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The contribution of overweight, obesity, and lack of physical activity to exit from paid employment: a meta-analysis
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This meta-analysis provides insight into the role of overweight, obesity, and lack of physical activity on three routes of premature exit from paid employment. In order to protect workers against displacement from the labor force, particularly due to disability pension, workplace health prevention programs to reduce overweight and obesity and promote physical activity are urgently required.

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The contribution of overweight, obesity, and lack of physical activity to exit from paid employment: a meta-analysis

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Objectives The objective of this review was to analyze systematically the association between overweight, obesity, and lack of physical activity (PA) and exit from paid employment through disability pension, unemployment, and early retirement. We also aimed to identify the influence of study population and study design on the magnitude of this association.

Methods We searched PubMed and Embase for English language, longitudinal, quantitative studies that described the relationship between overweight, obesity, or lack of PA and exit from work. A short checklist was used to assess the internal and external validity of the studies. We first estimated the pooled effects using a random effects model and then analyzed the influence of study and population characteristics on associations by stratified meta-analyses.

Results In total, 28 out of 1097 publications met the inclusion criteria. Obese [relative risk (RR)=1.53] and, to a lesser extent, overweight (RR=1.16) individuals had an increased likelihood of exit from paid employment through disability pension, but were not at statistically significant increased risk for unemployment or early retirement. Of 17 associations between a lack of PA and disability pension, 8 were statistically significant; this was also the case for 2 of 3 for unemployment. No associations were statistically significant for early retirement.

Conclusions Obesity is a risk factor for exit from paid employment through disability pension. There are also indications that a lack of PA is related to an increased risk of disability pension and unemployment. To protect workers against premature exit from paid employment, long-term interventions to prevent overweight and obesity and promote PA in the working population should be considered for implementation.

Key terms disability pension; early retirement; systematic review; unemployment.

Life expectancy is steadily increasing in developed countries. Governments are seeking to increase the proportion of elderly persons in paid employment by both extending working life through a higher official retirement age and preventing premature exit from paid employment. Therefore, many policies and programs are introduced to improve sustainable employability. In order to develop successful interventions to reduce premature exit from paid employment, insights into important modifiable risk factors for exit from paid employment are needed. From previous studies it is known that poor health is an important determinant of exit from paid employment, particularly due to disability pension (1). Furthermore, poor health has also been found to increase the likelihood of labor force exit into unemployment and early retirement (1). However, less is known about the role of important modifiable behavioral and social risk factors for poor health, especially lack of physical activity (PA) and obesity, in displacement from the labor force through disability pension, unemployment, and early retirement.

Recent studies have shown that a lack of PA and obesity are important risk factors for productivity loss at work (2), sickness absence (2), and reduced work ability (3). Numerous health promotion programs for a
healthier lifestyle have been offered to employees. These programs are also often evaluated in terms of health and productivity. In recent years, several systematic reviews have been conducted that corroborate the influence of lifestyle-related factors, mainly obesity, on productivity loss at work (4–6), and sickness absence (5–8). However, there is less insight into the particular role of these factors on different routes of premature exit from paid employment.

A systematic review of 16 cross-sectional and longitudinal studies reported that a higher body mass index (BMI) was significantly associated with disability pension (9). The potential contribution of overweight, obesity, and lack of PA to unemployment and early retirement is less well known.

In order to understand and quantify the importance of these factors on different labor market exit pathways, the literature needs to be synthesized. Hence, we conducted a systematic review and meta-analysis. The aims were to (i) describe the influence of overweight, obesity, and lack of PA on exit from paid employment through disability pension, unemployment, and early retirement, and (ii) identify the influence of study population and study design on the magnitude of this association.

**Methods**

Identification of the studies

Relevant articles were identified by means of a computerized search in the bibliographic databases PubMed, Embase, and Web of Science up to 31 December 2012. The search terms were related to (i) a lack of PA or overweight/obesity, (ii) early retirement or unemployment or disability pension, and (iii) a longitudinal design. The detailed search for each bibliographic database can be found in Appendix A (www.sjweh.fi/data_repository.php). To be included, articles had to meet the following criteria: (i) describe the relationship between overweight, obesity, or lack of PA and exit from paid employment through early retirement, unemployment, or disability pension; (ii) study this relationship in a longitudinal design; (iii) express the strength of the relation in a quantitative measure or provide sufficient information to calculate a quantitative measure and corresponding confidence interval; and (iv) be written in English. Studies on specific patient populations were excluded from this review.

Selection

The first author performed the literature search and selected titles and abstracts. A broad selection of studies was used so that we could include studies in the screening that did not primarily focus on the risk factors overweight, obesity, or lack of PA, but rather included these factors as confounding factors. Subsequently, the second author selected the fulltext articles to be included in the meta-analysis. In case of doubt, the first author was consulted.

Figure 1 shows the flow of the articles throughout the inclusion process. Based on title and abstract, 990 of 1097 articles (90%) were discarded because 818 abstracts (75%) did not describe exit from paid employment as an outcome, 156 abstracts (14%) did not study the role of lifestyle-related factors on exit from paid employment, and 16 abstracts (1%) did not describe a longitudinal study. In total, 107 articles were retrieved for full review of which 79 were excluded (74%) for various reasons (see figure 1). In case of duplicate use of data sets, the study providing the most complete information was chosen. Finally, 28 articles (3%) met our inclusion criteria.

Data extraction

The first author extracted information on population characteristics (sex, age, country of study), study characteristics (number of participants, length of follow-up), occurrence of exit from paid employment and the magnitude of the association with corresponding confidence intervals. When more associations were presented within a study, the maximal adjusted association was chosen.

Quality evaluation

The methodological quality was assessed according to an abbreviated version of the Methodological Evaluation of Observational Research checklist (10). Criteria for quality assessment in this systematic review addressed four items on internal (response, subject flow) and external validity (adjustment for confounding factors, loss to follow-up), whereby each criterion was scored as 1 (sufficiently met), 0 (insufficiently met or lack of essential information). The contrast in measurements is restricted to objective or subjective measurement of determinants and outcomes since all included studies derived comparable information. Therefore, no additional information concerning measurement quality will be presented. The detailed information on quality aspects is presented in Appendix B (www.sjweh.fi/data_repository.php).

Data synthesis and data analysis

The first step in the meta-analysis was to estimate the pooled effects using an excel spread sheet for pooling of relative risks (11). Due to observed heterogeneity (heterogeneity statistics $I^2 >50\%$ for disability pension) between studies, a random effects model was used in the meta-analysis on reported hazard ratios.
Robroek et al (HR), odds ratios (OR), and relative risks (RR). These measures of association were used interchangeably and interpreted as an expression of RR. Random-effects meta-analysis assumes that there are real differences between individual studies regarding the magnitude of the association between health determinants and exit from paid employment. It considers both between- and within-study variability (12).

The standard definitions for obesity (BMI≥30 kg/m²) and overweight (25≤BMI<30 kg/m²) will be used. For those studies that used other definitions (13, 14), BMI>27.5 kg/m² was considered as obesity, and BMI>22.5 kg/m² was considered to reflect overweight. In case BMI was presented as a continuous variable (15, 16), it was transformed to the corresponding categories with the assumption of a constant risk increment (17).

Subsequently, the influence of study and population characteristics on associations between obesity and overweight with exit from paid employment was analyzed by a stratified meta-analysis.

Results

In total, 28 longitudinal studies described the influence of BMI or lack of PA on disability pension (N=22), unemployment (N=5), or early retirement (N=3). One study provided associations with disability pension, unemployment, and early retirement (18). The study sizes varied between N=781 (19) and N=1 191 027 (20) and the median follow-up time was 10 years with a range of 2.5 (21) to 38 (20) years. Several studies presented more than one risk estimate, either through stratification (ie, gender), several cut-offs for the determinants, or numerous outcome measures. Therefore, the sum of associations presented for disability pension (obesity: N=29, overweight: N=23, lack of PA: N=17), early retirement (obesity: N=6, overweight: N=6, lack of PA: N=3), and unemployment (obesity: N=3, overweight: N=6, lack of PA: N=2) was >28 (Appendix C www.sjweh.fi/data_repository.php). Because of the

**Figure 1.** Flow chart describing the article search process. *One study included unemployment, early retirement, and disability pension as outcome measures [Robroek et al (18)]
Disability pension

Fifteen (13, 15, 16, 18, 20–30) and 17 studies (13, 15, 16, 18, 20, 21, 23–33) investigated the influence of overweight (23 associations) and obesity (29 associations) on the risk of disability pension, respectively (see figure 2). In 15 of 23 associations, overweight was a statistically significant risk factor with an overall estimate across all 23 associations of RR=1.53 (95% CI 1.35–1.72). The stratified meta-analysis shows stronger associations for obesity in Scandinavian (RR=1.57, 95% CI 1.39–1.78) than non-Scandinavian studies (RR=1.21, 95% CI 0.81–1.81). There were no differences in associations between studies performed among women (RR=1.53, 95% CI 1.27–1.86) or men (RR=1.56, 95% CI 1.29–1.87). Studies with a longer follow-up period showed slightly higher RR (RR=1.57, 95% CI 1.36–1.81; follow-up period ≥10 years: RR=1.57, 95% CI 1.36–1.81; follow-up period <10 years: RR=1.44, 95% CI 1.32–1.58). The more recently a study was published, the more likely they reported a lower association estimate (published in/after 2002: RR=1.44, 95% CI 1.25–1.66; published before 2002: RR=1.85, 95% CI 1.51–2.26). Concerning quality characteristics, there were no major differences in risk estimates between studies with a response level < or >30% or studies that did or did not adjust for other lifestyle factors. Studies with objective information (RR=1.67, 95% CI 1.44–1.94) on obesity were more likely to report a stronger association estimate than those based on self-reported information (RR=1.30, 95% CI 1.19–1.43). Studies lacking information about the flow of subjects were, although not statistically significant, more likely to report a stronger association between obesity and disability pension (RR=1.64, 95% CI 1.35–1.99 versus RR=1.46, 95% CI 1.24–1.71).

Ten studies (13, 16, 18, 22, 24, 31, 34–37) investigated the influence of lack of PA during leisure time on the risk of disability pension, presenting 17 associations (figure 5). In 8 of these associations, lack of PA was a statistically significant risk factor for disability pension. With the exception of one study (24), all presented a RR>1 for the association between lack of PA and disability pension.

Unemployment

Four (14, 18, 38, 39) and two studies (18, 38) investigated the influence of overweight (6 associations, none statistically significant) and obesity (3 associations, 1 statistically significant) on unemployment, respectively (see figure 3). After pooling, no statistically significant associations were found between obesity (pooled RR=1.20, 95% CI 0.64–2.25) or overweight (pooled RR=1.02, 95% CI 0.90–1.16, figure 3) and unemployment. Two studies (18, 19) investigated the influence of lack of PA during leisure time on unemployment presenting three associations (figure 5). Two of these associations presented a statistically significant increased risk of lack of PA on unemployment (figure 5).

Early retirement

Three studies (18, 40, 41) investigated the influence of overweight or obesity on early retirement presenting six associations (see figure 4). One of these associations presented an increased risk of early retirement among obese individuals, but no statistically significant association was found when all six studies were pooled (pooled RR=1.07, 95% CI 0.95–1.20, figure 4). Two of six associations presented a statistically significant increased risk of early retirement among overweight individuals, but again no statistically significant association was found when all the studies were pooled (pooled RR=1.08, 95% CI 0.95–1.23, figure 4). The two studies investigating the association between lack of PA and early retirement reported no statistically significant increased risk of early retirement (18, 40).

Discussion

This meta-analysis provides insight into the role of overweight, obesity, and lack of PA during leisure time on premature exit from paid employment. Obese – and to a lesser extent overweight – workers had an increased likelihood of exit from paid employment through disability pension among both men and women, but obesity was not a risk factor for unemployment or early retirement. Workers with lack of PA had an increased risk of disability pension and unemployment, but not of early retirement.

The finding that obesity, and to a smaller extent overweight, are related to future disability pension confirms the results of a previous systematic review on eight longitudinal studies (9). The majority of the studies included in the current review consistently reported a statistically significant association between obesity and disability pension in spite of different definitions.
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Figure 2. Association between obesity, overweight and disability pension. Body mass index as a continuous variable was transformed to the corresponding categories with the assumption of a constant risk increment.

Figure 3. Association between obesity, overweight, and unemployment.

Figure 4. Association between obesity, overweight, and early retirement.

Figure 5. Association between lack of physical activity and disability pension, unemployment and early retirement.

for both risk factor and outcome. Interestingly, in several studies, a lack of PA during leisure time was also a significant risk factor for disability pension. However, the available evidence in longitudinal studies suggests that obesity is more important than PA for sustained employability. Since the majority of the studies did not report information concerning the underlying reason for disability pension, we were not able to disentangle whether the relation between obesity and lack of PA with disability pension is mediated by specific diseases.

The increased risk of disability pension among obese workers is in line with the findings of recent studies on the relation between obesity and one hand and productivity loss at work and sick leave on the other hand (4–8, 42). The results imply that the increasing prevalence of obesity in most Western countries is a concern with
regard to work participation and sustainable employ-
ability. A healthy lifestyle and body weight are important for a productive workforce.

Three studies were included that reported on the association between obesity and unemployment and 
early retirement. The pooled estimate was weak and 
non-significant, suggesting that obesity plays a minor 
role in displacement from the labor market through both 
pathways. In general, these pathways are to a lesser 
extent driven by health problems (1). Other financial 
or social factors might play a more important role in 
these pathways of exit from work than might be the 
case when leaving the labor market through a specific 
health-related pathway such as disability pension (43).

Few studies investigated the relationship between a 
lack of PA and exit from work. Only two studies evaluated 
the role of lack of PA on early retirement and unemploy-
ment. For both disability pension and unemployment, 
several studies found lack of PA to be a risk factor. Other 
lifestyle-related factors, such as smoking or an unhealthy 
diet, were not evaluated in this meta-analysis. Several 
studies have shown that such lifestyle factors, particularly 
smoking, may play a role in premature exit from paid 
employment, especially through disability pension (18, 
38). Promoting a healthy lifestyle might thus be a way 
to prevent workers from leaving the workforce too early. 
Interventions could range from organizational workplace 
changes that enhance the ability of employees to engage 
in PA [eg, flexible working conditions (44)] to workplace 
health promotion and onsite PA and healthy eating initia-
tives (45). Most intervention studies on workplace health 
programs have follow-up periods of at best 24 months, 
which is far too short to demonstrate a noticeable impact 
on work participation. In order to gain more insight into 
the role of lifestyle on sustained labor participation, stud-
ies with repeated measurements during longer follow-up 
periods are needed.

Socioeconomic status is a potential confounder for 
the relation between lifestyle-related factors and exit 
from work. From previous studies, it is known that 
an unhealthy lifestyle and obesity are more prevalent 
among individuals in lower socioeconomic groups (46). 
Furthermore, individuals with a lower education or in 
a lower occupational class are more likely to leave the 
labor force due to disability pension, unemployment, 
or early retirement (1, 47). However, in the stratified 
meta-analysis no systematic lower risk of exit from paid 
employment was observed between studies adjusting for 
socioeconomic status, educational level, or job type and 
the studies that did not adjust for these factors. A potential 
explanation might be that the response in questionnaire 
surveys is typically higher among higher educated 
employees and, thus, study populations reflect better 
higher-educated populations.

A strength of this systematic review is the avail-
ability of various studies on disability pension, which 
supported an informative meta-analysis. In contrast, 
only few studies evaluated the role of obesity and lack 
of PA on early retirement and unemployment. There are 
also some limitations in this systematic review. First, the 
literature search was limited to three electronic databases 
and English publications. Therefore, it is possible that 
we still missed some useful studies. Second, there is 
substantial variation among studies concerning definitions 
for determinants (particularly for lack of PA) and out-
comes, the follow-up period, and the study populations. 
With the exception of three studies (18, 21, 33), all used 
register-based outcome data. We found that the method 
of measurement of determinant (self-report or objective 
measurement) did influence the pooled estimate. Stud-
ies based on objective information to define BMI were 
more likely to find a stronger association with disability 
pension. A possible explanation might be that weight is 
dererreported in studies using self-reported information. 
Since the heterogeneity in definitions was limited, we 
decided to pool the studies investigating overweight and/ 
or obesity in spite of heterogeneity. Third, the majority of 
studies are from Scandinavian countries, hampering the 
generalizability of findings to other countries. The strati-
ified meta-analysis shows stronger associations between 
obesity and the risk of disability pension among obese 
individuals in Scandinavian compared with non-Scandi-
vavian countries. This prompts a need for studies in other 
countries to corroborate or refute the association between 
obesity and disability pension. Last, although publication 
bias cannot be ruled out, there was no relation between 
the magnitude of risk estimates and their standard errors.

After summarizing the literature, it can be concluded 
that obesity is a risk factor for exit from paid employ-
ment through disability pension, but there is no evidence 
of a relationship with other routes of exit from work. 
There are also indications that a lack of PA during lei-
sure time was related to an increased risk of disability 
pension and unemployment. Although our meta-analysis 
is unable to identify the mechanisms through which 
obesity, overweight, and lack of PA contribute to labor 
market exit, it strongly suggests that – in order to main-
tain a productive and healthy workforce and protect 
workers against premature exit from paid employment – 
the implementation of long-term interventions and 
policies to promote PA and prevent overweight and 
obesity be considered.

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