Introduction

Obesity is increasingly common among working-age populations, with 70% of the U.S. adults being overweight or obese. In many European countries, the prevalence of overweight has exceeded 50% and obesity affects 20% of the adult population. Obesity is strongly associated with several chronic diseases, increased sickness absence and disability retirement. Sickness absence and disability retirement produce expenses to employers, employees and society, therefore adding to the financial burden of the present economic crisis in Western countries.

The association between obesity and increased risk of long-sickness absence is well established. However, studies on the association between obesity and short-sickness absence are few, and the results remain unclear. Our previous studies have found an increased risk for both short and long-sickness absence among obese employees, but all studies have not verified the association of obesity and short-sickness absence.

Although weight change is common during adult life, less is known about the association between weight change and sickness absence. There is evidence that weight change is associated with decreased functioning, occurrence of pain, risk of diseases and increased mortality, and therefore it is plausible that weight change is associated with sickness absence. Measuring weight at only one time-point may lead to incomplete findings, as previous weight change could bias the results regarding the effects of obesity. Recent study on health-related consequences of Body Mass Index (BMI) stressed that considering changes in BMI is crucial when examining the effects of obesity.

Two previous studies have examined weight change and sickness absence. Evidence from the Whitehall II study showed a slightly increased risk for sickness absence among those who were normal weight at the age of 25 years but obese at middle age. In a U.S. study, there was an association between weight change and sickness absence, and the influence of weight change depended on participants’ baseline BMI. However, although the U.S. study used measured weight, weight change and sickness absence were recorded at the same time-point, and the sickness absence was self-reported. A thorough understanding of the association between weight status and sickness absence is still lacking, and the measures to prevent the adverse consequences of obesity in work-life are insufficient.

Our aim was to examine the associations between weight changes and subsequent sickness absence among women and men. We examine whether the risk for sickness absence is affected by both baseline weight and subsequent weight change, and whether the risk is different for short- and long-sickness absence. We used survey data at two time-points linking these to register-based data on subsequent sickness absence while considering a range of covariates.

Methods

This study is part of the Helsinki Health Study cohort examining employees of the City of Helsinki. The City of Helsinki is the largest employer of Finland. The employees represent several hundreds of different blue-collar and white-collar occupations. The baseline questionnaire survey was mailed to 40–60-year-old employees during 2000–2002 (n = 8960, response rate 67%). The follow-up questionnaire with identical questions was mailed to the respondents of the baseline questionnaire in 2007 (n = 7332, response rate 83%). According to the non-response analysis, the data represent the target population satisfactorily. The data from the baseline and follow-up surveys were linked with employer’s sickness absence registers among employees who gave a written consent for the linkage and who were still employed by the City of Helsinki at the time of the follow-up survey (n = 4237). According to the analyses of non-consenting to data...
linkage, the consenters represent the target population satisfactorily. Those who were pregnant (n = 10) or with missing data on height and weight (n = 63) were excluded. Thus, the final study population included 4164 employees, of whom 709 were men. The study was approved by the ethics committees of the Department of Public Health, University of Helsinki, and the health authorities of the City of Helsinki.

**Study variables**

Self-reported weight and height were derived from the baseline and follow-up questionnaires. Weight change was calculated from the difference between the baseline and follow-up. The respondents were divided into seven groups according to their baseline weight and weight change: (i) normal weight weight-maintainers (baseline BMI 18.50-25.00, weight change <5%), (ii) normal weight weight-gainers, (baseline BMI 18.50-24.99, weight gain of ≥5%), (iii) overweight weight-maintainers (baseline BMI 25.00-29.99, weight change <5%), (iv) overweight weight-gainers, (baseline BMI 25.00-29.99, weight gain of ≥5%), (v) obese weight-maintainers (baseline BMI 30 or over, weight change <5%), (vi) obese weight-gainers (baseline BMI 30 or over, weight gain of ≥5%) and (vii) weight-losers (weight loss of ≥5% irrespective of baseline BMI).

The number of sickness absence spells during the follow-up was used as the outcome variable. Data on sickness absence were based on the employer’s registers, which are also the basis for salary. The employees of the City of Helsinki can take a self-certified sickness absences lasting 1–3 days but after that medical certification is required. Sickness absence spells were divided into short (1–3 days), intermediate (4–14 days) and long absence spells (more than 14 days). The follow-up started the day following the return of the follow-up questionnaire and continued until the end of 2010, or until retirement, death or the end of work contract. The mean follow-up time for sickness absence was 2.7 years (SD 0.86).

**Covariates**

Age, working conditions, occupational class, smoking, alcohol use, leisure-time physical activity and physical and mental functioning were used as covariates. These covariates were chosen, as they have been found to be associated with obesity and work disability in earlier studies and were assumed to contribute to the association between weight change and sickness absence. Covariates were obtained from baseline questionnaire, except for occupational class, which was obtained from personnel register data.

Age was treated as a continuous variable. Working conditions covered shift work, physical working conditions and psychosocial working conditions. Physical working conditions were assessed with an inventory developed at the Finnish Institute of Occupational Health. A factor analysis of the inventory was used to compress the data for the analyses. The factors included (i) physical workload, (ii) hazardous exposures, such as solvents, gases or noise and (iii) computer work, including sedentary work. Factor scores were divided into quartiles. Psychosocial working conditions were measured using Karasek’s job content questionnaire. Job demands and job control were assessed separately, and were assumed to contribute to the association between weight change and sickness absence.

**Statistical methods**

First, the incidence of sickness absence spells by 100 person-years by weight change category was calculated. Second, gender interaction was tested. Because an interaction was found, the data were analysed separately among genders. Third, Poisson regression was used to calculate rate ratios (RRs) for the risk of different lengths of sickness absence in weight change categories. Model 1 was adjusted for age. Model 2 included age, socio-economic position and working conditions. Model 3 was adjusted for age, smoking, alcohol use and leisure-time physical activity. Model 4 included age and physical and mental functioning. Model 5 was full model including all covariates. Next, sensitivity analyses were performed. First, weight-losers were categorized into two groups to evaluate whether the effect of weight loss is different depending on baseline weight. Second, weight change was defined as using a 10% limit instead of the 5% limit. Third, weight change was categorized as weight loss (<5%), weight-maintaining and weight gain (≥5%) without stratification for baseline BMI and analysed adjusting for age and BMI category while testing for interaction. Fourth, Model 1 was adjusted additionally for prior sickness absence (1 year before baseline).

**Results**

Table 1 shows key characteristics of the data. Among women, normal weight weight-maintainers had the lowest number of sickness absence spells (Table 2). The highest number of sickness absence spells was found among obese weight-gainers in each spell length category. Also weight-losers had more sickness absence spells than normal weight-weight-maintainers. Among men, the highest number of short and intermediate sickness absence spells was found among overweight weight-gainers and the highest number of long-term sickness absence spells was found among obese weight-maintainers. Similar to women, even among men, weight-losers had more sickness absence spells of all lengths than normal weight-weight-maintainers.

Among women (Table 3), the risk of short-sickness absence was highest among obese weight-gainers (age-adjusted RR 1.66, 95% CI 1.41-1.96) and obese weight-maintainers (RR 1.55, 95% CI 1.32-1.82). Normal weight weight-gainers, overweight weight-gainers and weight-losers also had a somewhat elevated risk compared with normal weight-weight-maintainers. Overall, adjusting for covariates had but minor effects on the results. Only among weight-losers, obese weight-maintainers and obese weight-gainers adjusting for physical and mental functioning slightly lowered the risk for short-sickness absence.

Similarly to short-sickness absence, obese weight-maintainers and obese weight-gainers had the highest risk for intermediate sickness absence (age-adjusted RR 2.07, 95% CI 1.71-2.52 and RR 1.98, 95% CI 1.61-2.45, respectively). Also normal weight weight-gainers, overweight weight-maintainers, overweight weight-gainers and overweight weight-maintainers.

**Table 1 Mean characteristics of the data among women and men**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean 53.7</td>
<td>Mean 54.5</td>
</tr>
<tr>
<td></td>
<td>SD 5.6</td>
<td>SD 5.7</td>
</tr>
<tr>
<td>Follow-up time (years)</td>
<td>Mean 2.7</td>
<td>Mean 2.7</td>
</tr>
<tr>
<td></td>
<td>SD 0.9</td>
<td>SD 0.9</td>
</tr>
<tr>
<td>Baseline BMI (kg/m2)</td>
<td>Mean 25.17</td>
<td>Mean 26.00</td>
</tr>
<tr>
<td></td>
<td>SD 4.41</td>
<td>SD 3.84</td>
</tr>
<tr>
<td>Change in BMI (kg/m2)</td>
<td>Mean 1.15</td>
<td>Mean 0.98</td>
</tr>
<tr>
<td></td>
<td>SD 1.58</td>
<td>SD 1.47</td>
</tr>
<tr>
<td>Short absence (n/person)</td>
<td>Mean 4.53</td>
<td>Mean 2.77</td>
</tr>
<tr>
<td></td>
<td>SD 5.23</td>
<td>SD 4.23</td>
</tr>
<tr>
<td>Intermediate absence (n/person)</td>
<td>Mean 1.69</td>
<td>Mean 1.00</td>
</tr>
<tr>
<td></td>
<td>SD 2.39</td>
<td>SD 1.69</td>
</tr>
<tr>
<td>Long absence (n/person)</td>
<td>Mean 0.59</td>
<td>Mean 0.38</td>
</tr>
<tr>
<td></td>
<td>SD 1.06</td>
<td>SD 0.78</td>
</tr>
</tbody>
</table>
weight-losers had an elevated risk for intermediate sickness absence. Adjusting for socio-economic position, working conditions and physical and mental functioning attenuated the risks somewhat, whereas health behaviours had negligible effects (Table 3).

The age-adjusted risk for long-sickness absence spells was most elevated for obese weight-maintainers and obese weight-gainers (RR 2.23, 95% CI 1.59–3.12 and RR 2.19, 95% CI 1.53–3.15, respectively).

The risk was also elevated for weight-losers, overweight weight-maintainers and overweight weight-gainers. Again, adjusting for physical and mental functioning attenuated the risk somewhat, whereas adjusting for health behaviours attenuated the risk only slightly. After full adjustment, the risk remained elevated among obese weight-maintainers and obese weight-gainers (RR 1.68, 95% CI 1.24–2.28 and RR 1.64, 95% CI 1.18–2.27, respectively) (Table 3).

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### Table 2 Weight changes over follow-up and subsequent number of sickness absence spells of different lengths (per 100 person-years)

<table>
<thead>
<tr>
<th>Weight change</th>
<th>Women</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Short absence</td>
<td>Intermediate absence</td>
<td>Long absence</td>
<td></td>
<td>Short absence</td>
<td>Intermediate absence</td>
<td>Long absence</td>
<td></td>
<td>Short absence</td>
<td>Intermediate absence</td>
<td>Long absence</td>
</tr>
<tr>
<td>Stable normal weight</td>
<td>1140</td>
<td>139</td>
<td>46</td>
<td>19</td>
<td>212</td>
<td>85</td>
<td>27</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal weight, weight gain</td>
<td>709</td>
<td>174</td>
<td>60</td>
<td>23</td>
<td>91</td>
<td>101</td>
<td>35</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable overweight</td>
<td>515</td>
<td>147</td>
<td>60</td>
<td>26</td>
<td>172</td>
<td>100</td>
<td>31</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight, weight gain</td>
<td>379</td>
<td>171</td>
<td>69</td>
<td>28</td>
<td>80</td>
<td>130</td>
<td>55</td>
<td>15</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Stable obesity</td>
<td>202</td>
<td>187</td>
<td>88</td>
<td>38</td>
<td>43</td>
<td>97</td>
<td>51</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obesity, weight gain</td>
<td>164</td>
<td>226</td>
<td>92</td>
<td>41</td>
<td>29</td>
<td>66</td>
<td>41</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight loss</td>
<td>344</td>
<td>165</td>
<td>70</td>
<td>30</td>
<td>82</td>
<td>104</td>
<td>31</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>3453</td>
<td>160</td>
<td>60</td>
<td>25</td>
<td>709</td>
<td>98</td>
<td>35</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### Table 3 Weight changes and risk ratios for short, intermediate and long absences with 95% confidence intervals

<table>
<thead>
<tr>
<th>Absence length</th>
<th>Gender</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Full</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short absence</td>
<td>Women</td>
<td>1.24 (1.11–1.37)</td>
<td>1.22 (1.10–1.35)</td>
<td>1.20 (0.98–1.33)</td>
<td>1.17 (0.96–1.29)</td>
<td>1.09 (0.77–1.55)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.49 (1.27–1.74)</td>
<td>1.26 (1.18–1.57)</td>
<td>1.18 (0.94–1.18)</td>
<td>1.13 (0.90–1.15)</td>
<td>1.22 (0.92–1.63)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.50 (1.27–1.77)</td>
<td>1.26 (1.16–1.35)</td>
<td>1.18 (0.94–1.18)</td>
<td>1.13 (0.90–1.15)</td>
<td>1.00 (0.79–1.26)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.27 (1.71–2.52)</td>
<td>1.77 (1.52–2.07)</td>
<td>1.72 (1.52–1.94)</td>
<td>1.63 (1.35–1.97)</td>
<td>1.71 (1.47–2.04)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.98 (1.61–2.45)</td>
<td>1.77 (1.52–2.07)</td>
<td>1.72 (1.52–1.94)</td>
<td>1.63 (1.35–1.97)</td>
<td>1.13 (1.05–1.56)</td>
</tr>
<tr>
<td>Intermediate absence</td>
<td>Men</td>
<td>1.80 (0.70–2.00)</td>
<td>1.26 (0.94–1.67)</td>
<td>1.44 (1.22–1.68)</td>
<td>1.27 (1.09–1.47)</td>
<td>1.05 (0.76–1.42)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.76 (1.50–2.05)</td>
<td>1.26 (1.04–1.51)</td>
<td>1.44 (1.22–1.68)</td>
<td>1.27 (1.09–1.47)</td>
<td>1.17 (0.86–1.66)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.42 (1.16–1.76)</td>
<td>1.26 (1.04–1.51)</td>
<td>1.44 (1.22–1.68)</td>
<td>1.27 (1.09–1.47)</td>
<td>1.05 (0.80–1.38)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.69 (1.05–2.51)</td>
<td>1.26 (1.04–1.51)</td>
<td>1.44 (1.22–1.68)</td>
<td>1.27 (1.09–1.47)</td>
<td>1.17 (0.86–1.66)</td>
</tr>
<tr>
<td>Long absence</td>
<td>Women</td>
<td>1.12 (0.71–1.40)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.12 (0.71–1.40)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.12 (0.71–1.40)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.12 (0.71–1.40)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
<td>1.00 (0.73–1.36)</td>
</tr>
</tbody>
</table>

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Model 1 adjusted for age.
Model 2 adjusted for age, socio-economic position and working conditions.
Model 3 adjusted for age, smoking, use of alcohol and the amount of exercise.
Model 4 adjusted for age, physical and mental functioning.
Model 5 adjusted for all covariates.
Among men, most associations between weight groups and sickness absence spells were weak, rarely reaching statistical significance (Table 3). Overweight weight-gainers and obese weight-maintainers had an increased risk for intermediate sickness absence spells (age-adjusted RR 1.76, 95% CI 1.20–2.58; RR 2.17, 95% CI 1.36–3.48, respectively). Similar to women, adjusting for socio-economic position and working conditions as well as physical and mental functioning attenuated the risk slightly.

Discussion

We studied the association between weight change and subsequent sickness absence, taking into account the baseline BMI and several covariates. Among women, those who maintained normal weight had the lowest risk for sickness absence. Weight loss, weight gain and stable obesity increased the risk for sickness absence spells of all lengths. The associations for long-sickness absence were somewhat stronger than for short-sickness absence. Long-sickness absence is generally because of chronic or otherwise serious illnesses, and many of such illnesses are associated with obesity. In contrast, short-sickness absence commonly results from more transitory conditions. Therefore, it is plausible that the association of relative weight and its changes with long absence is stronger than with short absence.

Among men, only few associations could be confirmed. This is probably because of the relatively small amount of men in the study population. Some weight change groups were small, for example, obese weight-gainers comprised only 29 men, and thus the associations with sickness absence are not reliable.

Weight losers had an increased risk for sickness absence of all lengths. In previous literature, weight loss has been associated with negative health outcomes, although the causes are not fully understood. Many serious diseases are associated with unintentional weight loss, whereas intentional weight loss has been associated with improved health. In the present study, it was not possible to distinguish those who had lost weight intentionally from those who had lost weight because of an illness. In our study, all weight losers were combined into the same group irrespective of their baseline BMI, as the number of weight losers was small (10% of study population). It has been suggested that the effect of weight loss depends on the baseline BMI. In sensitivity analyses, we separately examined weight-losers whose baseline BMI was more than 30, but the associations with sickness absence did not change notably according to the baseline BMI. Therefore, the role of weight loss requires further studies.

Sickness absence as a form of work disability is a multidimensional phenomenon. Employee’s health, functioning, work environment and health care system play roles in how work disability manifests in society. The present study showed that working conditions, occupational class and physical and mental functioning somewhat attenuated the risk for long-sickness absence. Our previous study on relative weight and sickness absence using the same baseline data as the present study found that although physical functioning attenuated the association between relative weight and sickness absence, working conditions and socioeconomic position did not. One possibility for the difference is that the follow-up period for sickness absence in the present study started several years later than in the previous study. Thus, the employees in the present study are older and they have been exposed to their working conditions for a longer time. For example, physical working conditions may be more arduous for older employees and therefore the amount of physical work could influence more sickness absence. In sensitivity analyses, we adjusted Model 1 additionally for prior sickness absence. The results did attenuate to a small extent when considering long-sickness absence but not when considering short-sickness absence. Contribution of health behaviours to the examined association between BMI and sickness absence was modest. This does not imply that health behaviours are unimportant when considering prevention, as health behaviours are associated both with obesity and sickness absence. The covariates were self-reported and derived from the baseline survey, and these behaviours could have changed over follow-up. Furthermore, the adjustments were not comprehensive, as no data on diet were available for in the analyses.

In our study, weight gain among the normal weight employees increased the risk of short-sickness absence. This could be because weight gain leads to obesity and the increased risk could only reflect the risk associated with obesity in the latter measurement point. However, half of the normal weight weight-gainers in our study still remained normal weight despite their weight gain, and only 1% of normal weight weight-gainers ended up being obese. We assume that for body fatness to cause health problems, one has to be exposed to body fatness for some time. Those with stable weight have been exposed to their weight for a longer time than those with weight change. Therefore, one should expect that overweight weight-maintainers would have higher risk ratios than normal weight weight-gainers. As this is not the case when considering short absence, we assume that weight gain itself could have an association with ill-health. Among obese weight-gainers and weight maintainers, the associations with sickness absence were almost equal. This could indicate that obesity is a strong risk factor for sickness absence but the risk associated with obesity does not increase by further weight gain. In a sensitivity analyses, we modelled sickness absence with weight change as a categorical measure, adjusting for age and baseline BMI category. According to analyses, weight gain was associated with sickness absence among men. This is in accordance with both previous studies on weight change and sickness absence. Similarly to our results, in the U.S. study, weight gain among normal weight employees increased the risk of sickness absence, whereas weight gain among obese did not.

On a practical level, it is important to acknowledge that obesity can potentially cause discrimination, and employees have a right to control their weight as they want. Nevertheless, obesity and weight gain are associated with ill-health, and work disability itself can cause suffering by means of decreased income and professional identity. Health behaviours including obesity are part of modern occupational health care, and health promotion measures should be available for employees at work places as well. This implies ethically sustainable methods avoiding negative labels.

Methodological considerations

A consensus on how to define weight change is lacking and therefore different definitions have been used. We defined weight change as a change of 5% from baseline weight and dividing participants according to their baseline BMI as normal weight, overweight and obese. In a sensitivity analyses, we also defined weight change using a 10% limit, but the results did not change notably. Small-scale weight fluctuation is common during middle age, and the mean weight change percent in our data set was 3.1 during a 5-7-year interval between the surveys. The strengths of this study include a large data set based on reliable register data, a prospective design and assessment of both weight change and weight maintenance in different BMI categories, a study design that has not been used previously.

Weight change was based on self-reported weight and height, which could lead to underestimation of the associations, as in surveys people tend to underreport overweight and obesity. However, our previous study on different weight measures as a predictor of sickness absence using the same baseline data as the present study found that BMI calculated from self-reported weight and height corresponded well with measured BMI, and thus major bias is unlikely.

The statistical methods included multiple testing, which can increase type I error.
Conclusion

Obesity and weight gain are associated with all lengths of sickness absence among women. A medical assessment and, if necessary, early support measures in occupational health care could benefit obese employees and those with notable weight change to maintain work ability. However, research on effective support measures is needed.

Acknowledgements

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Funding

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Conflicts of interest: None declared.

Key points

- Persistent obesity is associated with increased risk of short and long sickness absence among women.
- Weight gain among normal weight employees is associated with short-sickness absence among women.
- Weight loss is also associated with increased sickness absence. This finding requires further studies.
- Maintenance of normal weight is likely to reduce sickness absence. Early support measures in occupational health care could benefit obese employees and those with notable weight change to maintain work ability.

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