.00		1.00		1.00	
Previously obese, currently non-obese	3.15	1.63 to 6.11	2.75	1.35 to 5.59	1.83	0.83 to 3.82
Currently obese, but non-obese at ages 20 to 50 years	2.29	1.70 to 3.09	2.15	1.58 to 2.91	1.76	1.29 to 2.40
Obese since 50 years of age	4.33	2.59 to 7.23	4.01	2.41 to 6.69	3.26	1.85 to 5.75
Obese since 40 years of age	6.01	2.55 to 14.14	4.69	1.73 to 12.70	3.07	1.15 to 8.24
Obese since 30 years of age	8.97	3.06 to 26.29	9.65	2.94 to 31.71	6.47	1.51 to 27.71
Age*	1.15	1.13 to 1.16	1.14	1.12 to 1.16	1.13	1.11 to 1.15
Gender†	1.68	1.33 to 2.13	2.00	1.47 to 2.73	2.02	1.47 to 2.77
Education						
Basic (0 to 9 years)			2.84	1.97 to 4.11	2.61	1.77 to 3.83
Intermediate (10 to 12 years)			1.76	1.22 to 2.52	1.67	1.13 to 2.47
Higher (≥13 years)			1.00		1.00	
Smoking						
Current			2.61	1.76 to 3.88	2.75	1.84 to 4.12
Former			1.32	0.91 to 1.90	1.23	0.86 to 1.75
Never			1.00		1.00	
Alcohol use						
Heavy			1.99	1.04 to 3.78	1.94	0.98 to 3.85
Moderate			1.00		1.00	
None			1.77	1.31 to 2.37	1.65	1.22 to 2.23
Diabetes					2.19	1.48 to 3.24
Hypertension					1.43	1.09 to 1.88
Heart failure					2.7	1.43 to 5.10
Knee osteoarthritis					1.92	1.39 to 2.65
Hip osteoarthritis					2.14	1.46 to 3.12

OR, odds ratio; CI, confidence interval. Model 1, adjusted for age and gender; Model 2, Model 1 + adjusted for education, smoking, and alcohol use; Model 3, Model 2 + adjusted for obesity-related chronic diseases.
* Age in years.
† Reference for gender is male.

and gender-adjusted risk for walking limitation in obesity duration categories. ORs for walking limitation increased with a longer obesity duration up to 8.97 (95% CI, 3.06 to 26.29) for those who had been obese since the age of 30 years. The risk for walking limitation was significantly elevated also among those who were currently obese but had not been obese at the ages of 20 to 50 years (OR, 2.29; 95% CI, 1.70 to 3.09) and among currently non-obese persons who had previously been obese (OR, 3.15; 95% CI, 1.63 to 6.11). Unfortunately, we had no information on whether this weight loss had been intentional or unintentional.

After adjusting for the effects of education, smoking, and alcohol use (Model 2), the ORs were attenuated, but the association between obesity duration and walking limitation remained statistically significant in each obesity duration category. Adjusting for chronic diseases substantially reduced the effect of obesity duration on walking limitation (Model 3). However, the risk for walking limitation was statistically significant in each obesity duration category, except among those who had previously been obese but were currently non-obese (OR, 1.83; 95% CI, 0.83 to 3.82). In the final model, all of the covariates remained statistically significant.

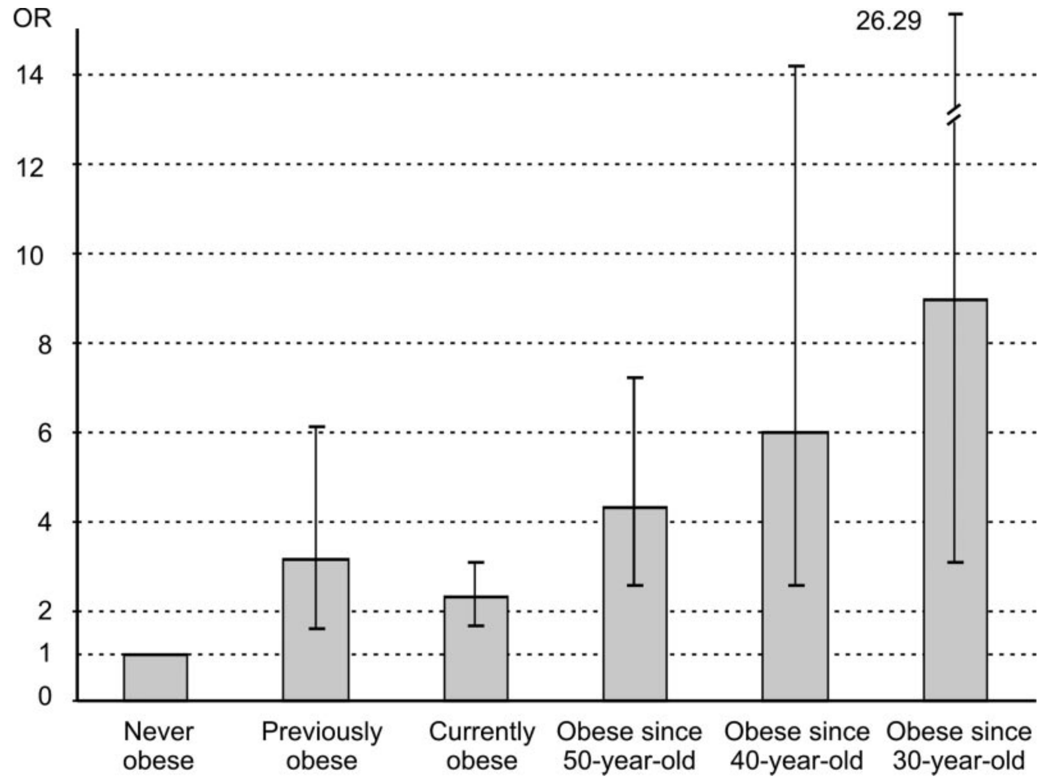

Figure 1: Age- and gender-adjusted risk (OR) and 95% CIs for walking limitation according to obesity history.

Despite a clear upward trend in ORs of walking limitation observed with the longer obesity duration, CIs were relatively wide among the longest obesity duration (obese since the age of 30 years). This was a consequence mainly of the limited quantity of observations in that category. To confirm the results of our study, additional analyses were performed in which the two obesity duration categories of the longest durations (obese since the ages of 30 and 40 years) were merged. The results of these analyses confirmed that the risk for walking limitation was higher among those who had been obese for the longest period of time.

It is possible that the observed effect of obesity history is partly explained by the current BMI because those who have been obese for a long time tend to have a higher BMI than those who have become obese more recently (Table 1). Therefore, the independent effect of obesity duration on walking limitation was analyzed separately among currently obese persons. After adjusting for age, gender, and current BMI, the ORs of walking limitation were 1.63 (95% CI, 0.90 to 2.97) for the obese since the age of 50 years, 1.89 (95% CI, 0.73 to 4.87) for the obese since the age of 40 years, and 3.13 (95% CI, 0.90 to 10.94) for the obese since the age of 30 years, when compared with subjects who were currently obese but had been non-obese at the ages of 20 to 50 years. Despite a borderline significance, the test for linear trend among obesity duration categories was statistically significant, indicating positive association with walking limitation.

In addition, a statistically significant independent effect of obesity history on walking limitation appeared when the last two categories were merged. According to this analysis, the ORs of walking limitations were 1.63 (95% CI, 0.90 to 2.95) for the obese since the age of 50 years and 2.14 (95% CI, 1.03 to 4.43) for the obese since the age of 40 years. Adjusting for chronic diseases did not substantially alter these associations.

Discussion

In this population-based study, risk of walking limitation was increased because of early onset of obesity and obesity duration, independently of age, gender, education, health behavioral factors, and obesity-related diseases. It was also found that obesity history had an additional effect on walking limitation beyond the effect of current BMI.

To our knowledge, previous studies have not examined the effect of obesity duration on mobility limitation or disability. The results of the present study complement the knowledge about the association between obesity and mobility limitation from cross-sectional (4,11–13) and prospective studies (3,14–17). It is an important finding that, in addition to the magnitude of obesity, long-term or previous obesity exposes persons to excess risk of walking limitation. This emphasizes the importance of maintaining a normal body weight throughout one's lifespan to prevent obesity-related health risks and loss of functioning.

The results of this study suggest that the effect of obesity history on walking limitation is mediated mainly through chronic obesity-related diseases. The longer the duration of obesity, the greater the risk of developing chronic obesity-related diseases and conditions (20–22). The impact of chronic diseases on walking limitation was particularly prominent among those who had previously been obese but were currently non-obese. It is likely that many of those subjects had lost weight unintentionally due to underlying inflammatory processes or diseases, but unfortunately data are not available to differentiate between intentional and unintentional weight loss. Although weight loss is generally recommended for obese persons (36,37), unintentional weight loss may have adverse effects on mobility among older people (3,14).

Although a large proportion of the effect of obesity history on walking limitation was mediated by chronic diseases, health behavioral factors and education explained part of that association. One important health behavioral factor, physical activity, was not included in our models because we did not have information about physical activity preceding the onset of walking limitation. It is obvious that walking limitation tends to reduce physical activity; therefore, including current physical activity in the explanatory models might have biased the results.

In addition to the covariates studied, there may be other factors that partially mediate the effect of long-term obesity on walking limitation. It is known that obese persons are physically more sedentary than normal-weight persons, and long-lasting sedentary lifestyle has a negative effect especially on muscle strength (38) and aerobic capacity (39), which, in turn, are prerequisites for good mobility (40–42). Therefore, long-term obesity may lead to mobility limitation through decreased physical performance, as well. Unfortunately, information about lower limb strength and aerobic capacity was not available for this study.

To study the independent effect of long-term obesity on walking limitation beyond the effect of current BMI, a subgroup analysis among the currently obese subjects was performed. We did not study the effects of current BMI and obesity history simultaneously among the total study population because information about current BMI was partially included in the categorization of obesity history. In addition, it is not likely that current BMI has a similar effect in each obesity history category because the association between BMI and mobility limitation seems to be non-linear (16). The results of the subgroup analysis among obese persons suggested that a long history of obesity is an independent risk factor for walking limitation and not just a correlate of current high BMI.

How should we then determine long-term obesity? It is typically evaluated by the number of years since the onset of obesity (21,24,43). However, this method ignores the fluctuation of body weight over the course of a lifetime that may result in overestimation of the duration of obesity. Another way to determine obesity history is to collect information about weight at different time-points and to define obesity status at each time-point as a binary (present or absent) (20,44), as we have done in this study. The advantage of this method is that it also offers information about previous obesity of the currently non-obese persons. In addition, using this type of obesity history categorization, we were able to study the effect of obesity throughout the lifespan.

There are several important strengths in the present population-based study. First, the sample was well representative of the middle-age and older Finnish population, and the participation rate was relatively high, indicating external validity of the findings. However, we had to exclude several persons from the analyses because not all subjects had complete information about their previous weights. To confirm our findings, additional analyses were performed on all subjects who had information about current BMI and at least two previous weights. These analyses did not show any significant differences in the primary results, suggesting that our findings can be generalized to the Finnish population and probably also to other white populations. Secondly, the Health 2000 Survey provided retrospective information starting from the age of 20 years that allowed us to study the phenomenon extensively. In other obesity history studies, the information about obesity history has generally been collected over a relatively short period of time (maximum 10 years) (21,22,44). Finally, information about walking limitation and chronic diseases was based primarily on clinical examination, supplemented with self-reports. This combination was chosen to include those subjects in the analysis who did not participate in the health examination. Otherwise, we would have missed the most diseased and disabled persons.

When interpreting the findings, one must consider the limitations of this study. First, the use of recalled weights over several decades may produce bias. Studies have shown that currently obese persons tend to underestimate and currently low-weight persons tend to overestimate their previous weights (45–47). In this study, the effect of obesity on the recall accuracy was controlled with the categorization of obesity history. Apart from body weight, other factors that might affect the accuracy of recalled weights include gender (45,47,48), race (45,47), and recall period (46). To reduce the potential bias, these variables, excluding race, were adjusted in our models. On the other hand, there is evidence that people can recall their past body weights over a long period of time with good accuracy (45–47,49,50). For example, Tamakoshi et al. (46) compared self-reported weight at age of 25 years with previously measured weight among Japanese men 34 to 61 years old. They found a strong correlation between the recalled and measured weights ($r = 0.85$). In addition, other studies have shown high correlations ($r \geq 0.80$) between recalled and measured weight in young adulthood among middle-age and older men and women (47,50).

Secondly, no information about baseline functional limitation was available, which prevents us from making any causal conclusions. However, it has been shown in several prospective studies that obesity precedes mobility limitations (3,14–17). In addition, mobility difficulties are highly uncommon in the younger population. According to the Health 2000 Survey, only 0.7% of the 30- to 39-year-old Finns had difficulties walking 500 m, supporting the interpretation that obesity precedes mobility difficulties. To get more accurate information about the effect of obesity on mobility limitation, prospective studies with repeated body composition and physical performance measurements are needed. In addition, it would be useful to study other potential mediating factors that cause mobility limitation among obese persons, namely low muscle strength, aerobic capacity, and physical activity. From the preventive viewpoint, it would also be important to gain knowledge about the effect of successful weight loss on mobility among obese persons (14,37). So far, intervention studies on the effect of weight loss in elderly people are scarce, but they suggest that among obese persons, weight reduction through diet and physical exercise may have positive effects on functional limitation and disability (51–53).

In conclusion, the findings of this study demonstrate that early onset of obesity and obesity duration increase the risk of walking limitation among middle-age and older persons, and the effect is only partially mediated through current BMI and higher risk of obesity-related diseases. Besides targeting interventions to currently obese persons, it is likely more important to prevent the excess weight gain throughout one's life course in order to promote good health and functioning in older age.

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