

What determines walking of older people in their neighborhood?

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ABSTRACT

Based on literature review and five focus groups, a model was analyzed describing individual, social environmental and physical environmental (perceived) determinants of walking by older people. Aim was to test whether these determinants were significantly associated with the duration of walking by older people ($N = 567$, 50 - 80 years) in a middle-sized Dutch town. Walking time was best predicted by attitude towards walking (partial correlation in model (partial r) 0.18; $p < 0.05$), social contacts (partial r 0.12, $p < 0.05$), perceived quality of life (partial r 0.21, $p < 0.01$), satisfaction with the demographics of the neighborhood (partial r -0.14, $p < 0.01$), and walking outside the neighborhood (partial r 0.28, $p < 0.01$). The model explained 20% of the total variance in walking time. Conclusion is that individual and social determinants predicted the most variance in walking time and that perceived environmental determinants played only a minor role. Health promotion actions may benefit from these insights.

Keywords: Older Adults; Physical Activity; Environment; Health; Determinants

1. INTRODUCTION

The composition of the Dutch population will change drastically over the coming decades. This is partly due to increased life expectancy and the aging “baby boomer generation”, also known as “double aging”. In 2035 it is expected that a quarter (25.1%) of the Dutch population is 65 years or older. Adequate physical activity has many positive effects on health. It is known to reduce the risk of cardiovascular disease, diabetes, osteoporosis and obesity [1,2]. Physical activity also has a beneficial ef-

fect on the course of several chronic diseases [3], cognition [4-6], welfare [7], physical functioning, and independence [8,9]. Many older people have insufficient physical activity for maintaining good health. The Dutch Standard for Healthy Physical Activity (NNGB) suggests that at least five days a week at least 30 minutes daily of moderate intensity physical activity should be performed to maintain and improve health [10]. This recommendation however, is not achieved by many older people in the Netherlands: 42.5% of the 65- to 74-year-olds and 56.5% of the over-75 s in 2008/2009 did not meet the NNGB [11]. One of the ways to meet the standards could be fulfilled by walking. Walking is the most feasible form of physical activity for older people. Together with swimming, cycling and gymnastics it is most popular [12]. Also, the risk of injuries is minimal compared to sports activities. To promote health and quality of life of older people, it is important to examine why older people may or may not walk, what kind of neighborhood characteristics are associated with walking, and what measures could be taken to encourage walking. Based on literature [13,14] and focus group interviews with older people [15] we analyzed a model (see **Figure 1**) to explain the neighborhood walking behavior of independently living older people (50 - 80 years).

2. METHOD

The model was tested among independently living older people (50 - 80 years), both native and immigrants in Schiedam (a Dutch middle size town). The protocol has been checked by the TNO medical ethic committee.

2.1. Selected Neighborhoods

For the study, three post-war neighborhoods were selected, similar in population composition (percentage of older natives and immigrants) and different in their physical environment (e.g. green areas, type of housing). This guaranteed us enough generalizability for this town.

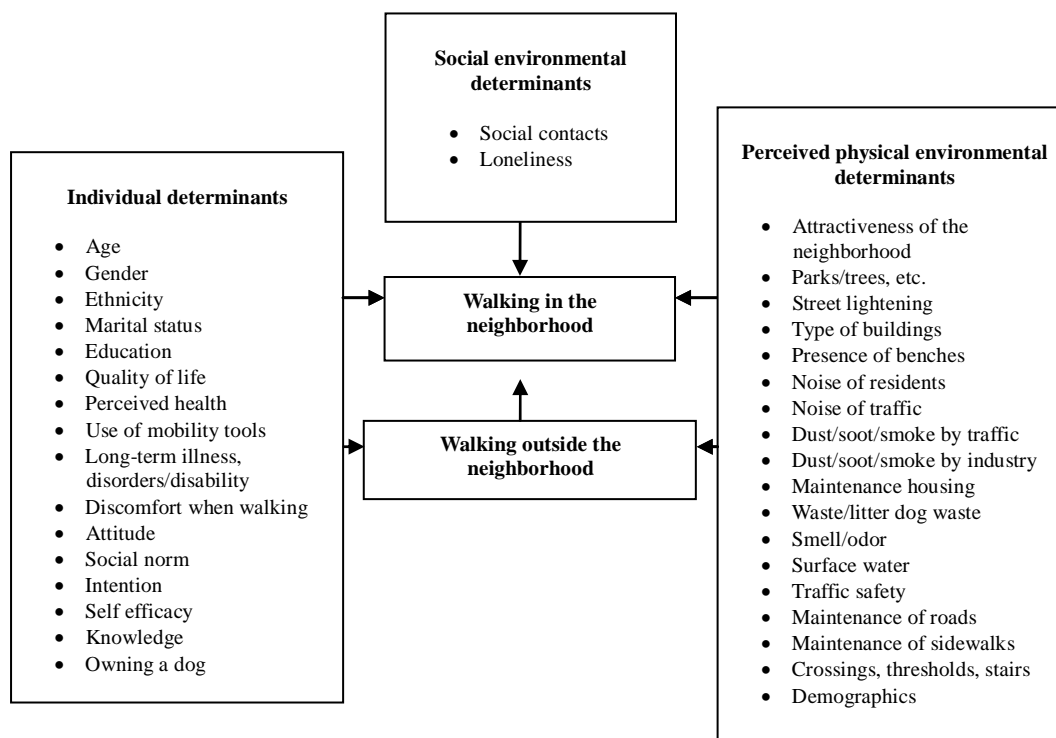


Figure 1. Model for walking in the neighborhood by older people.

2.2. Questionnaire

Based on five focus group interviews [15] with a total of 47 older people, a written questionnaire was developed and distributed by regular mail among 1800 older people (600 per neighborhood). The sample was provided by the municipality of Schiedam. The sample was stratified on age (classes of 5 years). For immigrants, a lower age (from 50 years) was allowed due to cultural differences such as having children at a relatively young age and the fact that immigrants of the first generation had low absolute numbers. Per family one person was invited to respond. To increase the response rate, the questionnaire was distributed using the town mail and picked up personally. People who were not at home were asked to send the questionnaire back using a pre-addressed return envelope. In the questionnaire, in addition to data on the walking duration and frequency, data on personal characteristics (e.g. age, gender, perceived health), social environment (e.g. social network, loneliness) and physical environment (including satisfaction with safety, litter, maintenance of sidewalks, etc.) was collected (see **Figure 1**). Furthermore, questions were included on ethnicity, socioeconomic status, physical disability, dog ownership and social cognitive factors such as attitude, social norm and intention with respect to “walking in the neighborhood”. At the time the study was carried out, no standard questionnaires were yet available about walkability. Quality of life was determined by the physical

functioning scale from the RAND-36 (scale scores 1 - 100) [16]. As a measure of readiness for walking and being a potential confounder, the frequency and duration of walking outside the neighborhood was also determined. Duration per walking motive (pleasure, shopping, health care, etc.) was asked using 4 categories (less than 5 minutes, between 5 to 10 minutes, between 10 to 20 minutes, more than 20 minutes; either: <10 minutes, 10 - 20 minutes, 20 - 30 minutes, >30 minutes), walking was asked in 6 frequency categories ranging from daily to <1 time per month. Duration and frequency of the components were then combined into a total walking time score. The whole questionnaire in Dutch is available from the first author.

2.3. Analysis

The questionnaires were entered and analyzed using the statistical program SPSS. We used descriptive statistics to characterize the study population and to describe walking behavior. To examine the univariate association between walking behavior (total minutes per week) and all determinants, Pearson correlations were calculated (if possible). Using a stepwise multivariate regression analysis, we examined the percentage of the variance in total walking time in the neighborhood that could be explained by the determinants. Variables were introduced in blocks: individual determinants, social environment, physical environment, walking outside the neighborhood

(as possible confounder). All analyses were corrected for multi-collinearity (>0.89) and skewed variables (skewness smaller or larger than 1). Since self-efficacy was only assessed in a sub-set (the group that walked), this variable was removed from the model.

The original walking time values (dependent variable) were recoded as follows: 2.5 = less than 5 minutes, 5 = less than 10 minutes, 7.5 = between 5 - 10 minutes, 15 = between 10 to 20 minutes, 25 = between 20 - 30 minutes, 35 = more than 30 minutes. For frequency: 0 = never, 0.125 = less than once a month, 0.25 = once a month, 0.5 = once every two weeks, 1 = once a week, 3 = several times a week, 6 = daily.

Coding of independent variables was as follows. Gender: 0 = female, 1 = male; Ethnicity: 0 = immigrant 1 = native; Marital status: 0 = living alone, 1 = lives together; Education (1 - 6): lowest = 1 highest = 6 (as dummies included because there is no linear relationship, see table); Perceived health (1 - 5): 1 = poor to 5 = excellent; Mobility aid: 0 = no, 1 = yes; Chronic illness: 0 = no, 1 = yes; Degree of limitations when walking: sum score of questions (0 - 48); Attitude: 1 = annoying 2 = neutral 3 = nice; Social norm: 0 - 2; Intention: (0 - 4) 0 = low, 4 = high; Knowledge: sum score of six questions (0 - 6); Owner of a dog: 0 = no 1 = yes; Social contacts: 0 - 6, 6 = daily; Loneliness: 0 = not lonely, 2 = sometimes, 3 = always lonely; Attractiveness of the neighborhood: sum score 3 - 15, 15 = highest; Stage of change (1 - 5): 1 = not walking and no plans for change, 5 = often walking and doing this a longer time already. Satisfaction with the environment was measured by 5 points scales (not at all to very satisfied). We used pairwise deletion of cases with missing values. P-values less than or equal to 0.05 were considered as statistically significant.

3. RESULTS

3.1. Response

Finally, 567 questionnaires were correctly completed and returned. This was a response rate of 32%, which is customary in the municipality of Schiedam. The mean age of respondents was 68.1 years (SD: 6.9 years). Sixty percent was female. Nine percent was from ethnic minorities (immigrants). The majority of respondents lived for several years in Schiedam (M: 49 years, range: 2 - 81 years).

3.2. Walking in the Neighborhood

Of all 567 respondents, 94% indicated to walk inside or outside the neighborhood. On average respondents walked more than two hours a week (144 minutes), including those not walking (see **Table 1**). Immigrants walked on average 105 minutes and native residents 128

Table 1. Overview of reasons for walking by study participants (Mean age 68.1 yrs., range 50 - 80 yrs., $N = 567$).

	Mean (SD, if skewed 25e to 75e percentile)
<i>Walking in the neighborhood</i>	
Walking for errands	
Percentage yes	84
Frequency per week ^a	3.5 (1.9)
Duration per time (minutes) ^a	11.7 (6.1)
Total time per week (minutes) ^a	42.1 (33.2)
Walking for health or caring	
Percentage yes	65
Frequency per week ^a	1.1
Duration per time (minutes) ^a	12.4 (6.1)
Total time per week (minutes) ^a	15.0 (1.9 - 15)
Walking to neighbors, friends, family or other persons	
Percentage yes	68
Frequency per week ^a	1.7
Duration per time (minutes) ^a	12.2 (6.7)
Total time per week (minutes) ^a	19.9 (3.7 - 22.5)
Walking with the dog	
Percentage that owns a dog	7
Frequency per week ^a	26.3 (23.3)
Duration per time (minutes) ^a	24.1 (9.3)
Total time per week (minutes) ^a	547.6 (312.9)
Walking for pleasure inside the neighborhood	
Percentage yes	61
Frequency per week ^a	2.3 (1.8)
Duration per time (minutes) ^a	29.9 (7.1)
Total time per week (minutes) ^a	69.5 (59.9)
Total time walking in the neighborhood (minutes)	126.0 ^b /136.1 ^a
<i>Walking outside the neighborhood</i>	
Walking for pleasure outside the neighborhood	
Percentage yes	54
Frequency per week ^a	1.2
Duration per time (minutes) ^a	32.3 (6.0)
Total time per week (minutes) ^a	37.4 (6.2 - 35)
Total time walking in and outside the neighborhood in minutes	144.0 ^b /153.7 ^a

^aPersons that do not walk (for this goal) are not included; ^bIncluding persons not walking.

minutes a week. Walking is mostly to run errands or go shopping. Nearly 85% of the respondents walked for that purpose on average over 10 minutes at a time, and on average more than 40 minutes per week (see **Table 1**). In addition, more than 60% of older people walked sometimes for pleasure in the neighborhood, on average 2 to 3 times a week. Especially people who have dogs (7% of respondents) walked a lot and often. Average walking the dog was around 9 hours a week (with a large variation from 3 hours to more than 20 hours per week).

About one in 10 respondents used a walking aid. In particular, the use of a walker (in 46% of these cases) and a cane (37%) was mentioned.

Reasons to walk. There may be many reasons for walking. In the questionnaires the respondents could mention up to three reasons why they go somewhere on foot. "Get a breath of fresh air" and "staying fit" motivated more than half of the respondents. About one third of respondents mainly walked to enjoy nature and/or to relax; one in ten respondents walked because the doctor said it's good, because it is a good use of free time, or to meet other people. Respondents could also mention up to three reasons why they walk or not. Nineteen percent of the respondents indicated that they always walk. Of the remaining cases, a third walked because the destination is not too far. About twenty percent don't walk because of weather conditions or health problems and about ten percent don't walk mainly because other activities give more fun, they are afraid of falling, or have lack of time. Other reasons mentioned for not going somewhere by foot are: safety concerns (darkness, paving, violence) (3%), heavy shopping bags (2%) or a preference for bike or car (7%).

Individual determinants. Of all individual determinants included in the model, the quality of life (Pearson correlation $r = 0.22$), perceived health ($r = 0.13$), the attitude towards walking ($r = 0.19$) and the social norm (0.11) were positively (significant different from zero and above 0.10) univariate associated with the total walking time (sum score in minutes, see **Table 2**). Having a chronic illness, disease or disability (asked in 1 item) was negatively associated with total walking time ($r = -0.11$).

After adjustment for all other individual determinants in the regression model (partial correlations), it appeared that only the quality of life and the attitude towards walking remained positive (and significant) associated with total walking time of the respondents. Other individual determinants were no longer significantly associated with total walking time. The (statistical) variance in the total walking time of the respondents in their neighborhood could so be explained for 8%.

Social environmental determinants. Having social contacts was positively correlated with total walking time (r

$= 0.15$, see **Table 2**). After adjustment for individual determinants, social contacts still remained significantly associated with walking time (partial $r = 0.12$). Total explained variance was 1%.

Physical environmental determinants. The top five aspects of the neighborhood which the respondents were not satisfied with, were: waste, litter and dog waste (41%), bad maintenance of pavements (39%), vandalism (37%), theft/robbery (29%) and lack of benches (29%).

The analysis showed no clear correlation between the degree of satisfaction with the physical environment and the total walking time. Older people who had a lower satisfaction with regard to waste, litter and/or dog waste ($r = -0.12$) and the population demographics ($r = -0.11$), walked more minutes in the neighborhood than those with higher satisfaction scores on these items. If the variables on the physical environment were added to the blocks with individual and social environmental determinants, these variables add 2% to the explained variance (due to the (dis)satisfaction with the population demographics (partial $r = -0.14$)).

Walking model. In total, the model for walking in the neighborhood including the frequency and duration of walking outside the neighborhood (partial $r = 0.20$, respectively 0.14), explained 20% of the statistical variance in the total weekly walking time.

4. DISCUSSION

The current study examined the added value of perceived social and physical environmental determinants in addition to individual determinants in an explanatory model of total weekly walking time of older people living in neighborhoods in a Dutch town. Our final model explained 20% of the variance in total walking time in the neighborhood. Walking by older persons in the neighborhood is best predicted by the perceived quality of life and the frequency of walking outside the neighborhood (as a measure of readiness for walking, but this was of course actually a confounder). To a lesser extent, having a positive attitude, more social contacts and dissatisfaction with the population demographics also predicted the variance in walking.

The analysis showed that the model where all variables are examined in conjunction, gives insights in addition to the univariate associations. Conclusion is that perceived environmental determinants played only a minor role in predicting walking time.

For a study in the same population described elsewhere [17,18] a subgroup of respondents kept a walking diary for a week. They drawn on a map their routes and the reason for walking there. They also marked the places that were perceived as attractive and unattractive for walking and the reasons why. Analyses of the diary

Table 2. Stepwise linear regression (N = 411 - 525; pairwise case deletion), dependent variable: walking in the neighborhood (sum score in minutes: range 0 - 870).

Independent variables	Univariate correlation walking in neighborhood	Partial correlation walking in neighborhood (within block, cumulative)	Partial correlation walking in the neighborhood (over all blocks)	R ²
<i>Individual determinants</i>				0.08
Age (dummy < 65 vs 65 - 70 yrs)	0.05	0.05		
Age (dummy < 65 vs >70 yrs)	0.01	0.07		
Gender (female = 2)	0.00	0.04		
Ethnicity	0.05	0.08		
Marital status (living alone vs living together)	0.07*	0.06		
Education (dummy low vs middle)	-0.09*	-0.09		
Education (dummy low vs high)	-0.03	-0.08		
Quality of Life (RAND 36 scale score)	0.22**	0.21**	0.13*	
Perceived health	0.13**	0.03		
Use of mobility tools	-0.09*	0.03		
Long-term illness disorders disability	-0.11**	0.05		
Discomfort when walking (sum score)	-0.09**	0.04		
Attitude on walking	0.19**	0.18**	0.12*	
Social norm on walking	0.11**	0.08		
Intention on walking	0.08*	0.00		
Knowledge on physical activity benefits (sum score)	0.05	-0.03		
Dog owner	0.02	0.00		
<i>Social environment</i>				0.01
Social contacts	0.15**	0.12*	0.10*	
Loneliness	-0.01	0.04		
<i>Physical environment</i>				0.02
Attractiveness of the neighborhood	0.03	0.05		
Satisfaction (Sat.) with parks/trees	-0.02	0.02		
Sat. Streetlights	0.04	0.06		
Sat. Type of buildings	-0.02	0.01		
Sat. Presence of benches	-0.03	-0.03		
Sat. Noises (outside) of residents	-0.04	0.00		
Sat. Noise and traffic	-0.07	-0.02		
Sat. Dust/soot/smoke by traffic	-0.07	-0.07		
Sat. Dust/soot/smoke by industry	-0.02	-0.01		
Sat. Maintenance of housing	-0.04	0.04		
Sat. Waste/litter/dog waste	-0.12**	-0.05		
Sat. Smell/odor	-0.11*	-0.09		

Continued

Sat. Surface water quality	0.01	-0.04	
Sat. Traffic safety	-0.09*	-0.05	
Sat. Road maintenance	-0.02	-0.02	
Sat. Maintenance of sidewalks	-0.05	-0.04	
Sat. Crossings/thresholds/stairs	-0.01	-0.03	
Sat. Demographics	-0.11**	-0.14**	-0.10*
<i>Walking in the neighborhood</i> [^]			0.09
Stage of change walking	0.52**	n.i.m. $r > 0.5$	
Frequency walking in the neighborhood	0.86**	n.i.m. $r > 0.5$	
Frequency walking outside neighb [^]	0.33**	0.28**	0.20**
Frequency walking in and outside the neighborhood	0.85**	n.i.m. $r > 0.5$	
Duration walking in the neighborhood	0.77**	n.i.m. $r > 0.5$	
Duration walking outside the neighborhood	0.32**	0.14	0.14**
Duration walking in and outside the neighborhood	0.69**	n.i.m. $r > 0.5$	
Total explained variance			0.20

* $p < 0.05$; ** $p < 0.01$; Variables showing collinearity ($r > 0.9$ with other variables in the block) were deleted. In the last block this was also done with variables $r > 0.5$ (n.i.m = not in model); [^]As an estimation for walking motivation and because it may act as a confounder, frequency and duration of walking outside the neighborhood was added to the model; ^{^^}Frequency and duration of walking are sum scores of different parts of the questionnaire (see **Table 1**). Six variables had a skewed distribution: (skewedness $>$ or <1): ethnicity, use of mobility tools, discomfort, knowledge, owning a dog and loneliness. After deletion of 15 cases with the highest residues: Kolmogorov-Smirnov test for normal distribution of residuals = 1.3; $p = 0.08$.

and observations by the researchers showed that objectively measured physical environmental characteristics, such as the presence of shops, stairs, green spaces and the bustle of the roads were associated with the route choice and the attractiveness of walking trails. Evidence also shows that people especially walk routes that lead to stores and shopping centers.

Our conclusion is consistent with a recent publication by De Melo *et al.* [19], who also found that especially personal and intrinsic features predict walking behavior of older people, and that the perceived environment predicts relatively less. Our study gives a valuable addition to the work of Nagel *et al.* [20] and Sallis *et al.* [21], because we added behavioral individual determinants, which explained considerable more variation in walking time than the build environmental variables did.

A disadvantage of our study is that questionnaires were self reported, so bias may be occurred in the actual walking time. In future studies, more objective measures such as accelerometers and global positioning system should be used (as a very recent example we mention Carlson *et al.* [22]). However, this was for us not feasible because of the costs and practical issues. By asking the walking behavior for several purposes and in both duration and frequency and taking summed scores, a best guess was made. Another limitation of the study was its cross-sectional nature, therefore no conclusions about the

direction of the relationships could be given. Although common in a survey in the municipality of Schiedam, the response rate (32%) was rather low. It may be that a selection has occurred, probably from people who regularly walk and felt more appealed by the subject.

For both age and level of education, we worked with dummy variables in the model because the relationships with walking time were not linear. Both the youngest and the oldest respondents walked less in the neighborhood than the group between 65 and 70 years. This may be related to the retirement phase where people have more free time. Later in life one generally gets more mobility problems. Both the respondents with the lowest and highest education categories walked more than the middle group. Perhaps this has to do with the need to the first group and walking for health by the second (highest education)?

Since attitude towards walking explained most of the variance it seems important to increase attitude through education and counseling, to convince older people (even in the case of physical disability) that walking is a healthy and feasible form of physical activity. A recent study by Temple *et al.* [23], unveiled that owning a dog serves as a motivational support for walking practice, even is the weather is bad.

Research by Stiggelbout *et al.* [24] shows that “Fun and relaxation”, “Competition”, and “Health and Care”

are the three main motivations of older people to start (sportive) physical activities. That study also indicates that “Sportive Walking” fit in all these groups and thus is an easy accessible activity that can potentially appeal to many older people. Such kind of walking interventions as a group activity could perhaps be organized in neighborhoods in towns to increase the number of older people motivated for walking.

In summary it was concluded that individual and social determinants predicted the most variance in walking time and that perceived environmental determinants played only a minor role. Health promotion actions may benefit from these insights.

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