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Daily walking and cycling to work: their utility as health-enhancing physical activity

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Abstract

The substantial health-enhancing potential of physical activity can be realised on population level best if people can incorporate physical activity into their daily life routines. Physically active commuting to and from work provides a promising mode for such activity. In a series of three studies we explored more specifically the population prevalence, the physiological effectiveness, and the promotional possibilities of commuting to work by walking and cycling in a mid-size Finnish town. The results of the questionnaire survey indicated that while about one-third of the working-age sample commuted by walking or cycling an additional one-quarter were in a position to either begin or increase physically active commuting. The controlled intervention study showed that this kind of moderate-intensity, high-frequency activity improved the health-related fitness and selected indices of metabolic health. The promotion project in a large industrial plant demonstrated that walking and cycling during work trips can be successfully promoted by relatively low cost measures. These experiences suggest that physically active commuting to work offers substantial potential as a health-enhancing measure for working-age population. © 1998 Elsevier Science Ireland Ltd.

Keywords: Walking; Cycling; Commuting; Health-enhancing physical activity; Health promotion

1. Introduction

Health-enhancing physical activity (HEPA) has been defined as accumulation of 30 min or more of moderate-intensity exercise on most, or preferably all days of the week, as introduced by Vuori [1] in this issue. Naturally, such activity can be practised in a number of ways and in various settings, but its incorporation into everyday life routines as a lifestyle strategy is likely to facilitate significantly the permanent adoption of such behaviour [2]. We have explored the possibilities to promote simple activities in an ordinary, everyday community environment by studying the potential of physically active work commuting, i.e. walking and cycling, as modes of health-enhancing physical activity.

In principle, walking and cycling, when practised regularly, briskly, and for sufficient duration meet well the quantitative and qualitative requirements of HEPA. Walking and cycling during work trips provide particularly attractive possibilities for HEPA because of the built-in framework for regular practice and the possibility to exploit their accumulation potential by making two daily activity bouts. Additional strengths of walking and cycling are that they

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can be practised relatively safely by a large number of people without big investments in special facilities. Thus, from the population promotion viewpoint, it seems worthwhile to evaluate more closely the utility of commuting to work by walking and cycling as widely applicable forms of HEPA.

More specifically, in a series of studies we have investigated (1) what is the population applicability [3], (2) the physiological effectiveness [4], and (3) possibilities for work-site promotion of commuting to work by walking and/or cycling [5]. The studies were conducted in the city of Tampere, a medium size city of nearly 200 000 people located in the south-west part of Finland with a strong industrial history but, by the time of the studies, under rapid transition into a high-tech post-industrial community.

2. How applicable is commuting to work by walking and cycling in an ordinary community environment?

The first study assessed, by a questionnaire survey, the current status of walking and cycling as means of commuting to work in Tampere. The survey addressed such aspects as seasonal prevalence, amount, and perceived reasons and constraints for active commuting.

2.1. Prevalence and characteristics

Different characteristics of active work trips during subsequent winter, summer and fall of a random sample of 2014 subjects representing the 20–64-year-old population of the city of Tampere were explored by three successive mail inquiries [3,6]. The response rates of the three surveys varied between 65 and 83%. The final analysis included only subjects employed outside their home (47–52% of the original sample).

The prevalence of regular walking to work was 18% in the fall, 21% in winter and 14% in summer. The corresponding figures for cycling were 6, 2 and 18%. The low prevalence of cycling in winter and in the fall is explained by cold weather and snowy and icy roads. A considerably higher proportion of women than men commuted by these modes. The proportion of walkers increased with age, and in the 50–64 years age group the proportion was 23–31% in different seasons, greatest in winter. The majority of the walkers and cyclists used these modes on a nearly daily basis. These modes of commuting were remarkably stable, because 87% of those walking or cycling in winter did so also during summer. Walking and cycling were reported to be brisk (causing slight sweating and shortness of breath) by most physically active commuters. The median one-way distance of walking was 1 km in summer and fall and 2 km in winter, and the respective activity time was 12–18 min. The median one-way cycling distance was 3–4 km and time spent was 10–15 min. The distances and times varied within a wide range.

2.2. Factors influencing participation

In the same survey the most often reported reasons for walking and cycling to work among those who practiced them were desire for fresh air, exercise and fitness (36–44% of active commuters during different seasons), short distance to work (20–27%), inexpensive and convenient way of transport (10–27%), poor connections by public transport (10–25%), and walking or cycling to or from bus stop (10–23%). Women reported more often than men that walking or cycling to work is their main form of physical activity and substitutes for other physical activity during leisure. The cyclists emphasised more than walkers that fitness and ease of transport were the main reasons for their choice of this commuting mode.

The most often reported factors hindering or limiting walking and cycling among the non-walkers or cyclers were bad weather conditions (61%), lack of interest (54%), and lack of time (50%). About 40% of all respondents considered the lack or poor condition of pedestrian and cycling routes as limiting their walking and cycling to work, and about 30% considered these activities as unsafe modes of transportation. Fear of accidents limited physically active commuting in 30% of all women and in 14% of all men. Seven percent of women and 5% of men had suffered from an accident in light traffic during the past year.

2.3. Population potential to increase activity

One of the main aims of the inquiries was to find out the proportion of an urban Finnish population which is both motivated and has possibilities to begin or to increase commuting to work by walking and cycling. In this survey the proportion was 32% of the total sample (Fig. 1), and 23% reported realistic possibilities (in terms of distance, time, etc.) but without motivation to either increase or begin walking or cycling during work trips. This segment of the sample can be considered as a primary target for promotional measures.

2.4. Summary on population applicability

The assessment indicated that commuting to work by walking and cycling offered regular exercise to about one-third of the employed urban population in Tampere. This activity was reported to be regular, frequent, rather stable year around, and brisk in tempo, thus meeting quite well the criteria for HEPA. Only the duration of these activity bouts was slightly short in comparison to the criteria. Besides the expected weather, interest and time constraints, poor and unsafe conditions for walking and cycling turned out to be the major obstacles for active commuting. These results suggest that there is substantial potential to increase walking and cycling during trips to and from work, but the perceived availability, conditions and safety of pedestrian and cycling routes may constitute a critical impediment for adopting such behaviour.

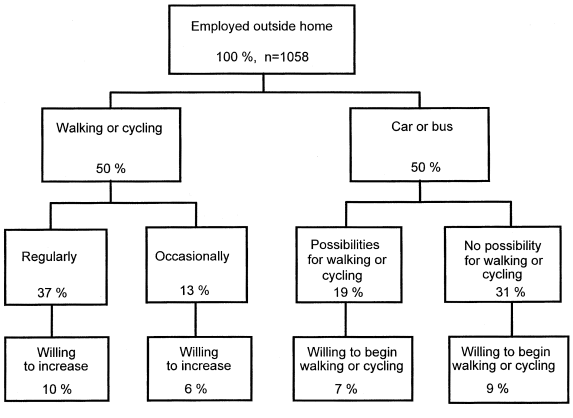

Fig. 1. Distribution of an urban population by mode of commuting to work, and the proportion of subjects who reported to be willing and to have the possibility to begin or to increase walking or cycling in their work trips [6].

3. Are commuting to work by walking and cycling physiologically effective?

3.1. A pilot study

A pilot study [7] indicated that the mean heart rate corresponded to 39% of maximal aerobic capacity during commuting to work by walking and to 57% during cycling. These observations were obtained in 24 healthy, moderately fit men and women (mean age 33±11 years), and suggested that the intensity of walking may be borderline low while that of cycling sufficiently high to be physiologically effective [8].

3.2. Randomised trial: subjects and design

The effects on physical fitness and on blood lipids of walking and cycling during work trips were assessed in a 10 + 10-week randomised controlled experiment [4]. The subjects were selected from 160 respondents of the survey described above, who volunteered to participate in the study and who had commuted by car or by bus in the past. The final population consisted of 40 men and 31 women who had no health-related contraindication to carry out the program, who were not regular leisure-time exercisers ($\leq 2\times$ per week), had a work trip of suitable length for walking or cycling, and met other conditions of participation, including agreement on randomisation. The first stratification into eventual walkers and cyclers was made on the basis of the length of work trip and gender. The second division was based on the aerobic fitness level within the activity–mode–gender groups. The final assignment was done by random selection of one-half of the subjects in the high- and low-fitness subgroups into an originally active group and the other half into a delayed active group. More detailed description of the design and the subject allocation is to be found in Oja et al. [4]. The effects of 10 weeks physically active ($n = 35$) vs. passive ($n = 33$) commuting were analysed with analysis of variance (ANOVA) with

repeated measures. The effects of gender and total active work time on the changes were tested with analysis of covariance.

3.3. Initial intervention

During the first 10 weeks the mean one-way walking distance was 3.4 km and cycling distance 9.7 km. The subjects were asked to travel the distance daily at their ordinary, self-selected speed. It was emphasised that the activity is not a matter of training but of commuting. The average time to work was 35 min for walking and 32 min for cycling. The return trip took on average 2 min more. These times were reduced by about 4 min towards the end of the 10-week period. Therefore, the mean walking speed was 5.8 km/h in the beginning and 6.2 km/h during the last part of the experimental period. The mean heart rate in walking was 121 beats/min during the whole period corresponding to 53% of $\dot{V}_{O_2max}$ in the beginning and to 51% at the end of the 10-week period. The corresponding figures for the cyclists were 17.6 and 20 km/h, 133 beats/min, and 65 and 62% of $\dot{V}_{O_2max}$. Thus, the cardiorespiratory strain of walking was in the lower border of effective aerobic stimulus range and that of cycling in the medium range [8].

Adherence to the programme was good; only one originally active and two delayed active subjects dropped out during the 10-week program. The program compliance was 78% of the workdays on average in the active and 92% in the delayed active subjects.

3.4. Effects on fitness and blood lipids

The 10-week initial intervention resulted in a small but consistent 4.5% net increase (difference between the change of active and control group) in $\dot{V}_{O_2max}$ ($p=0.02$) and 10.3% net increase in maximum treadmill time ($p<0.001$) in the combined walking and cycling group compared to the control group (Fig. 2). There were no significant changes in serum total cholesterol or triglyceride concentration (data not shown), but HDL cholesterol increased (net change +5%, $p=0.06$) in active subjects. At submaximal standard work load (85% of maximum)

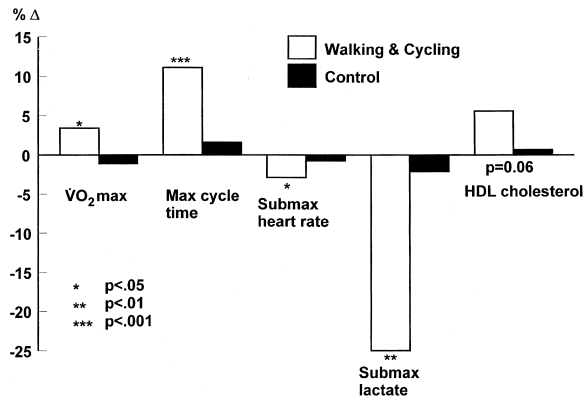

Fig. 2. Effects of commuting to work exercise. The bars indicate the % change in the measured variables [4].

heart rate ($p=0.04$) and blood lactate ($p=0.002$) decreased significantly. The same was found for RQ ($p=0.02$) and blood lactate ($p=0.001$) at a work load of 65% of maximum (data not shown). There were no changes in body weight or in leisure-time physical activity in either group.

3.5. Comparison of walking and cycling

In order to compare the specific effects of walking and cycling, the originally active subjects continued walking and cycling and the delayed active subjects began to walk or cycle depending on their original subgroup after the initial 10 weeks. The separate effects of walking ($n=39$) and cycling ($n=26$) were compared by ANOVA with repeated measures by using the pooled data of the active subjects during the first 10-week period with those of the delayed active subjects during the second 10-week phase. The mean cardiovascular load in walking was 52% of $\dot{V}_{O_2max}$ in the beginning and 51% at the end of this period (corresponding to mean heart rate of 121 beats/min). The corresponding values for cycling were 65 and 62% of $\dot{V}_{O_2max}$ (mean heart rate 133). During this phase of the study three delayed active subjects discontinued participation and compliance was 75% of workdays. The results indicated larger increase of $\dot{V}_{O_2max}$ in the cycling than in the walking group ($p=0.01$). The finding is consistent with the higher intensity in the cycling group.

3.6. Summary

The results of this randomised controlled trial showed that regular walking and cycling for a one-way average of about 30 min during commuting to work with self-paced speed improved aerobic fitness, decreased cardiovascular strain in submaximal standard work, increased the use of fats as energy source in physical activity, and caused slight favourable changes in blood HDL cholesterol in healthy young to middle-aged adults of low to moderate physical fitness. Cycling, having been practiced at higher relative intensity, was more effective than walking in improving fitness. It is probable that extending the duration of intervention over the 10 weeks would result in greater favourable changes in physical performance and HLD cholesterol. The results support the view that the activity involved in commuting to work has significant potential to maintain or improve health-related physical fitness of previously relatively sedentary healthy adults.

4. How can commuting to work by walking and cycling be promoted at the worksite?

4.1. Promotion setting, assessment and intervention

We carried out a promotional project in a large industrial plant [9], which had units in the center and in the suburban section of the city of Tampere.

A questionnaire inquiry at the beginning of the program was used as the program assessment and indicated that over 50% of the respondents already walked or cycled at least part of their trip to work, but 14% reported both the possibility and willingness to begin or to increase active commuting. Approximately half of the respondents from the plant in the city center indicated the lack of pedestrian and cycling routes, and one-third the fear of accidents, as the reasons limiting their walking and cycling. Otherwise the attitudes towards walking and cycling to work were positive: 90% of the respondents believed that walking and cycling improves physical fitness, and more than half of the respondents considered the planned promotion program as important while only about 10% felt it was unnecessary.

The aim of the project was to find out if promotion of commuting to work by walking and cycling is acceptable, effective and feasible in a worksite setting. The duration of the promotion program was 6 months. The promotion activities consisted mainly of information of the benefits of and the possibilities for walking and cycling to work. This information was distributed in bulletins, leaflets and company newsletters. Motivation was stimulated and supported by physical activity diaries, lottery incentives and fitness testing using the UKK 2-km walk test [10]. The facilities for cycle parking, showering and changing clothes were also improved.

An integral part of the assessment was a thorough survey of the safety of the most common commuting routes. This was carried out as a joint project with the state traffic and occupational safety officials, City of Tampere traffic engineers, and a private traffic planning consulting firm. On the basis of the survey, unsafe sites in the commuting routes were identified and reported to the municipal authorities for technical improvements, and detailed information of the safest routes in the form of maps were distributed to the employees. Fig. 3 is an example of the route safety map indicating the commuting routes and the problematic traffic sites.

The program was planned and implemented as a cooperative effort of the occupational health and occupational safety organs of the participating factories. It was supported by the executive management and all personnel groups. The researchers from the UKK Institute participated in the planning of the promotion program and in the production of information materials, but they did not contribute directly in the implementation of the measures. The UKK Institute evaluated the project.

4.2. Evaluation

The implementation of the program was evaluated by interviewing the responsible persons in the factories. The measures were considered generally to have been accomplished as planned although somewhat sluggishly. The results did not meet all the expectations of the members of the program groups. The time they had available for the project was insufficient, and there were no additional resources or alternative means like direct personal mailing for

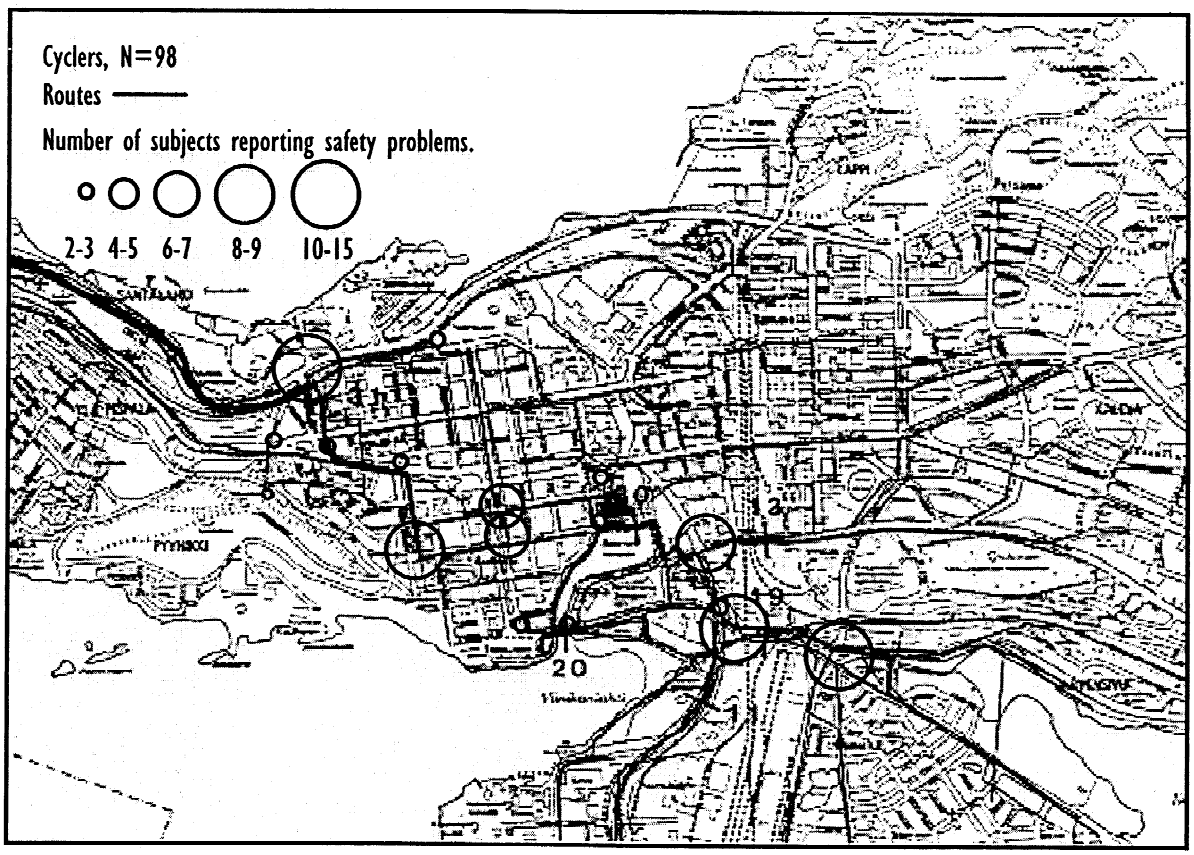

Fig. 3. Cycling routes and traffic sites with safety problems as indicated by the safety survey [9].

information distribution. The summer season interrupted the activities and they were not re-implemented with full intensity. It was felt that the problems indicated in pedestrian and cycling safety were corrected too slowly by the city authorities.

Evaluation of the program impact was based on questionnaires mailed to all employees ($n = 1256$) at the beginning and at the end of the program; the response rates were 70 and 57%, respectively. The inquiry at the end of the program indicated that the program was positively received (Fig. 4). Over 90% of the respondents had noticed the program, over half had talked about it with their workmates, and two-thirds of the respondents found the program important. Over half of them were of the opinion that the employer should motivate and support the personnel to commute by walking and cycling, but 16% expressed the view that commuting and its safety are not the responsibilities of the work sites [9].

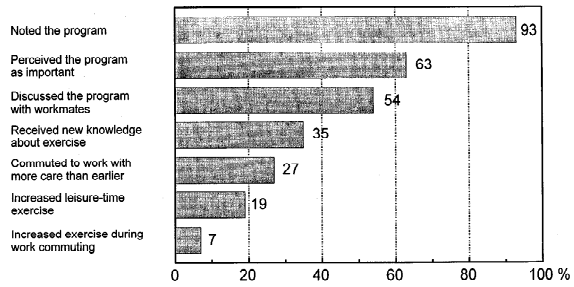

Fig. 4. Reception and self-reported effects of the program in post-programme survey, percent of respondents.

Seven percent of the respondents, or half of those who indicated potential to change, reported to have

increased their commuting to work activity and 19% reported to have increased their leisure-time physical activity during the program. About one-third stated that they had got new information on physical fitness and exercise. Consideration of traffic safety was increased during the program among both those commuting by car and those walking or cycling to work. At the end, 60% of the respondents considered that the promotion of walking and cycling during commuting is reasonable only when the conditions are appropriate.

4.3. Summary

The promotion trial showed that a large majority of the employees accepted the promotion activities and considered them important. It was felt that planning and implementation of these activities best fall under the responsibility of the occupational health and safety organisation. The questionnaire responses suggested that the rather modest promotional efforts, utilising primarily communication of information, resulted in significant positive changes in the attitudes and knowledge concerning physically active commuting to work. Likewise, the responses indicated a moderate increase in the number of people walking and cycling to work and a substantial increase in leisure-time physical activity. It is possible, however, that these self-reported data based on modest (about 60%) response rates and probable selection of the respondents may overestimate the real impact of the program. One possible reason for the positive overall attitudes towards the program was probably the use of the results of the survey on traffic safety as part of the information material. The survey also highlighted traffic safety as an essential prerequisite of acceptable promotion of commuting to work by walking and cycling.

5. Conclusions

The specific findings of the three studies on commuting to work by walking and cycling warrant the following conclusions pertinent primarily to the Finnish urban environment:

(1) Walking and cycling during work trips currently provide the possibility for regular physical activity for a considerable proportion of the working population, and there is potential for a substantial increase of actively commuting people. As practised typically today, physically active commuting to work appears to be optimally regular and frequent, suboptimally but nearly sufficiently intensive, and somewhat short in duration to serve by itself as an effective health-enhancing physical activity. Based on people's perceptions, poor and unsafe conditions for walking and cycling are major obstacles for active commuting.

(2) As shown by the controlled intervention study, physical activity of sufficient duration, expended by commuting to work, indeed improves the cardiorespiratory and metabolic fitness of previously sedentary adults. The changes are consistent with, although smaller than, those induced by more intensive exercise training. Cycling is more effective than walking, which is likely to be due to its somewhat higher intensity. Based on these observations it is plausible to recommend commuting to work by walking and cycling as an effective and widely applicable means of health-enhancing physical activity.

(3) Industrial firms provide a suitable setting for the promotion of physically active commuting to work in terms of employee attitudes, management support, and occupational health organisation's compatibility. It is possible to increase participation in commuting to work by walking and cycling, with a likely spin-off effect in leisure-time activity, by a promotional program employing primarily informational community level strategies and requiring modest resources. Cooperation with other parties interested in and responsible for public traffic and safety is likely to strengthen the programs and their outcomes. Perceived safety of walking and cycling routes appear to be major determinants of people's behaviour.

The following additional observations from these experiences may be relevant in a wider promotional context.

(4) Appropriate initial assessment helps tangibly to effectively focus the HEPA promotional efforts in terms of key target groups, overall promotional strategy, message formulation, supportive collaboration, and evaluation.

(5) Worksites provide an especially good setting for HEPA promotion. Homogenous target population,

ease of communication, close social networks, and built-in system of service providers can all be utilised effectively.

(6) Truly effective promotion of commuting to work by walking and cycling requires satisfactory provision for safe and comfortable pedestrian and cycling routes. In order to achieve the potential to the fullest the scope of promotion must be broadened to other public sectors responsible for the development of the entire traffic environment.

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