Low Back Pain among Cooks in Nursery Schools

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Abstract: A cross-sectional questionnaire study was conducted on cooks working for nursery schools in N city in order to verify epidemiological evidence of the work-relatedness of low back pain among them. After female workers aged 30 or more were selected from a study base of 2,799 workers in social welfare facilities, low back pain prevalence of cooks (n=240) was compared with nursery school teachers (n=955). Age-standardized prevalence ratios (PRs) of low back pain were 1.9 (95% CI: 1.5–2.5) in cooks compared with nursery school teachers. Among cooks, relative risks of low back pain increased with the increase in the number of lunches to be prepared and decreased with the increase in the number of cooks making lunches in a logistic regression model controlling age and body length. Low back pain was also found to be associated with self-estimated job stressors/ work load by logistic regression models. Multifactorial effects from ergonomic and psychosocial factors, and individual factors on the low back were suggested. From the viewpoint of epidemiological criteria for work-relatedness, it was concluded that the work-relatedness of low back pain among cooks in nursery schools was partially supported.

Key words: Cooks, Nursery schools, Lunches, Multifactorial

Introduction

Low back pain syndrome has been understood as one of the common work-related diseases with multifactorial etiology in recent decades1). The guidelines on the prevention of lumbago in the workplace2~ issued by the Ministry of Labor in Japan in 1994 listed several diverse activities causing low back pain on the basis of multifactorial etiology. Cooking tasks will involve at least two of those activities: handling heavy objects and standing erect while bearing an excessive burden on the back. There have been several studies3~5) on musculoskeletal problems among cooks for school lunch services. In some of them4,5,7), the biologic gradient, that is, the exposure-response relationship between the number of lunches to be prepared and low back pain prevalence, was reported. Later, musculoskeletal problems among cooks in smaller workplaces were also reported even though they usually prepared fewer lunches than those for school lunch services6~13). In most cases, however, the work-relatedness of their problems had not been epidemiologically studied using some rigorous criteria. To examine the association between work and the development of musculoskeletal disorders of the neck and limbs, Hagberg et al.14) applied the following criteria: (1) strength of the association, (2) temporal association, (3) consistency of the association, (4) predictive performance of the association including exposure-effect or exposure-response relationship, and (5) coherence of the association with current knowledge. Those criteria would also be applicable in examining the work-relatedness of other musculoskeletal disorders including low back pain.

Nursery school cooks usually make lunch for children...
and employees in the morning, and wash dishes, make snacks, and clean workplaces and grounds in the afternoon. Tasks for nursery school cooks were different from those for cooks in larger workplaces such as school lunch services in the following aspects. The number of lunches to be prepared by one cook was smaller in nursery school cooks (17–50 in the subjects) than in those for school lunch services (some 80–500). However, the former far less frequently used electric and/or mechanized cooking facilities and devices including dish washing and cutting machinery than the latter did. Usual cooking and washing tasks were only manually done without any modern cooking facilities and devices in nursery schools, which would force them to take constrained postures and to lift heavy objects. Thus, it was suspected that nursery school cooks were at risk of musculoskeletal disorders including back pain. As the number of cooks was usually smaller (two or three) in nursery schools than in school lunch services (usually more than three), close cooperation between cooks was especially necessary in order to manage their hectic tasks. Thus, psychosocial factors related to human relations were also suspected of having potential influence on health conditions among cooks in nursery schools.

The scope of this study was limited to low back pain because many musculoskeletal problems have been indicated in nursery school cooks, including epicondylitis, osteoarthritis of fingers, carpal tunnel syndrome, neck and shoulder pain, and low back pain, and there might be too diverse etiological bases among these problems to deal with in one study project. This study aimed to verify evidence of the work-relatedness of low back pain among cooks in nursery schools from the viewpoint of the epidemiological criteria.

Materials and Methods

A cross-sectional questionnaire study was done on cooks working for public nursery schools in N city. A branch of the municipal labor union in social welfare facilities agreed to participate in the study. The questionnaire was provided to all nonclerical full-time workers (n=2,829) in social welfare facilities, including 252 cooks and 1,447 teachers in nursery schools in 1992 and 1993. The number of workers who responded to the questionnaire was 2,799 (98.9%) involving 248 (98.4%) nursery school cooks and 1,434 (99.1%) nursery school teachers. From those responding, nursery school cooks were selected for this study. Nursery school teachers in the same workplaces were also selected as the referent workers. They took care of children from 0 to 5 years old and their tasks involved lifting and holding of children and forward bending and constrained postures in care of children.

The questionnaire included age, length of employment, physical dimensions including body length and weight, the number of cooks making lunches and lunches to be prepared, self-estimated job stressors/work load, low back pain, and pain at the neck, shoulders or arms. The severity of the pain in the previous month was ranked into five grades: (1) no pain, (2) occasional mild pain, (3) pain severer than mild pain but not so intense as to make workers take an occasional break/rest during work, (4) pain severe enough to make workers take an occasional break/rest during work, and (5) pain severe enough to make workers take occasional sick leave. Workers with low back pain were defined as having pains of grade 3 or more, in contrast to those with only occasional mild pain or no pain (grades 2 or 1). Body mass index (BMI) was calculated by dividing body weight (kg) by the square of body length (m).

In a comparison of prevalence, female workers aged 30 or more were studied because all cooks (n=248) and 99.5% (n=1,427 out of 1,434) of nursery school teachers were female, and the number of cooks below 30 was very few. Mean ages (s.d.) were 48.6 (6.8) for cooks (n=240) and 39.1 (6.1) for nursery school teachers (n=955). Lengths of employment in the current jobs were 14.3 (6.9) years for cooks and 17.0 (5.3) years for nursery school teachers. They fell into three age strata of 30–39, 40–49 and 50–59 years. In each age stratum, the prevalence ratio (PR) with its 95% confidence interval (95% CI) was calculated by dividing the prevalence among cooks by that among nursery school teachers. Age-standardized PR with precision-based 95% CI was also calculated as summary estimate.

Cooks were then divided into seven groups according to the number of lunches to be prepared and the number of cooks preparing them. Three subjects were not included in any groups because three cooks made lunches in their workplaces, whereas the number of lunches for them was only less than 90. The trend of low back pain prevalence with the number of lunches was tested by the Cochran-Armitage test. The Tukey multiple comparison (T-method) was done to test the difference between groups with regard to background conditions including age, length of employment, and physical dimensions.

In cooks, relative risks (RR), in other words odds ratios, were calculated by logistic regression models in order to study associations of low back pain with age, physical dimensions, and the numbers of lunches to be prepared and cooks preparing them. Some variables were eliminated after
the check of significance level (p=0.10) for the variable selection process using backward elimination. Then, associations of low back pain with self-estimated job stressors/work load were also studied by logistic regression models controlling age, body length and the numbers of lunches and cooks.

Calculations of PRs, RRs in logistic models, and multiple comparisons were done using the Statistical Analysis System (SAS) (SAS Institute Inc.) on the mainframe (Fujitsu: M-1800) in the Computation Center of Nagoya University. For the calculation of the Cochran-Armitage test, Microsoft Excel software (Microsoft Corporation) was used on an IBM-compatible personal computer. In general, expression of statistical significance was used in this study when null hypothesis was rejected by p-value less than 0.05 or when 95% CI of PR or RR did not contain 1.0 within its range.

**Results**

The prevalence of low back pain in the previous month was higher in cooks than in nursery school teachers (Table 1). The age-standardized prevalence ratios (PRs) of low back pain were 1.9 (95% CI: 1.5–2.5) in cooks compared with nursery school teachers. Three forth (75.9%) of cooks with low back pain also had pains in the neck, shoulders or arms, which was slightly higher than the proportion (66.3%) in the nursery school teachers with low back pain.

The prevalence significantly increased with an increase in the number of lunches to be prepared among groups with three or four cooks preparing lunches (p=0.039 by the Cochran-Armitage test) (Fig. 1). This trend was only slightly seen among groups with two cooks, being statistically insignificant (p=0.481). The two-cooks group had a higher prevalence than the three- or four-cooks group when both groups prepared the same number of lunches (90–104). Background conditions including age, length of employment and physical dimensions presented in Table 2 were not significantly different according to the T-method between groups in every comparative combination of groups.

In a logistic regression model for cooks, RRs of age and body length were 1.6 (95% CI: 1.0 to 2.4) and 1.9 (95% CI: 1.1 to 3.3), respectively, when differences of 10 years for age and 10 cm for body length were postulated (model 1 in Table 3). The length of employment was omitted from the model in order to avoid multicollinearity because it had a high correlation with age (r=0.81 p<0.0001). Body weight and BMI were also eliminated from the model in the backward variable selection process as their association with low back pain was regarded as statistically negligible. The numbers of lunches and cooks were also associated with low back pain (model 2 in Table 3). The RR

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**Table 1. Low back pain prevalence in cooks and teachers (NS teachers) in nursery schools and prevalence ratio (PR) with its 95% confidence interval (95% CI) in cooks compared with NS teachers (N=240)**

<table>
<thead>
<tr>
<th>Age</th>
<th>Cooks</th>
<th>NS teachers</th>
<th>Cooks vs NS teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Prevalence (%)</td>
<td>n</td>
</tr>
<tr>
<td>30–39</td>
<td>33</td>
<td>21.2</td>
<td>534</td>
</tr>
<tr>
<td>40–49</td>
<td>75</td>
<td>42.7</td>
<td>350</td>
</tr>
<tr>
<td>50–59</td>
<td>132</td>
<td>36.4</td>
<td>71</td>
</tr>
<tr>
<td>Total</td>
<td>240</td>
<td>36.3</td>
<td>955</td>
</tr>
</tbody>
</table>

*Age-standardized PR estimator with precision-based confidence interval.

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**Fig. 1. Trend of low back pain prevalence with the number of meals and the number of cooks preparing them**

Grade 3 in low back pain is pain severer than mild pain but not so intense as to make workers take an occasional break/rest during work. Grade 4 was pain severe enough to make workers take an occasional break/rest during work. Grade 5 was pain severe enough to make workers take occasional sick leave.
corresponding to the increase of 10 lunches was 1.3 (95% CI: 1.1 to 1.6) and that to one cook increase was 0.4 (95% CI: 0.2 to 0.9). The latter indicated the decrease in the risk of low back pain with the increase in the number of cooks.

Associations of low back pain with self-estimated job stressors/work load were found among cooks in logistic models controlling age, body length, and the numbers of lunches and cooks (Table 4). RRs were almost similar between models controlling age and body length only and those controlling the numbers of lunches and cooks in addition to age and body length (Table 4). Higher RRs were noted with regard to much static work posture (RR=4.7 or 4.8) and frequent repetitive work using shoulders, arms, hands or fingers (RR=7.1 or 8.9), followed by too many different tasks (RR=2.6 or 2.5). There were also several other job stressors/work load with RRs that were significantly higher than 1.0. Those were frequent lifting and handling of objects, frequent bending forward and/or half sitting, too much work, too much responsibility, great time pressure, difficult human relations at work, shortage of staff, and extra work due to the poor physical conditions of colleagues.

Discussion

It was noted that cooks had a higher prevalence of low back pain with 1.9 of PR even in comparison with nursery school teachers reported to be at risk of back pain\(^{1-20}\). Ono et al.\(^{18}\) reported that age-standardized relative risks were 1.6 for back accidents and 1.2 for back disorders among nursery school teachers (child-minders) as compared with the risks among the general population of all other employed women in Sweden. The present results suggests an extremely higher magnitude of the risk of low back pain among cooks. However, they were not compared with workers with lesser work load on the back than nursery school teachers in this study. Thus, it is unjustifiable and irrelevant to use the present results to underrate the risks among nursery school teachers.

As the number of lunches and many self-estimated job stressors/work load had associations with low back pain
among cooks, it was suggested that ergonomic and psychosocial factors had multifactorial effects on the low back. Higher RRs with regard to much static posture and frequent repetitive work suggest the influence and importance of ergonomic work load on the back. Observed by authors in inspectional visits to workplaces, repetitive work done by arms and hands would be combined with a constrained trunk posture in many tasks including cooking, dish washing and cleaning, which could construct main ergonomic work load for them together with frequent lifting and handling of objects, and frequent bending of the trunk. High prevalence of pain in the neck, shoulders or arms among cooks with low back pain would also support the above speculation regarding the relation between repetitive work and constrained trunk posture. On the other hand, the influence of psychosocial stressors including poor work organization was also suggested by the relatively high RRs with regard to too much responsibility and too many different tasks as well as to some other job stressors/work load including too much work, difficult human relations at work, and extra work due to the poor physical conditions of their colleagues. This assumption was supported by the review article by Bongers et al. on the association between psychosocial factors and back pain.

In this study, the trend of low back pain prevalence increasing with the number of lunches prepared was found among the three- or four-cooks groups. The two-cooks group had a higher prevalence than the three- or four-cooks group in the comparison between groups preparing 90–104 lunches. Moreover, the number of lunches had an association with low back pain with significantly higher RR (1.3) than 1.0 in the logistic regression model. This exposure-response relationship or biologic gradient will constitute predictive performance of the association to support work-relatedness of low back pain among cooks in the small facilities. The relationship was in accordance with the result in our previous study among cooks in the private nursery schools. Some studies in the larger school lunch services also supported such an exposure-response relationship between the number of lunches prepared and low back pain prevalence. The weaker relationship in the two-cooks groups in our study suggested the influence of other unknown uncontrolled factors including non-cooking tasks. Background conditions, however, including age, length of employment and physical dimensions, seemed unlikely to influence the relationship because of their similarity among all groups.

### Table 4. Association of low back pain with self-estimated job stressors and work load among cooks

<table>
<thead>
<tr>
<th></th>
<th>Controlling age and body length</th>
<th>Controlling age, body length, and no. of meals and cooks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95% CI</td>
<td>RR</td>
</tr>
<tr>
<td>Frequent lifting and handling of objects</td>
<td>2.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Much static work posture</td>
<td>4.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Frequent bending forward and/or half-sitting</td>
<td>2.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Frequent repetitive work using shoulders, arms, hands or fingers</td>
<td>7.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Too much work</td>
<td>2.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Too many different tasks</td>
<td>2.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Too much responsibility</td>
<td>2.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Much concentration required</td>
<td>1.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Great time pressure</td>
<td>1.9</td>
<td>1.1</td>
</tr>
<tr>
<td>Difficult human relations at work</td>
<td>1.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Shortage of staff</td>
<td>2.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Inexperienced in handling tasks</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Much unplanned work</td>
<td>1.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Extra work due to poor physical condition of colleagues</td>
<td>2.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Role ambiguity in the workplace</td>
<td>1.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Difficulties in acting on one’s own ideas</td>
<td>1.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Lack of frank discussion about work problems</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Difficulties in lowering work load at reduced working capacity</td>
<td>1.7</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Relative risks (RR) and 95% confidence intervals (95% CI) by logistic regression models were calculated by controlling age, body length, and the numbers of meals and cooks in one workplace (N=240).
Another important factor found in this study was the number of cooks, as its increase significantly decreased the RR of low back pain among cooks in the logistic regression model. Thus, it would be recommendable for the prevention of low back pain to reduce the number of lunches per cook by decreasing the number of lunches and/or increasing the number of cooks.

The number of lunches per cook was 17 to 50 in nursery schools, being far less than that in the school lunch services which were, in most cases, more than 100 and sometimes exceeded 400. Thus, the number of lunches should be studied in relation to the work load level in preparing a single meal and to related tasks including dish washing. On inspectional visits to nursery schools, the authors noticed that cooking facilities so rarely featured new labor-saving equipment that most cooks were engaged in continual manual tasks involving constrained trunk postures. The decrease in the work load resulting from the introduction of improved facilities and devices that was sometimes observed in the school lunch services was seldom the case in nursery schools. Moreover, kitchen layouts were often too poorly designed to facilitate the cooks' tasks either because of inadequate space or because necessary equipment and supplies were situated too low or high for convenient access. Thus, it was estimated that such poor ergonomic conditions would increase the risk of low back pain among cooks in nursery schools, even though the number of lunches per cook was far smaller than that in the school lunch services. Increase in age and body length was found to increase the risk of low back pain among cooks in the study. This result indicated the need of control for age and body length as confounders in epidemiological analyses aiming to make clear the work exposure effects on the low back among nursery school cooks. These results also suggested the importance of protecting disadvantaged workers with relatively advanced age or longer body length from excessive work exposure to them. Body weight and BMI, however, had little influence on the risk of low back pain.

The effect of age was in accordance with some studies, while there were also another study that did not find differences in low back pain prevalence among age groups. In those studies, however, effect of age was not analysed by simultaneously controlling other potential risk factors including work exposure and confounders such as body length. Thus, it would be worthy of note that the effect of age was found even by controlling body length and the numbers of lunches and cooks in our study. In general, aging would be accompanied by pathological changes in the musculoskeletal system or by decreases in muscular strength, which could reduce the enduring capacity of the back structures against work load and increase the risk of low back pain among workers. Our result regarding effect of age was coherent with this speculation based on the knowledge of musculoskeletal system.

In some studies, taller people were found to be at greater risk for low back pain, although there were also some studies which did not find any association between body length and low back pain. A suggested explanation of the higher risk among taller people was their ergonomic disadvantage, nutritional unfavorableness of a greater disc volume, and kinesiologically greater excursion of a taller pelvis. With regard to kitchen workers, Pekkarinen and Anttonen reported an increasing tendency in the prevalence of the disorders of the lumbar region with the increase in workers' body length. As kitchen layouts were poorly designed in nursery schools, it was suspected that taller cooks had often to bend deeply in using sinks, kitchen tables and other facilities which increased the load on the back. Thus, the association of body length with low back pain would be coherent with the current knowledge regarding the work of nursery school cooks.

To summarize the above epidemiological discussion, the work-relatedness of low back pain among cooks in nursery schools was partially supported. The association between work exposure and low back pain was suspected to be strong because of higher PR in cooks than in nursery school teachers and increased RRs for the number of lunches and several self-estimated job stressors/work load. The biologic gradient of low back pain prevalence was observed in relation to the number of lunches, which constitute predictive performance of the association. This gradient was consistent with other studies of cooks in similar and larger scale workplaces. The association of ergonomic and psychosocial factors with low back pain was coherent with current knowledge in the domain of occupational health. The coherence of association was also suspected with regard to the relation between low back pain and individual variables including age and body length. As the multifactorial effects of diverse ergonomic and psychosocial factors, and individual factors on the low back were suggested, the specificity of the association with limited factors was not considered. It would be misleading to use specificity as a criterion of work-relatedness of low back pain among nursery school cooks as Hagberg et al. indicated that specificity of the association would be low in work-related musculoskeletal disorders (WMSD). Since this study was cross-sectional, it would be irrelevant to refer to
the temporality of the association between work and low back pain. However, some speculative interpretation of such a temporal association would be possible since the study used retrospective occupational history variables such as job titles and self-estimated job stressors/work load.

This study roughly suggested the magnitude of diverse risk factors for the low back pain among cooks. In future studies, more precise work exposure assessments are necessary, including observational studies, ergonomic direct monitoring, and psychophysiological measurements. Intervening measures should also be taken in order to prevent low back problems. Ergonomic improvement by introducing improved kitchen facilities and devices to decrease the manual work load and constrained postures would be important, as would organizational changes including the reduction of the number of lunches per cook.

There were some limitations in this study. Information bias was not negligible because overrating or underrating among responders was not controlled in this questionnaire study. With regard to the validity of the comparison, nursery school teachers with a similar risk of low back pain were used in the study, even though prevalence was lower among them than among the cooks. In our analysis of the biologic gradient, age, the length of employment and physical dimensions were fortunately similar on average among all groups. However, possible effects of the difference among workplaces with regard to job stressors/work load were not systematically controlled because of the small sample size of the subjects. Thus, the biologic gradient might have been distorted to some extent. In the analyses of the association of low back pain with self-estimated job stressors/work load, each logistic model was calculated for one respective exposure factor among those factors. Plural factors from those exposure factors were not simultaneously put into one model. Thus, more valid and complicated models would have been possible if several exposure factors and interaction effect variables had been included at the same time. There was also the problem of multiple testing in selecting independent variables in logistic regression models, that would make the results imprecise.

References

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