International Journal of Industrial Ergonomics 91 (2022) 103339

Contents lists available at ScienceDirect

International Journal of Industrial Ergonomics

journal homepage: www.elsevier.com/locate/ergon

Active commuting and work ability: A cross-sectional study of chicken meat industry workers in Thailand

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ARTICLE INFO

Keywords:
Active commuting
Work ability
Poultry industry
Occupation

ABSTRACT

There is ample evidence regarding positive health effects of cycling or walking to work (active commuting [AC]). However, little is known about the effects of AC on work ability. Therefore, we examined 422 Thai chicken meat industry workers who assessed their current work ability (CWA) compared to their lifetime best by assigning scores ranging from 0 to 10. The CWA was compared between active and non-active commuters using linear regression, cumulative distributions, and quantile regression. Overall, 46 workers (11%) were active commuters. The average CWA score was 8.2 (standard deviation, 1.3; range, 4–10). It was higher by 0.5 units (95% confidence interval: 0.2–0.8) in active commuters. Cumulative distributions showed higher CWA scores among active commuters throughout the CWA scale, with the greatest difference (one CWA unit) at scores of 8–9. This benefit of AC persisted after adjustments and was observed at the 33rd, 50th, and 67th percentiles of CWA but not at percentiles higher or lower than the aforementioned ones. The model-predicted CWA scores for selected combinations of personal and work-related factors were up to two units higher among active commuters. In conclusion, active commuters have better work ability than non-active commuters. However, the potential effects may be limited to workers with good work ability.

Relevance to the industry: Since commuting is a necessary daily activity for most of the working population, AC may offer great potential to produce positive effects on work ability and health. AC should be encouraged and included in health promotion programs at national and organizational levels.

1. Introduction

Physical exercise in conjunction with habitual daily activities such as walking and cycling has beneficial health effects. Light-intensity physical activity may improve the cardiovascular risk factor profile (Chastin et al., 2019), reduce non-fatal and fatal coronary events (Manson et al., 1999), and reduce all-cause mortality (Chastin et al., 2019). Low-intensity recreational exercise is associated with better mental health (Ohta et al., 2007) and lower prevalence of depressive symptoms (Fukai et al., 2020). Consequently, light physical activity has been incorporated into current health recommendations (Ding et al., 2020; Piercy et al., 2018). Furthermore, moderate to high-intensity exercise during leisure time is associated with better cardiorespiratory fitness, lower incidence and mortality of cardiovascular events (Cheng et al., 2018; Lear et al., 2017), and better self-rated health (Eriksen et al., 2013). Leisure-time physical activity has also been linked to better self-reported work ability (Päivärinne et al., 2019).

Walking or cycling to work is a type of light to moderate physical activity, termed active commuting (AC). It has been associated with a lower incidence of cardiovascular diseases (Celis-Morales et al., 2017; Fan et al., 2019; Hamer and Chida, 2008), cancer (Celis-Morales et al., 2017; Patterson et al., 2020), diabetes (Hu et al., 2003), and lower cardiovascular and all-cause mortality (Andersen et al., 2000, Patterson et al., 2020). AC is also associated with better mental health (Ohta et al., 2007), especially in terms of stress and the ability to concentrate and enjoy daily activities (Martin et al., 2014). While most studies on AC are observational and may not prove causality, the effect of AC on cardiovascular risk factors has been demonstrated in experimental studies on

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https://doi.org/10.1016/j.ergon.2022.103339
Received 23 October 2020; Received in revised form 29 June 2022; Accepted 10 July 2022
Available online 11 August 2022
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cycling to work (Møller et al., 2011) or school (Østergaard et al., 2012).

Considering the beneficial health effects of AC, it can be assumed that AC also improves work ability. However, only one study involving male Japanese employees in an electronic company reported an association between AC and work ability (Tsuboi et al., 2017). Another population-based study in Australia focused on AC, job performance, and employee productivity (Ma and Ye, 2019). To obtain more information, we examined whether AC was linked to better self-perceived work ability among Thai chicken meat industry workers. The sample consisted of both men and women from various occupational groups with different work characteristics.

Thailand is a major producer of chicken meat and its products worldwide. In 2020, the country was ranked as the fourth-largest exporter after Brazil, the US, and the EU (Department of Trade Negotiations, 2021). There were 537 chicken slaughter factories (with the capability of slaughtering 5.03 million chickens per day) and 69 chicken product processing plants throughout the country. A total of 2.5 million tons of chicken meat were produced and 0.98 million tons were exported that year (Office of Industrial Economics, 2022; Department of Foreign Trade, 2022). The bulk of the consumable output of the chicken industry is in the form of chilled chicken products, frozen chicken products, and chicken that is cooked or flavoured, and then frozen. Altogether, 60% of this produce is for domestic consumption and 40% is for exports (Poultry World, 2020).

The export value of chicken meat and products was 107,828 million Thai Baht (3340 million USD) in 2020. With an improved pandemic situation, production facilities, and food safety practices, the output of chilled, frozen, and processed chicken products is expected to increase by 3% by 2023. (Krungsri Research, 2020; Office of Agricultural Economics, 2019; Office of Agricultural Economics, 2021; United States Department of Agriculture, 2021). Among the total labour force of 38.5 million, 5.98 million individuals work in manufacturing including chicken meat industry (Ministry of Labour, 2021). The work is labour-intensive, most of the workers come from lower social classes, and many of them are migrant workers from neighbouring countries. Occupational risk factors include cold temperatures, long working hours, improper work postures, and psychosocial aspects that may impair work ability. Thus, any positive effects of AC on work ability would be applicable to a large number of workers (Shephard, 2008), and would produce marked improvements in terms of health and productivity.

2. Methods

2.1. Population

Data were obtained from a database of Thai poultry industry workers who were examined for cold-related health adversities. The details of the sampling process and population have been described previously (Auttanate et al., 2020; Chotiphan et al., 2020; Phanprasit et al., 2021). In short, 13,092 workers from four chicken meat factories in central and northeastern Thailand were offered to participate in a health survey to determine the prevalence of cold-related and other occupational complaints. Among them, 422 workers were recruited via convenience sampling. The work in the factories consisted of chicken meat cutting, processing, storing, packing, and paperwork. The work was conducted in manufacturing halls, cold storages, and offices. The mean worksite temperature was 4 °C (range: −22–23 °C across various departments). The study was approved by the Ethical Review Committee for Human Research, Faculty of Public Health, Mahidol University, Bangkok, Thailand. The interviewees were informed that their participation was strictly voluntary and that all information would remain confidential. All participants signed a written informed consent form.

2.2. Interview

Trained interviewers interviewed the participants using a questionnaire (Auttanate et al., 2020), which consisted of questions regarding personal details, living habits, and work-related factors. Perceived work ability was elicited by the following question: 'If your best work ability during your lifetime received a score of 10, what score would you assign to your present work ability?' This question was selected from a series of seven questions that constitute the Work Ability Index, which has been widely used in previous occupational research (Kujala et al., 2005; Lundin et al., 2017; Päivärinne et al., 2019; Sormunen et al., 2009). Lundin et al. (2017) measured the predictive ability of this single question (current work ability [CWA] compared to the lifetime best) in terms of sickness absence during a follow-up period of 4 years. Their receiver operating characteristic analysis yielded an area under the curve value of 0.78 during the first year of follow-up and 0.72 during all 4 years, indicating acceptable validity. Information regarding the mode of travel and travel time was collected via the following open questions: "How do you travel to work and back home?" and "How many minutes do you travel to work and back home?" The travel modes included walking, cycling, motorbikes, cars, and public transport (van, bus, and minibus). Commuting was classified into 'active commuting' (walking or cycling) or 'non-active commuting' (motorbike, car, and public transport). Travel time was coded as 0–14, 15–29, 30–44, and 45+ minutes and dichotomised as 0–14 vs. 15+ min. Information about recreational physical activity was elicited by the following question: 'How often do you exercise in your leisure time to the point of experiencing shortness of breath or sweating?' (Response alternatives: once a week, twice a week, three times a week, four times a week, and five or more times a week). Answers were dichotomised as $\geq$3 times a week vs. $<$3 times a week. Other questions were related to the job category (office work, manufacturing work, cold storage work, forklift driving), physical strain at work (light: sedentary or other light work; heavy: medium heavy or heavy work), body weight and height (converted to body mass index [kg/m^2]), smoking (never smoked, previous smoker, regular smoker), and alcohol consumption (no consumption, occasional consumption, monthly consumption, weekly consumption).

2.3. Data analysis

Initially, the cumulative distributions of CWA were compared between active and non-active commuters, and the difference was tested using the Kolmogorov-Smirnov test. The CWA was then analysed using ordinary linear regression (OLR) involving AC and adjustment variables. Since we assumed that AC might affect work ability in different intensities depending on whether the work ability was poor, moderate, or good; we used quantile regression (Koenker and Hallock, 2001) to determine the association between CWA and AC at different levels of work ability. Quantile regression uses pre-defined quantiles as the response variable and allows the association to vary at different levels of the outcome variate. The model was fitted using a variant of the Barrodale and Roberts algorithm, as described by Koenker and D'Orey (1987). The quantiles of CWA were determined by assigning 1/6 of the observations to each class (corresponding to percentiles P_{17}, P_{33}, P_{50}, P_{67}, and P_{83}), and quantile regressions were run using each of these percentiles as outcomes. Sextiles were used instead of other quantiles because they described the response pattern in adequate detail without being too erratic. The explanatory factor of interest was AC, the effect of which was adjusted for travel time, leisure-time exercise, sex, job category, and physical work strain. Age, body mass index, smoking, and alcohol consumption were also considered; however, they had only marginal effects on the results and were omitted. The results were expressed as regression coefficients indicating the difference in CWA scores between the active and non-active commuters and between classes of other variables at each percentile, and their confidence intervals were obtained by the bootstrap method with 5000 replications.

The combined effects of AC and personal and work-related factors were illustrated using model-predicted CWA scores for the selected worker profiles. The results were calculated using the rq function available in the R environment (https://CRAN.R-project.org/).

3. Results

3.1. Participant characteristics

The mean age of the participants was 33 years (standard deviation [SD], 12 years; range, 18–57 years). Among these, 47% were men, 23% were regular smokers, 12% consumed alcohol on a weekly basis, and 38% were classified as obese (body mass index ≥25 kg/m^2). Altogether, 35% of the participants were manufacturing workers, 33% were office staff, 24% worked in cold storages, and 8% were forklift drivers (Table 1). Among the included participants, 43% performed heavy work (men: 70%, women: 20%), and heavy work was more commonly performed by participants aged 15–29 years (50%) than by older participants (35%). Twenty-six respondents (6%) reported elevated blood pressure as diagnosed by a doctor and <5% reported other diagnosed medical conditions.

Altogether, 46 participants (11%) were active commuters (30 walked and 16 rode bicycles) (Table 1). A greater number of men were active commuters compared to women (14% vs. 9%), while the mode of commuting showed marginal differences (≤2 percentage points) across other factors (age, leisure-time exercise, job category, work strain, smoking, and alcohol consumption). Altogether, 102 participants travelled for 0–14 min and 318 travelled for 15+ minutes (active commuters: 23% and 7%, respectively).

Table 1
Work ability score by mode of commuting and personal and work-related factors.

Variable	Mean (SD)	Difference[a] (95% CI[b])	Range	N
Mode of commuting				
Non-active	8.1 (1.3)	Ref.	4–10	374
Active	8.6 (1.3)	0.5 (0.2, 0.8)	4–10	46
p value[c] ~	0.02			
Travel time				
0–14 min/day	8.4 (1.2)	Ref.	5–10	102
15+ min/day	8.1 (1.4)	−0.3 (−0.5, 0.0)	4–10	318
p value[c] ~	0.12			
Leisure time exercise				
0–2 times/week	8.1 (1.3)	Ref.	4–10	355
3+ times/week	8.5 (1.3)	0.4 (0.1, 0.7)	5–10	66
p value[c] ~	0.03			
Sex				
Females	8.0 (1.3)	Ref.	4–10	225
Males	8.5 (1.3)	0.5 (0.3, 0.7)	4–10	197
p value[c] ~	0.00			
Age				
18–29 yr	8.1 (1.3)	Ref.	4–10	182
30–57 yr	8.3 (1.3)	0.2 (−0.1, 0.4)	4–10	239
p value[c] ~	0.24			
Job category				
Office staff	8.1 (12)	Ref.	4–10	134
Manufacturing worker	8.3 (1.3)	0.2 (−0.1, 0.4)	5–10	142
Storage worker	8.3 (1.4)	0.3 (0.0, 0.6)	4–10	95
Forklift driver	8.7 (1.2)	0.6 (0.2, 1.0)	5–10	33
p value[c] ~	0.09			
Physical work strain				
Light	8.1 (1.3)	Ref.	4–10	239
Heavy	8.3 (1.3)	0.2 (−0.1, 0.4)	4–10	182
p value[c] ~	0.22			
All	8.2 (1.3)		4–10	422

[a] Regression coefficient from simple linear regression.
[b] Bootstrapped confidence interval.
[c] From one-way anova.

3.2. Distribution of CWA

The distribution of CWA was skewed, with a greater number of observations exhibiting higher scores (Fig. 1A). The mean CWA score was 8.2 (SD 1.3, range: 4–10). The mean CWA score was 8.6 among active commuters (SD: 1.3, range: 4–10) and 8.1 among non-active commuters (SD: 1.3, range: 4–10) with a difference of 0.5 (95% confidence interval: 0.2–0.8). Fig. 1B depicts the comparison of CWA scores between active and non-active commuters in terms of cumulative distributions and demonstrates higher scores for active commuters throughout the scale, with the greatest difference (1.0) at the 67th percentile of CWA (scores 8–9). The one-sided Kolmogorov-Smirnov test produced a p-value of 0.06.

3.3. Mean CWA

Table 1 summarises the variations in the mean CWA score among all subgroups of workers and demonstrates differences up to 0.6 among the groups. CWA was significantly higher in workers who exercised at least three times a week during leisure time. Moreover, it was higher in male workers than in female workers and lower in office staff than in all other job categories, especially in forklift drivers. CWA was not significantly associated with travel time, age, or physical work strain.

3.4. Multivariable analysis

Table 2 elaborates on the aforementioned associations using OLR and quantile regressions, with adjustments for multiple factors. The adjusted OLR regression coefficients did not indicate increases of greater than 0.4 in the CWA score in various groups (AC, leisure-time exercise, male sex, and forklift driving). However, no increase or decrease was observed in travel time, work strain, or job categories other than forklift driving. In contrast, quantile regression showed a significant and independent increase of one CWA unit among active commuters, but only at P_{33}, P_{50}, and P_{67}. Similar increases in CWA were also observed for males at P_{67}, as well as for manufacturing and storage workers and forklift drivers at various percentiles.

Fig. 1C illustrates the model-predicted CWA scores by comparing active and non-active commuters combined with the selected personal and work-related characteristics defined by sex, job category, work strain, leisure-time exercise, and travel time. Male forklift drivers who were active commuters, who performed heavy work, exercised 3+ times a week, and who travelled for 15+ minutes exhibited CWA scores two units higher at P_{33}, P_{50}, and P_{67} than female office workers who were non-active commuters who did light work, who exercised 0–2 times a week, and whose travel times were similar to those of male workers. Differences in one CWA unit were observed at P_{17} and P_{83}.

4. Discussion

4.1. Summary of findings

We observed a positive association between AC and self-perceived work ability. The association was weak or moderate when assessed in terms of the mean CWA score based on ordinary linear regression, but stronger associations were observed when allowance was made for the level of work ability. Thus, the adjusted CWA score was significantly higher in active commuters than in non-active commuters but only at relatively good levels of work ability. Furthermore, work ability was better in men than in women at good levels of work ability. It was better for manufacturing and storage workers and forklift drivers than for office staff throughout the CWA scale. Even greater differences were observed between the subgroups of workers additionally classified according to sex, leisure-time activity, and work-related factors. Our study adds to the findings of a previous Japanese workplace study (Tsuboi et al., 2017), because we focused on CWA at various locations of its

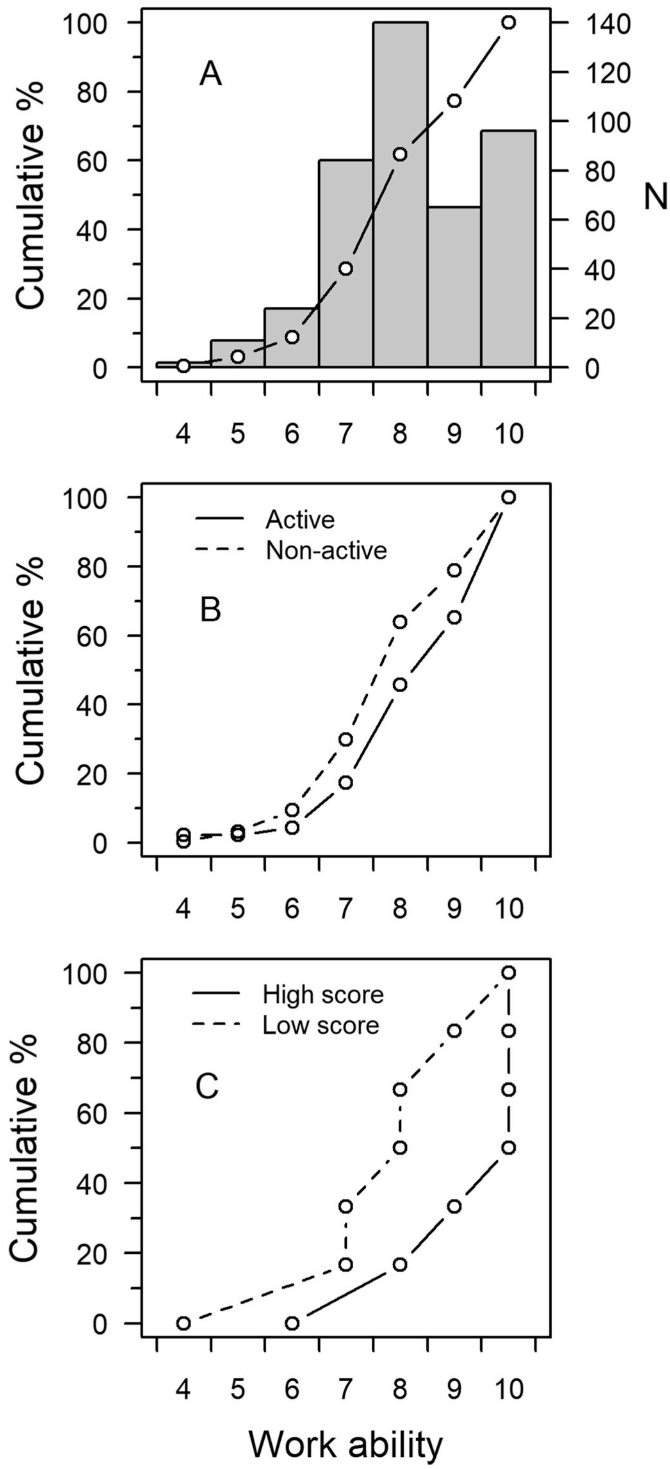

Fig. 1. Distribution of current work ability index, CWA. A) Histogram and empirical cumulative distribution of CWA in the entire sample, B) empirical cumulative distributions of CWA among active and non-active commuters, C) model-based cumulative distributions of CWA among selected groups of workers. High score group: actively commuting male forklift drivers who did heavy work, exercised 3+ times/week and travelled to work and back for 15+ minutes. Low score group: non-actively commuting female office staff who did light work, exercised 0–2 times/week and travelled to work and back for 15+ minutes.

distribution, and our observations were based on a heterogeneous sample containing both sexes and a variety of occupational groups and working conditions.

4.2. Work ability and active commuting

A Finnish study involving frozen food processing workers assessed work ability using the same method used in our study (Sormunen et al., 2009) and classified CWA ≥7 as 'good' work ability. Using this criterion, 89% of the participants in the aforementioned study had good work ability, which is comparable to the percentage observed in the present study (91%). In a Japanese study, two-thirds of workers in an electronic company were classified as workers with good work ability (Tsuboi et al., 2017). However, their method of defining work ability was slightly different, and their sample comprised only of sedentary males. While Tsuboi et al. (2017) reported 2.4-fold odds of observing good work ability in active commuters compared to non-active commuters, our findings showed that potential improvements due to AC might be limited to workers with moderate to good work ability. Workers with the poorest work ability might be unable to engage in active commuting because of health problems, and workers with good work ability would have less room for further improvement. Our data did not show any effect of travel time on work ability. Similarly, no such finding was reported in an Australian study on work performance (Ma and Ye, 2019). However, the authors noted an association with travel distance, which was not measured in this study. The literature regarding this issue is sparse. However, in their study regarding mental well-being, Martin et al. (2014) concluded that travel time was less important than the mode of travel. Tsuboi et al. (2017) studied travel time and travel mode in combination and did not analyse travel time separately. Related observations of Australian researchers who reported an association between AC and performance in the current job (Ma and Ye, 2019) are similar, but not identical, to our study that used current work ability vs. the lifetime best value of work ability.

In the present study, the association between AC and work ability was not confounded by leisure-time physical exercise, which in itself showed a marginal positive relationship with work ability. According to some studies, leisure-time exercise has positive effects on work ability, especially in workers who perform heavy work (Päivärinne et al., 2019). However, Tsuboi et al. (2017) found no such association among sedentary workers (alone or with allowances for personal and workplace factors). We observed that occupations that are physically more strenuous (forklift driving, manufacturing, and storage work) were linked with better work ability than office work throughout the CWA scale. Moreover, there was a positive association between male gender and work ability among workers whose work ability was already good. However, none of these factors confound the association between AC and work ability.

Ma and Ye (2019) suggest that better moods, better cognitive functions, and positive emotions improve work ability among active commuters. Physically active individuals reportedly have better physical fitness, mental health (Martin et al., 2014; Ohta et al., 2007), cognitive performance (Chang et al., 2012), and self-rated health (Eriksen et al., 2013). Physical exercise also reduces the occurrence of cardiovascular (Andersen et al., 2000; Celis-Morales et al., 2017) and musculoskeletal conditions, and the harm caused by these conditions at work (Norheim et al., 2019). However, the low number of sick individuals in the present sample and the cross-sectional design of the study prevented us from testing these associations.

Since commuting is a necessary daily activity for most of the working population, AC offers great potential to produce positive effects on health and work ability (de Nazelle et al., 2011). Only 11% of the current participants were active commuters, and similarly low percentages have been reported in Australia (8%) (Ma and Ye, 2019), China (12%) (Hu and Yin, 2018), and England and Wales (16%) (Patterson et al., 2020). In contrast, 44% of the population in Sweden is involved in at

Table 2
Quantile regression and ordinary linear regression (OLR) of work ability score[a]. Figures are regression coefficients (b) and their 95% bootstrapped confidence intervals (CI).

Percentile	Mode of commuting (active vs non-active)	Travel time (15+ min vs 0–14 min)	Leisure-time exercise (3+ vs 0–2 times/week)	Sex (males vs females)	Manufacturing vs office work	Storage vs office work	Forklift driving vs office work	Heavy vs light work
	b (95% CI)	b (95% CI)	b (95% CI)	b (95% CI)	b (95% CI)	b (95% CI)	b (95% CI)	b (95% CI)
P_{17}	0.0 (-0.8, 0.8)	0.0 (-0.6, 0.6)	0.0 (-0.6, 0.6)	0.0 (-0.4, 0.4)	0.0 (-0.4, 0.4)	0.0 (-0.5, 0.5)	1.0 (0.2, 1.8)	0.0 (-0.4, 0.4)
P_{33}	1.0 (0.2, 1.8)	0.0 (-0.4, 0.4)	0.0 (-0.6, 0.6)	0.0 (-0.5, 0.5)	1.0 (0.2, 1.8)	1.0 (0.2, 1.8)	1.0 (0.2, 1.8)	0.0 (-0.4, 0.4)
P_{50}	1.0 (0.2, 1.9)	0.0 (-0.1, 0.1)	0.0 (-0.8, 0.8)	0.0 (-0.6, 0.69)	0.0 (-0.2, 0.2)	0.0 (-0.6, 0.6)	1.0 (0.0, 2.0)	0.0 (-0.2.0.2)
P_{67}	1.0 (0.3, 1.7)	0.0 (-0.4, 0.4)	0.0 (-0.7, 0.7)	1.0 (0.4, 1.6)	0.0 (-0.7, 0.7)	0.0 (-0.9, 0.9)	0.0 (-0.9, 0.9)	0.0 (-0.6, 0.6)
P_{83}	0.0 (-0.5, 0.5)	0.0 (-0.3, 0.3)	0.0 (-0.3, 0.3)	0.0 (-0.8, 0.8)	1.0 (0.2, 1.8)	1.0 (0.2, 1.8)	1.0 (0.2, 1.8)	0.0 (-0.6, 0.6)
OLR	0.4 (0.0, 0.7)	−0.1 (-0.4, 0.1)	0.3 (0.0, 0.6)	0.4 (0.1, 0.6)	0.2 (-0.1, 0.5)	0.2 (-0.2, 0.5)	0.4 (-0.1, 0.8)	−0.2 (-0.4, 0.1)

[a] Adjusted for all factors in table.

least low-dose active commuting (Eriksson et al., 2020), and in Finland, 28% of men and 42% of women are active commuters (Helldán et al., 2013). In a Japanese study, 40% of sedentary workers (Tsuboi et al., 2017) were classified as active commuters. Another Thai study reported that 43% of health care workers were active commuters (Lerssrimongkol et al., 2016). These differences indicate that it is possible to increase AC. In particular, a Finnish study concluded that good pedestrian and cycling infrastructure may promote commuting physical activity (Mäki-Opas et al., 2016). However, all measures to promote active commuting must take into account the increased risk of accidents (Welsh et al., 2020).

4.3. Strengths

A strength of our study is that we assessed the association between AC and work ability at various levels. It is natural to conclude that healthy and able individuals can walk or cycle with adequate intensity to maintain and enhance their work abilities. Indeed, the assumed effects of AC and sex vary according to work ability level. This information would have been missed in the analysis involving standard linear or logistic regression. Regression of specific percentiles of CWA instead of its logit (Sormunen et al., 2009; Tsuboi et al., 2017) also avoids the need to define a cutoff point between 'good' and 'poor' work ability, which is bound to be artificial. Furthermore, we used the bootstrap method to calculate the confidence intervals for regression coefficients. This method does not presuppose any predefined error distribution for the outcome.

4.4. Limitations

The present study had some limitations. Only 11% of the workers were active commuters, probably because of local traffic conditions that do not favour walking or cycling. In the studied areas, bikeways are uncommon or do not exist, pavements are crowded, and walking is discouraged owing to high levels of air pollution. The sparsity of the data prevented us from conducting separate analyses for walking and cycling, which may have different effects on health outcomes (Cecil-Morales et al., 2017). Moreover, we could not study potential curved or graded associations between AC and work ability, similar to those reported between AC and cardiovascular events (Celis-Morales et al., 2017). Owing to the cross-sectional study design, the associations observed do not prove causality, although they are consistent with the causal hypothesis. The observed associations might be subject to selection bias (healthy workers with good work ability possibly favouring active commuting) and reflect reverse causation. However, a survey consisting of a wide range of occupational groups in three major cities in Australia (Ma and Ye, 2019) concluded that reverse causation from job performance to the mode of commuting is weak. Sample size influenced the classification of the variables. For example, a walking time of 15 min per day may not be long enough for significant health effects to be observed (Sjöström et al., 2006). Self-reported information may be questioned, although the reliability of self-reports on AC is considered adequate (Tsuboi et al., 2017). Perceived work ability is a subjective measure, and its validity cannot be assessed in terms of a gold standard. However, it remains a valid predictor of long-term illness (Lundin et al., 2017). Self-reports on most personal characteristics, including age, sex, and smoking, have reasonable face validity. The lack of information regarding AC intensity also restricted our ability to draw conclusions about the effects of AC on work ability. Our findings must not be over-interpreted in favour of physical exercise, as physical activity also accrues as part of other commuting modes (Patterson et al., 2020; Rissel et al., 2012).

5. Conclusions

The present study shows that (1) AC is associated with CWA among food industry workers, and (2) the strength of the association varies depending on the level of CWA –aspects not addressed in previous research. The cross-sectional study design and uncertainties possibly related to self-reported information, selection, and reverse causation prevent us from drawing causal inferences about the effects of active commuting on work ability. Further longitudinal studies are needed to confirm whether AC itself and not only better health among active commuters improve work ability. However, the present results are consistent with previous knowledge on how light daily physical activity improves health and work ability, and we therefore believe that practical recommendations are justified. National and local decision-makers and employers should encourage AC by recommending biking and walking. Community infrastructure should be improved to favour AC by increasing bikeways, and free or rentable bicycles should be made available. Behaviour patterns to guarantee safe biking in urban environments should be promoted through health education at workplaces, schools, and national institutions, and the importance of traffic rules must be emphasised to prevent accidents. Promoting AC could also introduce positive changes in the health of the entire population, reduce traffic congestion and consequent air pollution, accumulation of greenhouse gases, and reduce travel costs. Further research should be extended to a wider range of industries and the long-term effects of AC, and more efforts should be devoted to identifying the detailed causal mechanisms of how AC could promote work ability.

Ethical statement

The manuscript has been prepared in accordance to the STROBE protocol.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author statement

Wantanee Phanprasit: Project Administration, Resources, Supervision, Conceptualization, Data curation, Writing-Original Draft, Writing-Review-Editing. Chotirot Chotiphan: Data curation, Investigation, Writing-Original Draft, Writing-Review-Editing. Pajaree Konthonbut: Investigation, Writing-Original Draft, Writing-Review-Editing. Wisanti Laohaudomchok: Investigation, Writing-Original Draft, Writing-Review-Editing. Tiina M Ikäheimo: Conceptualization, Investigation, Writing-Original Draft, Writing-Review-Editing. Jouni J.K. Jaakkola: Writing-Original Draft, Writing-Review-Editing. Simo Näyhä: Software, Formal Analysis, Methodology, Investigation, Writing-Original Draft, Writing-Review-Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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