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Perceived health status associated with transport choice for short distance trips

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ABSTRACT

Background. This study examines the association between active transport and perceived general health, perceived psychological wellbeing and a healthy body weight in the Netherlands. *Methods.* Data were collected by an online questionnaire (N = 3663) in the Netherlands. Data collection was conducted over a period of one calendar year starting July 2012. Logistic regression analyses were used to investigate the association between choice of transport mode (bicycling vs car use and walking vs car use) and perceived general health, perceived psychological wellbeing and having a healthy weight respectively. The presented OR's may be interpreted as the likelihood of an average person in our dataset to have a better perceived health or body weight when choosing active transport (either bicycling or walking) over using the car for trips up to 7.5 km. *Results.* Cycling was found to be significantly associated with a better perceived general health (OR = 1.35, 95%CI:1.07–1.70) and having a healthy body weight (OR = 1.52, 95%CI:1.28–1.79), but not with a better perceived psychological wellbeing (OR = 1.12, 95%CI:0.93–1.34). Walking was found to be significantly associated with having a healthy body weight (OR = 1.35, 95%CI:1.09–1.69), but not with a better perceived general (OR = 1.12, 95%CI:0.84–1.51) or psychological wellbeing (OR = 0.85, 95%CI:0.67–1.08). *Conclusion.* Our results suggest that active transport use has been associated with a better perceived general health and a healthy body weight. However, more research is needed to be able to elucidate which factors cause this better health. No associations were observed between transport choice and perceived psychological wellbeing.

Introduction

Physical inactivity is one of the main health-related problems in Western countries. It is estimated to cause 21–25% of the burden of disease due to breast and colon cancer, 27% of the burden of disease due to diabetes and about 30% of the burden of disease due to ischaemic heart disease (WHO, 2009). The Global Burden of Disease study showed that physical inactivity and low physical activity accounted for about 3.2 million deaths annually (Lim et al., 2012). Therefore, interventions effectively stimulating physical activity are of great importance.

One way to increase physical activity is by stimulating people to choose active modes of transportation (e.g. walking and cycling instead of using the car). The Toronto Charter for Physical activity states that transport policies and systems that prioritize active transport are among the best investments to stimulate physical activity since active transport is the most practical and sustainable manner to increase physical activity on a daily basis (Global Advocacy for Physical activity the Advocacy Council of the International Society for Physical activity and Health, 2011).

Previous research showed that walking and cycling are both associated with a lower risk of all-cause mortality (Kelly et al., 2014) and that walking and cycling specifically for commuting purposes is associated with better perceived general health (Humphreys et al., 2013; Bopp et al., 2013) and less overweight (Bopp et al., 2013; Goodman et al., 2012; Olabarria et al., 2014). However, mixed results have been found for the association between active commuting and perceived psychological wellbeing (Humphreys et al., 2013; Martin et al., 2014; Proper

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et al., 2012). It can be argued that, next to methodological differences, situational differences (e.g. urban design, connectivity) between countries in which these studies are performed could have influenced the results. This raises the question if the association between transport choice and health outcomes (general perceived health, perceived psychological wellbeing and a healthy body weight) persists irrespective of these situational differences between countries. Therefore, with a raising awareness of the importance of stimulating active transport around the world, it is interesting to investigate if these associations between transport choice and the different health outcomes also hold in a country that is already characterized by high levels of active transport and good health outcomes. Compared to other European countries, the Netherlands has the highest proportion of the population that use the bicycle as a mode of transport on a typical day (TNS Opinion & Social, 2014a). The Netherlands are among the countries with the best perceived (TNS opinion & social, 2014b) and psychological wellbeing (TNS opinion & social, 2010). Of the before mentioned studies only one (Proper et al., 2012) has been performed in the Netherlands. The present study is part of the impActs of actiVE traNsport in Urban Environments (AVENUE) project which uses national representative data. In the present study the hypotheses were tested that active transport is associated with better perceived general health, a better perceived psychological wellbeing and with having a healthy body weight.

Methods

Data source

A description of the AVENUE project was reported elsewhere (Scheepers et al., submitted for publication). The aim was to provide in depth information on (a) characteristics of short car and active (cycling & walking) transport trips and (b) the feasibility of replacing short car trips with active transport modes. Short trips were defined as trips with a distance of up to 7.5 km (Scheepers et al., submitted for publication). AVENUE included four trip purposes: 1) shopping; 2) going to public natural spaces; 3) going to sports facilities; and 4) commuting. In this project we only focused on trips made by one transport mode.

The data presented in this paper were collected through an online questionnaire specially designed to investigate transport choice (car, cycling and walking) for the predefined trip purposes. The study population consisted of an Internet panel (N = 35,000) representative for the general Dutch population. A random selection of participants aged 18 years or older (minimum age to get a driver's license in the Netherlands) was drawn (N = 8,813; Fig. 1). Participants had to meet two selection criteria: 1) they were not hampered by their health to use at least one of the three transport modes; and 2) they had made at least one short trip a week using at least one of the three transport modes. A total of 4,021 participants were offered the main questionnaire. Data collection was conducted over a period of one calendar year starting July 2012, during which on each day an average of ten participants filled in the questionnaire. The questionnaire was completed by a total of 3,663 persons (45.6% of the sample; 90.5% of the respondents). This study population was shown to be quite representative for the general Dutch population with respect to mobility behavior and personal characteristics (Scheepers et al., submitted for publication). Respondents differed significantly from non-respondents on age, household structure, making trips to public natural spaces as well as meeting the selection criteria (Scheepers et al., submitted for publication).

Since an approval of the Institutional Review Board (IRB) is only needed when daily life of participants is influenced or participants should perform specific actions, an IRB approval was not warranted and therefore not obtained. The data were anonymized prior to the moment that the investigators received the dataset from the owner of the internet panel. The authors did not have access to any identifying information.

Transport mode

For the purpose of this study, respondents were only included if they made short distance trips by car, cycling or walking for at least one ofthe

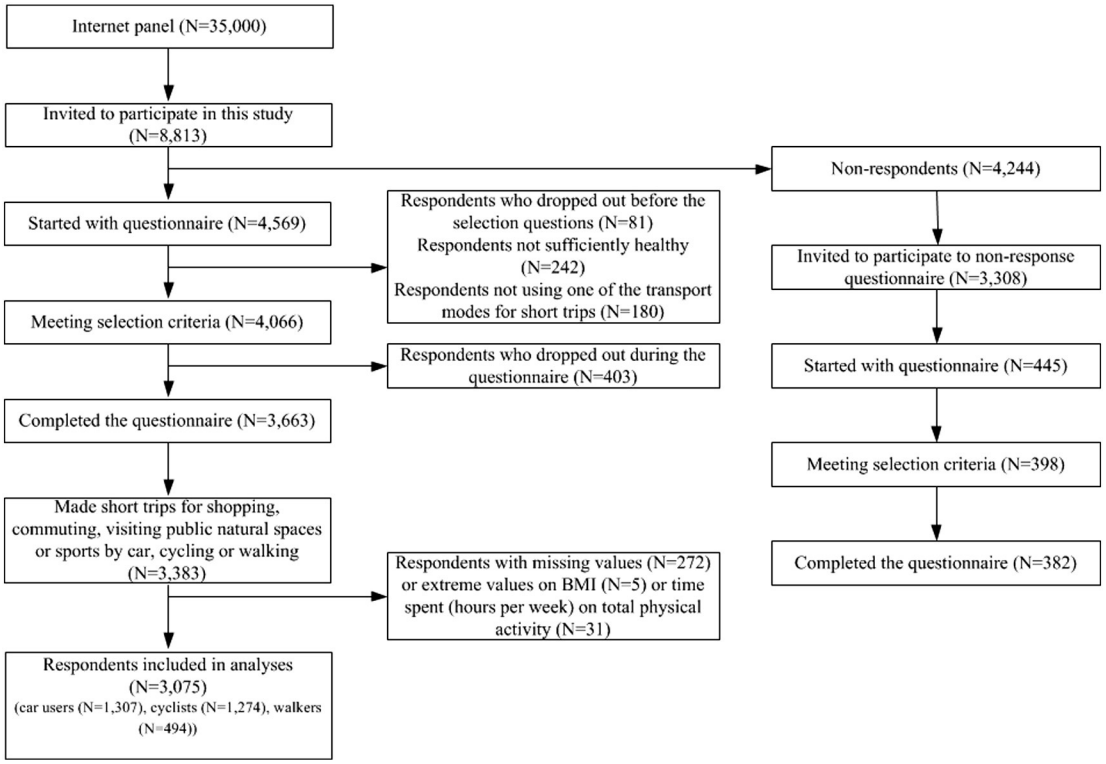

Fig. 1. Flow-chart showing selection of study population.

trip purposes (N = 3383). Respondents were classified into transport groups based on their preferred transport choice: car users, cyclists, and pedestrians. Their preferred choice was inferred from the frequency of using the car, cycling or walking for all trip purposes they mentioned making short distance trips by car, cycling or walking. When persons used two or more transport modes with a similar frequency, they were categorized as a car user if one of the transport modes was a car since the primary aim of the AVENUE project was to provide in-depth information on the feasibility of replacing short car trips with active transport modes. If persons used cycling and walking with a similar frequency (and did not use the car), they were categorized as a cyclist.

Health outcomes

In this study, three different self-reported health outcomes were used: general health, psychological wellbeing and Body Mass Index (BMI). Perceived general health was measured using a question from the RAND 36 (Van der Zee & Sanderman, 2012; VanderZee et al., 1996) in which respondents were asked to rate their general health on a 5 point scale ranging from "excellent" to "bad". The answers were dichotomized and were presented as "healthy" (including "excellent", "very well", and "good") or "unhealthy" (including "mediocre" or "bad").

Perceived psychological wellbeing was measured by using the Mental Health Inventory (MHI-5) which measures general psychological wellbeing. The MHI-5 is a subscale of the RAND 36 (Van der Zee & Sanderman, 2012). The MHI-5 comprises 5 questions in which respondents were asked to indicate on a 5 point scale, ranging from 'All the time' to 'not at all', how often in the past 4 weeks they felt: 1) very nervous; 2) down in the dumps; 3) calm and peaceful; 4) downhearted and blue; and 5) happy. Each respondent could achieve a total score between 5 and 25. For the third and fifth question the scoring was reversed so that lower scores indicated worse psychological wellbeing. Item scores of the answers were added and multiplied by four, creating a score ranging from 0 to 100, with 100 representing optimal psychological wellbeing. The answers were dichotomized by using a cut-off point of 60 (Perenboom et al., 2000), where a score higher than 60 represents a good psychological wellbeing.

BMI was derived from questionnaire results. Respondents were asked to report their body weight and height (without clothes and shoes). Subsequently, BMI was calculated as body weight in kilograms divided by the square of the body height in meters. The answers were dichotomized according to WHO cut-off points and were presented as having a healthy weight (<25 kg/m^2) and being overweight or obese (≥25 kg/m^2) (WHO, 2014).

Covariates

Personal characteristics and season were taken into account as covariates in the statistical analyses. Personal characteristics were obtained by the online questionnaire and included gender (male, female (reference)), age (year), educational level (low, medium, high (reference)), household composition (living alone, with a partner, with children <18 years, with other adults (parents, children ≥ 18 years, or other adults; reference)), physical activity level, smoking (smoker/non-smoker (reference)) and alcohol consumption (number of glasses per week). Regarding educational level, "low" was defined as primary school and lower general secondary education; "medium" as intermediate vocational education, higher general secondary education, and pre-university education; and "high" as higher vocational education and university. Physical activity was assessed with the validated 'Short QUestionnaire to ASsess Health-enhancing physical activity' (SQUASH), which contains questions about multiple activities referring to a normal week in the past months (de Hollander et al., 2012; Wendel-Vos et al., 2003). Results from the SQUASH were converted to time spent (hours per week) on total physical activity including commuting, household, leisure time and sport activities, and activities at work or school (de Hollander et al., 2012; Wendel-Vos et al., 2003; Kemper et al., 2000).

Season (winter, spring, summer, autumn (reference)) was determined by the date respondents filled in the questionnaire.

Data analyses

Participants with missing values on one or more covariates (N = 272), extreme values on BMI (BMI ≥ 50 kg/m^2; N = 5) or time spent on total physical activity (N = 31) were excluded from statistical analyses. Reported time on physical activity was considered extreme when exceeding 112 h per week (that is sleeping for eight hours per day, leaving a maximum of 7 × (24 − 8) for physical activity). Ultimately, statistical analyses included data concerning 3,075 respondents (Fig. 1). Descriptive statistics were used to characterize the study population.

To investigate the association between transport choice (bicycling vs car use and walking vs car use) and perceived general health, perceived psychological wellbeing and having a healthy weight respectively, logistic regression analysis was used. The presented OR's may be interpreted as the likelihood of an average person in our dataset to have a better perceived health, a better psychological wellbeing or having a healthy body weight when choosing active transport (either bicycling or walking) over using the car for trips up to 7.5 km. In this paper, we examined the following model:

Dependent	Independent	Covariates
Health outcome[a]	Transport choice[b]	Age, gender, educational level, household composition, physical activity level, (BMI,) smoking, alcohol consumption, season.

[a] Either perceived general health, perceived psychological wellbeing or healthy body weight.
[b] Either bicycling vs car use or walking vs car use.

In line with the study of Humphreys et al (Humphreys et al., 2013), we decided to present models for perceived general health and perceived psychological wellbeing before and after adjustment for BMI since it can be argued that BMI can act as a confounder or a mediator (Fig. 2). For all statistical analyses, SAS 9.3 was used.

Results

Table 1 shows the characteristics of the study population included in the analysis. Most covariates differed between cyclists/pedestrians and car users. Exceptions were gender, alcohol consumption and season. Taking into account differences in gender, age and education level, both cyclists and pedestrians differed from car users with respect to healthy body weight. Only cyclists differed from car users with respect to perceived general health and no differences between transport mode groups were found concerning perceived psychological wellbeing.

Transport choice and health outcomes

Table 2 shows the adjusted association between transport choice and the three health outcomes. Comparison of cycling and car use showed that cycling was associated with significantly higher odds of perceiving a good general health (OR = 1.35, 95%CI:1.07–1.70) and significantly higher odds of having a healthy body weight (OR = 1.52, 95%CI:1.28–1.79). Inclusion of BMI attenuated the association between cycling and perceived general health, resulting in a non-significant association (OR = 1.20, 95%CI:0.95–1.53). Comparison of walking and car use also showed that walking was associated with significantly higher odds of having a healthy body weight (OR = 1.35, 95%CI:1.09–1.69), but was not significantly associated with perceiving a good general health. No significant association was found between transport choice and perceived psychological wellbeing.

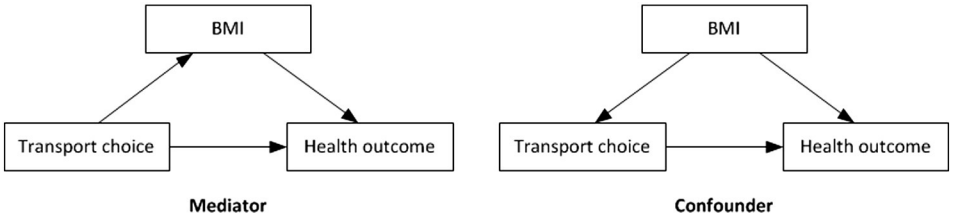

Fig. 2. Schematic description of BMI as a mediator or confounder.

Discussion

Aim of this study was to test the hypothesis that the association between transport choice and the different health outcomes also holds in a country characterized by high levels of active transport and good health outcomes (the Netherlands). Cycling compared to car use was found to be associated with a better perceived general health and having a healthy body weight, but not with a better perceived psychological wellbeing. Walking compared to car use was found to be associated with having a healthy body weight, but not with a better perceived general health or psychological wellbeing.

The association between cycling and a better perceived general health is in line with the results of Humphreys et al. who found a positive association between time spent on active commuting in general (walking and cycling together) and physical wellbeing for participants of the "Commuting and Health in Cambridge" study. No separate associations for walking and cycling were reported in that study (Humphreys et al., 2013). Bopp et al. who investigated the association between transport choice for commuting trips and perceived general health in the mid-Atlantic region of the USA also found a positive association for both walking and cycling to the workplace and general perceived health (Bopp et al., 2013). To our knowledge, these are the only two other studies investigating transport choice with regard to perceived general health. However, besides differences in study population (e.g. country) these studies also differ in research methods. Humphreys et al. (Humphreys et al., 2013) used the Medical Outcomes Short Form (SF-8) of which four questions (general health, physical functioning, role physical, bodily pain) are used to calculate the summary score for physical wellbeing. In contrast, Bopp et al. (Bopp et al., 2013) used a same question as we did in our study in which they asked respondents to rate their current health status from 1 (poor) to 5 (excellent). Therefore, due to the low number of studies, as well as differences in study population and research methods, we are unable to draw any firm conclusions concerning the association between transport choice and perceived general health. The absence of a significant association between walking and perceived general health in our study could have been caused by the high levels of walking in the Netherlands in general and it is possible that walking only influences perceived general health for the relatively inactive populations. The same has already been argued by Hoevenaar-Blom et al. who investigated the relation between self-reported leisure time physical activity and fatal/nonfatal cardiovascular diseases incidence in the Netherlands (Hoevenaar-Blom et al., 2011). They found, in contrast to other studies, no relation between walking and cardiovascular diseases

No statistically significant association between transport choice and psychological wellbeing was found in this study. To our knowledge, only three earlier studies investigated this association between transport and psychological wellbeing. However, taking a closer look at these studies shows a diverse set of research methods and only one other study used the MHI-5. In this study, where the association between sedentary behavior and psychological wellbeing was investigated in the Doetinchem Cohort Study (in the Netherlands), no association was found between time spent on sitting in a motor vehicle and psychological wellbeing (Proper et al., 2012). Comparison with studies using another questionnaire to investigate this association showed mixed results. Humphreys et al. (Humphreys et al., 2013), who used the SF-8 found also no significant association between transport choice and psychological wellbeing for the commuters in Cambridge. However, Martin et al., who used the 12-item General Health Questionnaire (GHQ-12), did find a positive association between transport choice and psychological wellbeing for commuters in Great Britain (Martin et al., 2014). Hoeymans et al. found a moderate agreement between the MHI-5 and the GHQ-12 for the Dutch Population (Hoeymans et al., 2004). Therefore, future research should focus on the comparability of these different research methods and draw conclusions about which method would be most applicable. Besides these differences in research methods, these studies also differ in geographical study setting (situational difference). To be able to draw more definite conclusions on the persistence of an association between transport choice and psychological wellbeing, future research should also focus on these differences between countries and how these could influence this association.

In contrast to perceived general health and perceived psychological wellbeing, the association between active transport and having a healthy weight (BMI) has been studied more extensively. The association between transport choice and having a healthy body weight shows, in line with previous research (Bopp et al., 2013; Goodman et al., 2012; Olabarria et al., 2014), that car users were less likely to have a healthy body weight when compared to active transport users. In a longitudinal study performed by Sugiyama et al. (Sugiyama et al., 2013), who examined whether commuting by car was associated with weight gain over 4 years in Australia, it was shown that adults

Table 1
Characteristics of the study population (N = 3075).

	Car user (N = 1307)	Cyclists (N = 1274)	Pedestrians (N = 494)
Personal characteristics			
Gender (% male)	53.4	51.1	57.1
Age (Mean (SD))	50.0 (13.9)	47.8 (14.9)	47.8 (15.0)
Educational level (%)			
Low	30.4	26.8	27.9
Medium	44.3	42.8	39.5
High	25.3	30.4	32.6
Household composition (%)			
Alone	16.0	21.6	26.7
Partner	44.0	38.4	38.5
Children < 18 years	26.9	21.0	19.0
Other adults (children ≥ 18 years, parents, or other adults)	13.1	19.0	15.8
Physical activity (h/week; mean(SD))	19.6 (16.0)	22.7 (16.0)	20.7 (17.5)
Self-reported BMI (kg/m^2; Mean (SD))	26.7 (4.6)	25.5 (4.2)	25.8 (4.3)
Smoker (%)	26.0	15.9	22.5
Alcohol consumption (glasses/week; Mean (SD))	6.8 (7.2)	6.3 (6.8)	6.7 (6.7)
Season			
Winter	27.6	26.4	27.1
Spring	22.1	19.4	23.9
Summer	24.3	27.6	23.1
Autumn	26.0	26.6	25.9
Health outcomes			
Good perceived general health (%)	82.6	88.2	85.0
Good perceived psychological wellbeing (%)	73.6	75.3	69.2
Healthy body weight (BMI < 25 kg/m^2) (%)	38.9	50.3	48.0

Table 2
Association between transport choice and perceived general health, perceived psychological wellbeing or healthy body weight.

	Perceived general health (with BMI)	Perceived general health (without BMI)	Perceived psychological wellbeing (with BMI)	Perceived psychological wellbeing (without BMI)	Healthy body weight
Transport choice					
Cycling	1.20 (0.95–1.53)	**1.35 (1.07–1.70)**	1.09 (0.91–1.32)	1.12 (0.93–1.34)	**1.52 (1.28–1.79)**
Walking	1.02 (0.75–1.38)	1.12 (0.84–1.51)	0.84 (0.66–1.06)	0.85 (0.67–1.08)	**1.35 (1.09–1.69)**
Car use	1.00	1.00	1.00	1.00	1.00
Men	**1.37 (1.10–1.70)**	**1.33 (1.07–1.65)**	**1.23 (1.04–1.46)**	**1.22 (1.03–1.45)**	**0.64 (0.55–0.75)**
Age (year)	**0.98 (0.97–0.99)**	**0.97 (0.96–0.98)**	**1.02 (1.02–1.03)**	**1.02 (1.02–1.03)**	**0.97 (0.96–0.97)**
Education level					
Primary school or lower general secondary degree	**0.62 (0.45–0.84)**	**0.54 (0.40–0.73)**	**0.76 (0.60–0.96)**	**0.74 (0.58–0.93)**	**0.66 (0.53–0.82)**
High school or secondary school degree	**0.64 (0.48–0.85)**	**0.59 (0.44–0.78)**	0.99 (0.81–1.22)	0.98 (0.80–1.19)	**0.74 (0.61–0.88)**
University or college degree	1.00	1.00	1.00	1.00	1.00
Household composition					
Alone	0.72 (0.51–1.01)	**0.68 (0.49–0.96)**	**0.76 (0.57–0.98)**	**0.74 (0.57–0.97)**	0.95 (0.74–1.22)
Partner	1.16 (0.83–1.61)	1.17 (0.85–1.62)	1.20 (0.93–1.55)	1.20 (0.93–1.55)	0.84 (0.67–1.05)
Children < 18 years	1.29 (0.88–1.89)	1.20 (0.83–1.73)	1.01 (0.78–1.32)	0.99 (0.76–1.29)	**0.70 (0.55–0.89)**
Other adults (children ≥ 18 years, parents, or other adults)	1.00	1.00	1.00	1.00	1.00
Physical activity (hour/week)	**1.02 (1.01–1.02)**	**1.02 (1.01–1.03)**	1.00 (0.999–1.01)	1.00 (0.999–1.01)	1.00 (0.995–1.004)
BMI	**0.90 (0.88–0.92)**	/	**0.98 (0.96–0.997)**	/	/
Smoker	**0.57 (0.45–0.73)**	**0.66 (0.52–0.84)**	**0.77 (0.63–0.95)**	**0.79 (0.65–0.97)**	**1.60 (1.32–1.93)**
Alcohol consumption (glasses/week)	0.99 (0.98–1.002)	0.99 (0.98–1.002)	**0.98 (0.97–0.996)**	**0.98 (0.97–0.996)**	0.99 (0.98–1.004)
Season					
Winter	1.03 (0.77–1.38)	1.04 (0.78–1.39)	**0.71 (0.57–0.89)**	**0.71 (0.57–0.89)**	1.11 (0.90–1.36)
Spring	0.80 (0.60–1.09)	0.83 (0.62–1.11)	**0.74 (0.58–0.94)**	**0.74 (0.58–0.94)**	0.98 (0.79–1.22)
Summer	1.04 (0.77–1.39)	1.03 (0.77–1.39)	0.83 (0.66–1.05)	0.82 (0.65–1.04)	1.03 (0.84–1.27)
Autumn	1.00	1.00	1.00	1.00	1.00

Bold numbers represent a significant association.

commuting by car tended to gain more weight (even when they were sufficiently active during leisure time). As mentioned earlier, it is unclear if BMI is a confounder or a mediator. If BMI is a mediator in this association between transport choice and health this will influence the causal relationship between transport choice and our health outcomes. In our study we found that inclusion of BMI did influence the association between transport choice and perceived general health. However, since we used a cross-sectional study design we were unable to test if BMI did indeed act as a mediator in our study. Therefore, future research with a prospective design is needed to study this influence of BMI on the association between transport choice and perceived general and psychological wellbeing.

Influence of environmental factors

Several environmental factors are argued to influence health (WHO, 2006) and behavior such as transport choice (Scheepers et al., 2013, submitted for publication; Saelens et al., 2003). In the AVENUE project we had information available about neighborhood typology, satisfaction with the living environment, road traffic noise and air pollution. As a sensitivity analysis we included information about these environmental factors as covariates into our analyses. The results of this sensitivity analysis did not influence our main findings (data not shown).

Strengths and limitations

We used a questionnaire specifically designed to investigate transport choice as well as the three different health outcomes. In addition, we were able to adjust for individual characteristics and season. However, in the present study, the sample size was too small to allow stratification by personal characteristics when analyzing the differences in transport groups. In addition, BMI was calculated based on self-reported weight and height which could have influenced our results.

We categorized respondents in transport groups based on frequency using a specific transport mode for one or more of the trip purposes. This categorization may have influenced our results since persons using for example the car and bicycle equally frequent are in this article categorized as car user. As a sensitivity analysis we only included respondents solely using one transport mode for all trips. Assuming an association between transport mode and health, this selection of our data set would yield larger contrasts in transport modes and therefore in health. However, it did not affect any of our main findings (data not shown).

We decided to dichotomize the three health outcomes instead of analyzing the data continuously (perceived psychological wellbeing, BMI) or categorical (perceived general health) so the obtained results could be interpreted in the most straightforward way. However, it can be argued that this dichotomization prohibited us to use our data to the full extent. As a sensitivity analyses we used the continuous (perceived psychological wellbeing, BMI) and categorical (perceived general health) outcome measures. This did not affect any of our main findings (data not shown).

Evidence for an association between active transport and better perceived general health has come mainly from cross-sectional studies, including the present study. As a result, it is unknown if a better perceived general health or perceived psychological wellbeing results in active transport use or vice versa. To our knowledge, only Martin et al. used longitudinal data to investigate the association between active transport and health (psychological wellbeing) (Martin et al., 2014). Therefore we recommend that future studies use a longitudinal research design when investigating this association between transport choice and health.

In this study, no information was available concerning physical disabilities or illnesses which could possibly have influenced our results. However, participants selected in this study were included if they were not hampered by their health to use at least one of the three transport modes. On the one hand this will have resulted in exclusion of individuals with health problems that prohibit car driving. Since this resulted in excluding only 242 members (5%) of the existing internet panel from the main questionnaire, this selection is not expected to have influenced our results. On the other hand, the design of the questionnaire enabled the respondents who stated to be hampered by their health for a specific transport mode (in the selection question) to fill in the specific questions of this transport mode in the main questionnaire. As a result these persons could be categorized (based on their frequency using the specific transport modes) to the transport group of the mode they stated to be hampered in. It can be argued that these physical disabilities or illnesses could have influenced their responses on the different health outcomes. As a sensitivity analysis we excluded, after

categorization in transport groups, those persons that were severely hampered by their health to use the mode of the transport group they were categorized in. The results of this sensitivity analysis did not influence our main findings (data not shown).

Conclusion

Our results suggest that in the Netherlands active transport use has been associated with a better perceived general health and a healthy body weight. However, more research is needed to be able to elucidate which factors cause this better health. No associations were observed between transport choice and perceived psychological wellbeing.

Conflict of interest statement

The authors declare there are no conflicts of interest.

Transparency document

The Transparency document associated with this article can be found, in the online version.

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