Cycling and walking for transport and their associations with diabetes and risk factors for cardiovascular disease

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Abstract

Introduction: Active travel is recommended and promoted to increase physical activity and reduce the risk of several non-communicable diseases. The health effects of active travel in populations of low socioeconomic status (SES) are unclear. This study was performed to investigate the associations of cycling and walking for travel with diabetes and other risk factors for cardiovascular disease (CVD) in a multi-ethnic, low-SES population. **Methods:** Cross-sectional data from 2445 adults (age, 48.0 ± 9.8 years; 43.6% men) in two multi-ethnic, low-SES districts in Oslo, Norway, were collected. The data included objective measurements (blood pressure, weight, height, blood parameters), questionnaire data (physical activity, diabetes, use of medication, working status, education, smoking), sex, age, and country of origin. Associations were analyzed by multiple logistic regression models. **Results:** Cycling and walking for travel were performed by 26.5% and 80.1% of adults, respectively. Self-reported diabetes (OR, 0.47; 95% CI 0.23–0.94) high-density lipoprotein cholesterol level of <1.3 mmol/L (OR, 0.77; 95% CI, 0.62–0.95) and obesity (OR, 0.71; 95% CI, 0.55- 0.92) were inversely associated with cycling after adjustment for SES, smoking, leisure-time physical activity, walking for travel, age, and sex. Systolic blood pressure of >140 mmHg (OR, 0.74; 95% CI, 0.57–0.97) was inversely associated with walking for travel. **Conclusion:**
In the current multi-ethnic low SES population, those engaged in active travel and cycling for travel in particular had lower odds of diabetes and lower risk factors for cardiovascular disease compared to those not engaged in active travel.

Key words: Exercise, hypertension, dyslipidemia, cycling, walking

1. Introduction

Physical inactivity is a major risk factor for many non-communicable diseases and shortens life expectancy (Lee et al., 2012), while physical activity is associated with a reduced risk of cardiovascular disease (CVD) (Yu, Yarnell, Sweetnam, Murray, & Caerphilly, 2003), type 2 diabetes, and obesity (Healy et al., 2008). The World Health Organization (WHO) promotes active travel, such as cycling and walking (WHO, 2010). Active travel has the potential to increase physical activity levels and is associated with a reduced risk of cardiovascular events (Hamer & Chida, 2008), obesity (Lindstrom, 2008), and cancer (Celis-Morales et al., 2017) and type 2 diabetes (Rasmussen et al., 2016). In 2008, Hamer and Chida (2008) published a review and meta-analysis regarding active commuting and the risk of CVD, including 173,146 participants from eight prospective cohorts. They concluded that active commuting provided an overall 11% reduction in the risk of CVD. However, the review was weakened by heterogeneous effect sizes and inconsistent adjustment for confounders (Hamer & Chida, 2008a). Because they investigated the effect of active commuting (cycling and walking combined), the separate effect of cycling or walking could not be assessed. Walking is reported to reduce risk factors for CVD (Murtagh et al., 2015), and to be inversely associated with CVD risk (Hamer & Y Chida, 2008b). Cycling as active travel is likely to provide similar or greater health effects than walking because the preferred work intensity of cycling is higher than that of walking (Oja et al., 1991), and exercise intensity is associated with a reduced risk of coronary heart disease (Tanasescu et al., 2002). Superior health effects of cycling over walking were demonstrated in a recent study including more than 250,000 participants (Celis-Morales et al., 2017). Some other studies have also analyzed cycling as a separate exposure (Andersen et al, 2000; Oja et al., 2011; Rasmussen et al., 2016); however, the specific associations between cycling for travel and health outcomes needs to be assessed in more detail.

Inequalities in health are linked to socioeconomic status (SES) (Mackenbach et al., 2008) and SES is also related to health behaviors such as smoking, diet, and physical activity (Beenackers et al., 2012; Menvielle et al., 2009). Low SES is also a risk factor for a sedentary lifestyle (Beenackers et al., 2012). However, SES affects engagement in physical activity differently depending on the physical activity domain (Popham & Mitchell, 2007). Active travel by cycling and walking has the potential to build physical activity into everyday life and decrease socioeconomic inequalities in physical activity because it is inexpensive and most people regularly need to go to work or other activities. A systematic review from 2012 (Beenackers et al., 2012), concluded that there is no clear pattern in the associations between SES and active travel. However, a Dutch study from 2017 showed that, despite low levels of active travel, more deaths were prevented in low SES groups compared to high SES groups, because of larger population size and higher mortality rates in the low SES groups (Gao, Helbich, Dijst, & Kamphuis, 2017).

Oja et al. (2011) conducted a systematic review on the health benefits of cycling. They included two cross-sectional and seven prospective cohort studies of adults. Six studies showed a consistent positive dose–response relationship between the amount of cycling and health benefits. However, none of these studies were performed on a low-SES population. Thus, the aim of the present study was to investigate the independent associations of cycling and walking for travel with diabetes and other risk factors for CVD in a multi-ethnic population with a low SES.

2. Materials and methods

2.1 Design and study population

The present study is part of the “Romsås in Motion” (MORO) study, a quasi-experimental community-based intervention to promote physical activity in a low-SES population, previously presented in detail (Jenum et al., 2003). In total, 6140 individuals aged 30 to 67 years residing in two low-SES districts in Oslo were invited to participate in a health survey in 2000. Data on physical activity, education level, working status, and smoking status were collected by self-administered questionnaires in Norwegian, Turkish, Vietnamese, English, Urdu, or Tamil (the most common native languages of the inhabitants in the included districts). Data on age, sex, and country of origin were available from Statistics Norway (www.ssb.no). Blood pressure and body height and weight were measured and blood samples were obtained during a physical examination. Analyses of the non-responders were previously reported (Jenum et al., 2003). All participants gave voluntary informed consent to participate, and the regional ethics committee and Norwegian Data Inspectorate approved the study protocol.

2.2 Self-reported physical activity

The amount of cycling, walking, and leisure-time vigorous physical activity was assessed by the original International Physical Activity Questionnaire, long version (IPAQ-L), usual week form (which assesses physical activity in a usual week), adapted to Nordic seasonal variation (Craig et al., 2003). The participants were asked to recall the number of days, hours, and minutes they engaged in different physical activity domains in a usual week. They provided one answer representative for summer and one answer representative for winter. Bouts of physical activity of ≥10 minutes’ duration were to be reported (Graff-Iversen, Anderssen, Holme, Jenum, & Raastad, 2007). The amounts of cycling, walking, and leisure-time vigorous physical activity were analyzed as the mean for summer and winter.

Cycling for travel was defined as cycling for a minimum of 10 minutes once a week, and walking for travel was defined as walking for a minimum of 10 minutes once a week. Vigorous leisure-time physical activity was categorized into three levels, no leisure-time vigorous physical activity, >0 to ≤1 hours per week (h/w), and >1 h/w (Haskell et al. 2007).

2.3 SES, self-reported diabetes, and smoking

Participants born in North America, Western Europe, Australia, and New Zealand were categorized as Western. Other immigrants were categorized as from Eastern Europe, the Mediterranean region, Sub-Saharan Africa, South Asia, East Asia, or Central or South America in the descriptive analyses and classified as non-Western immigrants in the regression models. A self-administered questionnaire previously used in other Norwegian surveys (Sogaard, Selmer, Bjertness, & Thelle, 2004) included questions regarding education, employment, and smoking. Education level was divided into three categories: 0 to 9 years, 10 to 12 years, and ≥13 years based on the question “How many years of school have you completed?” Working status was assessed by the question “Do you have paid work?” and categorized according to three answer options: “Yes, full time”; “Yes, part time”; and “No.” Participants were defined as having self-reported diabetes if they answered yes to the question “Do you have or have you had diabetes?” Participants were classified as smokers if they answered yes to the question “Have you been smoking or do you smoke daily?” Physical activity students were present during the survey to answer participants’ questions regarding the IPAQ-L.

2.4 Physical examination

The physical examination included measurements of body height, body weight, blood pressure, and non-fasting serum total cholesterol, high-density lipoprotein cholesterol (HDL), triglycerides, and glucose according to established standards (Bjartveit, Foss, Gjervig, & Lund-Larsen, 1979). Participants with a high non-fasting serum glucose level were asked to return for measurement of a fasting blood sample. Participants who did not report diabetes but who had an elevated fasting serum glycated hemoglobin and/or glucose level or who were not present for collection of fasting samples were categorized as having undiagnosed diabetes (Jenum et al., 2003). Body height and weight were measured without shoes, in light clothing, and using the same electronic device (DS 102; Arctic Heading, Tønsberg, Norway). Resting blood pressure (Dinamap, model no. 8,100/8,101; Criticon, Tampa, FL) was measured according to established standards (Jenum et al., 2003; Sogaard et al., 2004).

2.5 Risk factors for CVD

Objectively measured risk factors for CVD were defined according to international standards (Jenum et al., 2003) as follows: systolic hypertension, systolic blood pressure of >140 mmHg; diastolic hypertension, diastolic blood pressure of >90 mmHg; hypercholesterolemia, total cholesterol of >6.2 mmol/L; low HDL, HDL of <1.3 mmol/L; high triglycerides, triglyceride level of >1.7 mmol/L; overweight, body mass index (BMI) of ≥25 to <30 kg/m^2; and obesity, BMI of ≥30 kg/m^2. In addition, use of medication to reduce blood pressure or cholesterol was defined as an answer of “yes” on the questions “Do you use antihypertensive medication?” and “Do you use lipid-lowering medication?,” respectively. The CVD risk score was computed by adding up the number of risk factors present in each individual. The risk factors included in the CVD risk score were hypertension (systolic and/or diastolic hypertension or the use of antihypertensive medication), hypercholesterolemia (or the use of lipid-lowering medication), low HDL, high triglycerides, and obesity.

2.6 Statistical analysis

Data are presented as mean ± standard deviation or 95% confidence interval (CI), number with percentage of the total sample, or odds ratio (OR) with 95% CI. Chi-square tests were used to analyze differences between the invited population and the analyzed sample. Logistic regression analyses with diabetes or a risk factor for CVD as the dependent variable and cycling or walking for travel as the independent variable were used to assess the associations between health and active travel. Each risk factor (and diabetes) were analyzed in separate models with two levels of adjustment, 1) adjusted for sex and age, and 2) adjusted for sociodemographic factors, smoking status, and vigorous leisure time physical activity, and active travel. If cycling for travel was exposure then walking for travel was included as confounder and vice versa. Hosmer's manually backward elimination technique was used for the multivariate regression models. The association between cycling and walking as travel, and CVD risk score was analyzed by linear regression in two models with the same adjustments as in the logistic regression. The multivariate models were tested for interactions between SES and active travel by including an interaction term (education* cycling/walking as travel). Statistical analyses were performed with IBM SPSS version 23 (IBM SPSS, Inc., Armonk, NY). Statistical significance was set at $p < 0.05$.

3. Results

Of the 6140 subjects invited to the study, 2950 (48.1%) participated. Of these, 2445 (39.8% of those invited, 82.9% of those who participated) completed the IPAQ-L and constituted the sample included in the analysis. There were greater proportions of men (51.3% vs. 43.6%) and non-Western immigrants (27.7% vs. 17.8%) in the invited population than in the analyzed sample ($p < 0.001$). Overall, 26.5% of the participants reported any cycling for travel, and among these the mean amount of cycling for travel was 1.64 h/w. The corresponding values for walking for travel were 80.1% and 3.80 h/w. The distributions of sociodemographic factors and physical activity in the total sample, stratified by mode of active travel, are presented in Table 1. There was no interaction between SES (education) and cycling or walking for travel (data not shown).

Among the participants included in the study, 6.4% had diabetes, 27.1% had a systolic blood pressure of ≥140 mmHg and/or diastolic blood pressure of ≥90 mmHg or used blood pressure-reducing medication, 33.6% had a total cholesterol level of >6.2 mmol/L or were taking medication to reduce cholesterol, 44.9% had an HDL level of <1.3 mmol/L, 45.9% had a triglyceride level of >1.7 mmol/L, 62.8% had a BMI of ≥25 m/kg^2 and 21.5% were obese (Table 2). A CVD risk score of 0 was present in 23.3% (n = 558), while 32.0% (n = 766) had three or more risk factors for CVD.

Diabetes (all and self-reported), use of antihypertensive medication, use of lipid-lowering medication, low HDL, high triglycerides, and obesity were all negatively associated with cycling for travel after adjustment for age and sex (Table 3). Self-reported diabetes, low HDL and obesity were still negatively associated with cycling for travel after adjustment for country of origin, education, smoking, sex, age, employment status, walking for travel, and leisure-time vigorous physical activity. There was no interaction between SES (education) and cycling or walking for travel (results not shown). Cycling for travel was negatively associated with the risk score for CVD both after adjusting only for age and sex [β = -0.26 (-0.37– -0.14)] and in the fully adjusted model [β = -0.13 (-0.25–-0.01)]. Walking for travel, adjusted for sex and age, was inversely associated with systolic hypertension and obesity. In the fully adjusted model (adjusted for country of origin, education, smoking, sex, age, employment status, cycling for travel, and leisure-time physical activity), systolic hypertension was still inversely associated with cycling for travel (Table 4). Walking for travel was not associated with the risk score for CVD in any of the models [β = -0.12 (-0.25–0.02)and -0.03 (-0.17–0.10)].

4. Discussion

The present study is the first to present associations of cycling for travel with diabetes and risk factors for CVD in a low-SES population. Approximately one in four participants cycled for travel, while four of five walked for travel at least 10 minutes once a week. Participants that reported the use of cycling for travel had a reduced risk of diabetes, low HDL and obesity, while those walking for travel had a reduced risk of systolic hypertension. These associations were independent of country of origin, education, smoking, sex, age, employment status, other forms of active travel, and vigorous leisure-time physical activity. A negative association was also present between the number of risk factors for CVD and cycling, but not for walking for travel.

This study confirms that physical activity (Aune et al., 2015), especially cycling (Rasmussen et al., 2016), is associated with a reduced risk of type 2 diabetes and demonstrates that this association is specific to cycling and not walking for travel. This builds upon evidence from other cross-sectional studies reporting associations between cycling for travel and the risk of diabetes (Laverty, Mindell, Webb, & Millett, 2013; Millett et al., 2013). The OR for self-reported diabetes in the present study was comparable with the OR for diabetes when comparing commuter cyclists with those using passive travel in a representative sample from the UK (Laverty et al., 2013) as well as the results from an Indian study (Millett et al., 2013). The criterion for being a cycling commuter was stricter (daily cycling) in the latter studies; thus, the present study indicates that even small amounts of cycling may reduce the risk of diabetes. Several biological mechanisms may be operating in the reduction in the risk of diabetes by cycling. An interventional study of outdoor cycling showed improved glucose tolerance, insulin resistance, and insulin secretion in young men (Madsen et al., 2015). Additionally, interventions on bicycle ergometers revealed improved glucose metabolism (Boule et al., 2005; Finucane et al., 2010) by a reduction in fasting insulin (Boule et al., 2005) and C-peptide levels (Finucane et al., 2010) as well as increased insulin sensitivity (Boule et al., 2005). Moreover, a cross-sectional study showed a negative association between outdoor cycling and glucose intolerance (Van Dam, Schuit, Feskens, Seidell, & Kromhout, 2002).

In the present study, walking for travel was not associated with diabetes. This confirms the findings from some (Dunstan et al., 2004; James et al., 1998; Van Dam et al., 2002) but not all cross-sectional studies (Kabeya et al., 2016). The latter study involved a large cohort of >26,000 participants, providing strong statistical power. Although the study showed a weak but statistically significant negative association between walking and diabetes, no longitudinal association was shown during a 5-year follow-up. A meta-analysis from 2015 combining more than 11,000 cases of diabetes and 300,000 participants from 7 prospective cohorts reported a relative risk of 0.85 (0.79–0.91) of type 2 diabetes in participants with high versus low levels of walking (Aune et al., 2015). This estimate is comparable with the non-significant estimate in the present study.

Low HDL was negatively associated with cycling in the present study. This is in contrast to previous studies in adults (Berger, Qian, & Pereira, 2017; Hu, Pekkarinen, Hanninen, Tian, & Guo, 2001) and children (Ramirez-Velez et al., 2017) that showed no significant association between cycling and HDL. To the best of our knowledge, the present study is the largest to investigate the association between cycling and HDL. Although previous studies have implied similar associations, they were not statistically significant, possibly because of low statistical power. Another factor adding to the uncertainty of the results was that low cholesterol levels were self-reported in the study by Berger et al. (2017). In line with our findings, a meta-analysis (Kodama et al., 2007) including 25 articles showed that regular aerobic exercise was modestly associated with clinically important elevations in HDL. Even if individuals walking for travel reported more walking than the cyclists reported cycling, walking was not associated with HDL in the present study. This may indicate that the exercise intensity during walking is too low to elevate the HDL level (Oja et al., 1991). In contrast to our results, Pizarro et al. (2013) reported that walking to school was associated with increased HDL also after adjusting for moderate to vigorous leisure-time physical activity, indicating that exercise intensity does not drive the association between physical activity and HDL. This assumption is supported by the previously mentioned meta-analysis (Kodama et al., 2007).

Obesity was negatively associated with cycling for travel. Fuller and Pabayo (2014) claimed that the association between utilitarian cycling and body size in prospective cohorts is unclear. However, a recent meta-analysis including both cross sectional and longitudinal studies found that cycling for travel was negatively associated with obesity (Nordengen, Andersen, Solbraa & Riiser).

Systolic hypertension was inversely associated with walking for travel, but not cycling for travel, in the present study. These findings are in line with those in a study from the UK including approximately 20,000 participants (Laverty et al., 2013). The exact mechanisms responsible for the association between physical activity and systolic hypertension are complex and unclear. Exercise training has been shown to reduce vascular resistance, total peripheral resistance, body weight, and insulin resistance, which are structural and neurohormonal adaptations that may reduce blood pressure (Huai et al., 2013). The reason why walking but not cycling for travel may reduce systolic hypertension remains unclear; however, this phenomenon indicates that duration rather than work intensity is important when aiming to reduce blood pressure, as shown by the fact that the mean duration of walking was seven times longer than the mean duration of cycling in the present study. This assumption is supported by a meta-analysis of 72 trials, which showed that endurance exercise reduced blood pressure but revealed no association between exercise intensity and blood pressure (Cornelissen & Fagard, 2005).

The CVD risk score was associated with cycling for travel. The present study demonstrated that individuals who stay physically active through cycling for travel had reduced risk of having a cluster of CVD risk factors. Our finding build on evidence from other studies that showed that objectively measured physical activity (Healy et al., 2008) and cycling to school (Andersen et al., 2011) was associated with a reduced metabolic risk score.

In the present study cycling for travel was associated with more health benefits compared with walking for travel even if those walking for travel walked more than the cyclist cycled. This may be explained by the higher preferred work intensity of cycling (Oja et al., 1991) as exercise intensity is associated with a reduced risk of coronary heart disease (Tanasescu et al., 2002). The amount of cycling and walking for travel required to gain health benefits remains unclear, and most studies within the field require a larger amount of active traveling to be classified as an active traveller compared to the present study. It seems plausible that a larger amount or active travel would provide greater health benefits as the dose-response relationship between chronic physical activity levels and health outcomes is well established (Garber et al., 2011). Thus, the low amount of active travel needed to be classified as a cycling or walking traveller might explain why we fail to discover any association between cycling or walking for travel and many of the investigated health variables. However, the mean amount of cycling among the cyclist was almost 100 min/week providing 2/3 of the minimum recommendations for weekly amount of moderate-intensity cardiorespiratory exercise training (150 minutes), and more than the minimum recommendations of 75 minutes of vigorous-intensity cardiorespiratory exercise training (Garber et al., 2011). Among the studies investigating the health effects of lower levels of cycling, Salquist et al. (2013) reported no effect of cycling 1-50 min/week while riding an hour a week or more was prospectively associated with CVD mortality. Celis-Morales et al. (2017) reported reduced risk of CVD incidence and mortality among long distance cycling commuters, but not among not among short distance cycling commuters. The latter study also reported dose response trends for CVD incidence and mortality by commuting distance, while a recent meta-analysis found no dose-response relationship between cycling and CVD (Nordengen et al.).

4.1 Strengths and limitations

A large population-based sample from two low-SES , objective measurements of CVD risk factors according to international standards and a validated questionnaire (IPAQ-L)strengthens the present study. A novelty of this study is that we analyzed the health associations of cycling and walking for travel separately. This may be important because cycling and walking are different in nature and require different strategies for facilitation. Reporting active travel rather than active commuting

makes the results more generalizable because it also includes individuals not working (23%) and those working from home. The questionnaires were translated into the most common native languages of the inhabitants in the included districts, reducing barriers for participation, and students were available for guidance if the respondents had trouble answering the questionnaires.
The present analysis also has several limitations. Although we controlled for SES, smoking, and other domains of physical activity, the study would have benefited from controlling for dietary intake because diet may have a substantial effect on diabetes and CVD risk factors. Additionally, the cross-sectional design provides no information regarding causality or temporal relationships. Thus, it is possible that individuals with diabetes and hypertension are not able to perform active travel because of complications caused by the disease (reverse causation). We used an early version of the IPAQ-L (the usual week form). It was also adopted to Nordic conditions by asking for one answer representative of summer and one answer representative of winter for each question. Thus, the IPAQ was quite complicated and perhaps not fit for the present study population. This may have weakened its validity and might partly explain the relatively large uncertainties (confidence intervals) in the associations. The notion that the questionnaire was too complicated is supported by the change from "usual week" to "the last 7 days" with respect to how physical activity should be reported and the recommendation for using the IPAQ short form when monitoring physical activity (Craig et al., 2003). Additionally, the independent variables in the present study of cycling and walking for travel relied on self-reported information, which may introduce recall bias and social desirability bias, leading to overestimation or underestimation of the associations. Moreover, some questions may have been misinterpreted, especially by individuals with low education and of non-Western origin, even when students were present to assist. Finally, the present study did not examine differences in duration, frequency, or intensity, all of which have a major impact on the health effects of walking and cycling.

4.2 Perspective

Based on the results of the present study, cycling (and walking) for travel should be facilitated to increase the physical activity level in multi-ethnic, low-SES communities. Because cycling for travel has greater health effects than walking for travel, cycling-specific strategies should be employed to increase the level of active travel. In populations with low SES, there is a large potential health gain through cycling and walking for travel because the prevalence of non-communicable diseases are higher (Mackenbach et al., 2008) and the prevalence of active travel is normally lower (Gao et al., 2017) in these populations than in the general population. Future studies should focus on the longitudinal association of walking and cycling for travel with diabetes and CVD risk factors in multi-ethnic, low-SES populations as well as other populations.

4.2 Conclusion

The present study indicates that people engaging in active travel in general and cycling for travel in particular had lower odds of diabetes and lower risk factors for cardiovascular disease compared to those not engaged in active travel.

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Table 1: Characteristics for total sample and by travel mode

	Total sample, n= 2445	Cycling, n= 648	Walking, n= 1961
Country of origin			
Western countries, % (n)	82.2 (2010)	90.3 (585)	83.2 (1632)
Eastern Europe, % (n)	1.3 (32)	1.1 (7)	2.1 (24)
Mediterranean region, % (n)	3.7 (90)	1.9 (12)	3.8 (75)
Sub-Sahara Africa, % (n)	1.8 (43)	1.1 (7)	1.3 (26)
South Asia, % (n)	5.2 (128)	2.2 (14)	4.7 (93)
East Asia, % (n)	4.9 (121)	2.9 (19)	4.8 (95)
Central- and South America, % (n)	0.9 (21)	2.9 (19)	0.8 (19)
Working status			
No paid work, % (n)	23.0 (554)	13.9 (89)	22.6 (436)
Paid work part time, % (n)	13.3 (319)	15.3 (98)	13.7 (265)
Paid work full time, % (n)	63.7 (1532)	70.8 (454)	63.7 (1231)
Education			
Years, mean (sd)	12.0 (3.8)	12.7 (3.6)	12.1 (3.7)
0-9 years, % (n)	22.6 (540)	14.5 (92)	21.9 (420)
10-12 years, % (n)	37.7 (899)	37.4 (238)	37.3 (716)
≥13 years, % (n)	39.7 (948)	48.1 (306)	40.9 (789)
Smoking status			
Non-smokers, % (n)	62.8 (1520)	70.1 (451)	63.2 (1230)
Leisure time vigorous physical activity			
Hours/week, mean (sd)	1.2 (2. 9)	2.2 (3.9)	1.2 (2.8)
No leisure time vigorous physical activity % (n)	65.2 (1575)	42.3 (270)	63.3 (1229)
> 0 ≤ 1 hour/week % (n)	10.5 (253)	15.3 (98)	11.5 (224)
> 1 hour/week % (n)	24.4 (589)	42.4 (271)	25.2 (489)
Cycling for travel			
Hours/week, mean (sd)	0.44 (1.19)	1.64 (1.82)	0.51 (1.28)
Minimum 10 minutes once a week, % (n)	26.5 (648)	100 (648)	30.6 (601)
Walking for travel			
Hours/week, mean (sd)	3.08 (4.92)	3.54 (5.02)	3.80 (5.21)
Minimum 10 minutes once a week, % (n)	81.0 (1961)	93.0 (601)	100 (1961)
Gender			
Men, % (n)	43.6 (1066)	47.4 (307)	42.3 (829)
Height, cm, mean (sd)	170 (96)	171.5 (94.3)	169.9 (96.7)
Weight, kg, mean (sd)	77.5 (16.2)	77.4	77.1 (16.2)
Age, years, mean (sd)	48.00 (9.82)	45.8 (9.3)	47.8 (9.79)

Sd: standard deviation

Table 2: Diabetes and various risk factors for cardiovascular disease for total sample and by travel mode.

Diabetes	Total sample, n= 2445	Cycling, n= 648	Walking, n= 1961
All, % (n)	6.4 (156)	4.0 (26)	5.9 (116)
Self-reported, % (n)	3.9 (96)	1.9 (12)	3.6 (71)
Blood pressure (mmhg)			
SBP, mean (sd)	126.6 (18.0)	125.1 (17.2)	126.1 (17.7)
DBP, mean (sd)	74.0 (11.0)	73.3 (10.7)	73.3 (11.1)
SPB ≥ 140 and/or DBP ≥ 90 and/or BPmed	27.1 (660)	21.8 (141)	26.4 (515)
Cholesterol (mmol/l)			
Total cholesterol, mean (sd)	5.66 (1.08)	5.62 (1.03)	5.65 (1.06)
Cholesterol medication and/or Total cholesterol > 6.2 % (n)	33.6 (809)	30.0 (194)	33.3 (645)
HDL, mean (sd)	1.41 (0.41)	1.45 (0.41)	1.42 (0.40)
Triglycerides (mmol/l)			
mean (sd)	1.95 (1.30)	1.81 (1.21)	1.93 (1.25)
BMI (m/kg^1)			
mean (sd)	26.84 (4.69)	26.32 (3.98)	26.7 (4.66)
Overweight, BMI ≥ 25 < 30, % (n)	41.3 (1007)	44.6 (289)	47.7 (817)
Obese, BMI ≥ 30, % (n)	21.5 (526)	15.9 (103)	20.4 (400)
CVD risk score, mean (sd)	1.72 (1.36)	1.50 (1.31)	1.69 (1.34)

Systolic blood pressure: SBT. Diastolic blood pressure: DBP. High density lipoproteins: HDL. Body mass index: BMI. Standard deviation: sd.

Table 3: Odds ratios (95% confidence interval) from logistic regression showing the association between diabetes or risk factors for cardiovascular disease (CVD) and cycling for travel.

CVD risk factor	Adjusted for age and gender	Adjusted for all confounders #
Diabetes		
All	**0.601 (0.387 ; 0.932)**	0.734 (0.447 ; 1.207)
Self-reported	**0.424 (0.229 ; 0.786)**	**0.471 (0.227 ; 0.976)**
Blood pressure		
SPB > 140 mmhg	0.824 (0.642 ; 1.057)	0.779 (0.594 ; 1.021)
DBP > 90 mmhg	0.955 (0.654 ; 1.395)	1.094 (0.726 ; 1.648)
Blood pressure medication (BPmed)	**0.679 (0.481 ; 0.960)**	0.763 (0.524 ; 1.110)
SPB > 140 and/or DBP > 90 and/or BPmed	0.819 (0.652 ; 1.028)	0.816 (0.638 ; 1.045)
Cholesterol		
Total Cholesterol > 6.2 mmol/l and/or Cholesterol medication	0.930 (0.759 ; 1.140)	1.092 (0.875 ; 1.364)
HDL < 1.3 mmol/l	**0.674 (0.554 ; 0.820)**	**0.782 (0.631 ; 0.968)**
Triglycerides		
Triglycerides > 1.7 mmol/l	**0.770 (0.637 ; 0.932)**	1.011 (0.820 ; 1.248)
BMI		
BMI ≥ 25 m/kg^2	0.905 (0.749 ; 1.094)	0.938 (0.762 ; 1.156)
BMI ≥ 30 m/kg^2	**0.636 (0.501 ; 0.807)**	**0.713 (0.552 ; 0.920)**

Each risk factor represent a separate regression model presented with two levels of adjustment. Systolic blood pressure: SBT. Diastolic blood pressure: DBP. High density lipoproteins: HDL. Body mass index: BMI.. #: Country of origin, working status, educational level, smoking status, walking for travel, leisure time physical activity, gender and age.

Table 4: Odds ratios (95% confidence interval) from logistic regression showing the association between diabetes or risk factors for cardio vascular disease (CVD) and walking for travel.

CVD risk factor	Adjusted for age and gender	Adjusted for all confounders #
Diabetes		
All	0.795 (0.540 ; 1.170)	0.780 (0.520 ; 1.171)
Self-reported	0.765 (0.475 ; 1.234)	0.775 (0.468 ; 1.283)
Blood pressure		
SPB > 140 mmhg	**0.716 (0.559 ; 0.917)**	**0.718 (0.554 ; 0.931)**
DBP > 90 mmhg	0.807 (0.554 ; 1.176)	0.785 (0.533 ; 1.158)
Blood pressure medication	1.123 (0.803 ; 1.571)	1.166 (0.821 ; 1.656)
SPB > 140 and/or DBP > 90 and/or BPmed	0.896 (0.707 ; 1.136)	0.895 (0.698 ; 1.147)
Cholesterol		
Total Cholesterol > 6.2 mmol/l and/or Cholesterol medication	1.009 (0.807 ; 1.263)	1.034 (0.817 ; 1.307)
HDL < 1.3 mmol/l	0.904 (0.728 ; 1.122)	0.975 (0.777 ; 1.225)
Triglycerides		
Triglycerides > 1.7 mmo/l	0.941 (0.762 ; 1.162)	1.052 (0.841 ; 1.317)
BMI		
BMI ≥ 25 $m*kg^{-2}$	0.932 (0.750 ; 1.158)	0.975 (0.776 ; 1.225)
BMI ≥ 30 $m*kg^{-2}$	**0.728 (0.575 ; 0.922)**	0.785 (0.612 ; 1.008)

Systolic blood pressure: SBT. Diastolic blood pressure: DBP. High density lipoproteins: HDL. Body mass index: BMI. #: Country of origin, working status, educational level, smoking status, walking for travel, leisure time physical activity, gender and age.