Published in final edited form as:
Health Place. 2010 September ; 16(5): 903–908. doi:10.1016/j.healthplace.2010.05.002.

Do neighborhood environments moderate the effect of physical activity lifestyle interventions in adults?

Jacqueline Kerr[1], **Gregory J. Norman**[1], **Marc A. Adams**[1], **Sherry Ryan**[2], **Lawrence Frank**[3], **James F. Sallis**[2], **Karen J. Calfas**[1], and **Kevin Patrick**[1]

[1] Dept of Family & Preventive Medicine, University of California, San Diego, Calit2 - Atkinson Hall - 3rd Floor, 9500 Gilman Drive, La Jolla, CA 92093-0811. Tel: 858 534 9305 Fax: 858 534 9404 (address for correspondence)

[2] Department of Psychology, San Diego State University, 3900 5th Ave, Suite 310, San Diego 92103

[3] Bombardier Chair In Sustainable Transportation, School of Community and Regional Planning, University of British Columbia, 231-1933 West Mall, Vancouver, BC Canada V6T 1Z2

Introduction

Ecological models of behavior change are based on the proposition that behaviors such as physical activity are influenced by factors at multiple levels, including individual, social/cultural, physical environment, and policy (Sallis et al., 2006). The inclusion of physical environment and policy levels (such as legislation) distinguishes ecological models from psychosocial models that focus on individual behavior change (Sallis, Owen, Fisher, 2008). Though correlates of physical activity have been documented at all levels, several limitations of the literature have been noted (Sallis, Owen, Fisher, 2008). First, almost all the studies of built environment correlates of physical activity have been cross-sectional (Heath et al., 2006; Sallis & Kerr, 2006; TRB-IOM, 2004). Second, a few evaluations of trails, bicycle paths, and traffic calming have shown environmental changes can increase physical activity (Foster et al., 2006), but it is difficult to evaluate major changes in community design because of limitations in experimental control and need for long timelines. Third, there are few studies of interactions across levels of influence (for example do changes in individuals vary across neighborhoods), which is a key principle of ecological models (Sallis, Owen, Fisher, 2008). Fourth, multi-level interventions that simultaneously address individual, interpersonal, institutional and community factors are challenging to implement and evaluate, but they are expected to be the most powerful approach to behavior change.

One specific hypothesis derived from ecological models of behavior change is that individually-oriented behavior change interventions are expected to be more effective when social and built environments and policies support the target behavior. In other words, environments and policies are expected to moderate the effects of individual behavior change interventions. Two recent studies investigated the moderating effect of social and built environments on physical activity lifestyle interventions (King et al. 2006; Sallis et al. 2007). Results from both studies generally supported that those reporting safer neighborhoods had greater increases in physical activity. Both studies used self report measures of environments that were very limited in scope. Neither study included measures of the characteristics of walkable neighborhoods that have been consistently associated with physical activity (Heath et al., 2006; TRB-IOM, 2004), such as mixed land use (homes, schools, shops and worksites available in neighborhoods to encourage walking to multiple destinations), connected streets (short street blocks in a grid like pattern that allow easy access in multiple routes), and residential density (high numbers of residents per acre tend to reflect apartment blocks in urban areas rather than single residences in suburban areas with less street connectivity). Neither of the published studies included objective assessments of actual built form. The current study aimed to assess the moderating effect of environmental variables, assessed objectively and with self-report, on walking levels in adults from two physical activity lifestyle intervention studies.

Rationale

The current study explored the interaction between changes in walking over time, the effect of study arm (intervention vs control), and the walkability of participants' home residential neighborhood. Our hypothesis for these analyses was that participants in more walkable neighborhoods in the intervention group would increase their walking more. Analyses were performed on data from two separate randomized intervention trials, conducted by the same research group, which used similar measurements and theoretical framework and sampled participants from the same geographic area in San Diego County. Each intervention trial had statistical power to detect meaningful differences in physical activity, diet and weight loss. The two studies were conducted as separate trials and were not intended to be directly compared.

There was not any a priori hypotheses in the original studies regarding how the built environment might impact the effect of the behavior change interventions. The exploration of intervention-build environment interactions occurred post hoc with additional funding to support the creation of GIS built environment neighborhood variables. The participants were not selected into these trials based on geographic characteristics and the interventions did not focus specifically on the built environment. Conducting the analyses in both samples allowed for a test of the replication of the findings.

Methodology

Participants

Data for this study were derived from two randomized controlled trials of web-based interventions for physical activity and diet behavior change. In the first study, conducted between 2001 and 2004, 401 women aged 18 through 55 with a body mass index (BMI) of 25 to 39 were recruited through 4 primary care sites to participate in a 1-year intervention program. In addition to being overweight, eligible participants were required to have access to the Internet, be able to read and speak English, provide informed consent, and not intend to become pregnant or move out of county for 2 years. Women with scheduled appointments with their physician were screened for eligibility and interest. Women were randomly assigned to either the "*Patient-centered Assessment and Counseling for Exercise and nutrition via the Internet*" (PACEi) intervention or an "*enhanced*" standard care comparison group, who received some basic written materials on nutrition and physical activity topics.

In the second study, conducted between 2004 and 2007, 441 men age 25 through 55 years with BMI of at least 25 (overweight or obese), access to the Internet, able to read and speak English, provide informed consent, and who did not intend to move out of county for 2 years were recruited from the community through newspaper advertisements. Men interested in the study completed an initial web screener. Eligible participants were invited to the research office for baseline assessment, randomization and orientation to the web-based intervention. Participants were randomized to either a PACEi intervention designed specifically for men or a general health information website

Interventions

The PACEi intervention for women consisted of a computerized assessment that produced a stage based action plan to improve physical activity and nutrition behaviors. Patients then received brief counseling from their primary care provider based on the printed plan. Participants were encouraged to log on to the website each month to learn about physical activity, nutrition, and skills for change through tutorials and tip sheets and to set monthly behavior change goals. Support and tailored feedback were provided by trained PACEi health counselors on a monthly basis by email and quarterly telephone counseling sessions. The target behaviors were increasing physical activity, fruit and vegetable intake, fiber intake, and decreasing dietary fat. Intervention participants could complete a total of 12 computer modules during the 1 year intervention period.

Women randomized to the standard care group received usual advice from their provider to change their physical activity and eating habits and a standard set of materials summarizing recommendations for diet and exercise. Standard care participants had the option to receive the PACEi intervention after 12 months.

The Men's study intervention had three components. First, an interactive computer program was completed by participants to assess their initial status on each of the same five behavioral targets. Then the computer software guided them to select and set goals in each area. Participants were encouraged but not required to take a printed copy of their goals to their health care provider and discuss the goals and their importance as a means of weight loss. Over the next year, participants completed monthly web-based activities including learning about and applying a new behavioral skill and reading about diet and physical activity topics. Tip sheets, topical news items and archived content were available online, and content was updated weekly. Participants were encouraged to log on weekly to report their weight and progress on goals and to set new goals. Tailored graphical feedback was provided that portrayed both improvements and instances when behaviors fell below previously attained levels. Men were given pedometers to assess daily steps and were encouraged to input the data on the website for tracking purposes. Men reported the number of minutes spent in activities not measurable by a pedometer (e.g., swimming, cycling). The website converted these to an equivalent number of steps using an algorithm developed for this intervention and added these to the web log of physical activity. Finally, case managers had occasional e-mail and phone contact with the participants to facilitate interaction with the website and trouble-shoot technical difficulties.

Men randomized to the control condition were given access to an alternate website and encouraged to log on monthly. The control website contained general health information of interest to men that were considered not likely to lead to changes in diet or physical activity behaviors. Examples included information on sun exposure protection, hair loss, worksite injury prevention, and heart health.

While the intervention in both studies did not focus specifically on the built environment, the Social Cognitive Theory framework does emphasize the importance of addressing context in relation to behavior and individual-level factors. For example, if safety or lack of neighborhood features that facilitate walking was raised by participants as a barrier, then counselors advised alternative locations for activity. Locations such at malls, around work, or recreation centers were suggested. On the website participants were encouraged to exercise in settings where they felt most comfortable and to find convenient locations to walk even for short periods. Walking was a target behavior of both interventions as it is often the easiest activity for individuals to perform to meet activity goals.

Measures

Total minutes walking per week was measured at baseline and 12 months by the International Physical Activity Questionnaire Long form (IPAQ). The validity and reliability of various IPAQ questions and summary scores was supported by a study of about 2500 adults carried out in 12 countries (Craig et al., 2003). The questions asked on how many days do you walk for at least 10 minutes and for how many minutes on a usual day. The number of days was multiplied by the usual number of minutes to create a weekly minute count, which was then divided by 7 to create a mean daily count. This count was truncated at 180 minutes per day as per the IPAQ scoring guidelines (www.ipaq.ki.se). Leisure and transportation walking time were combined to create an overall walking time outcome variable.

Participants completed a shortened version of the Neighborhood Environment Walkability Scale (NEWS) (Saelens et al. 2003). Men completed this at baseline, while women completed the measure at the 12-month assessment. The original NEWS is a 68-item survey designed to assess multiple attributes of neighborhood built and social environments believed to be related to physical activity (Saelens et al., 2003). Reliability and validity of the NEWS have been documented in 3 countries (De Bourdeaudhuij, 2003; Leslie, 2005; Saelens et al., 2003). Most scales had test-retest reliability ICC's > .75 (Saelens et al., 2003). Participants specified on a four point scale their agreement or disagreement with statements. Participants also indicated whether a list of 16 destinations (e.g. schools, shops, recreation facilities, public services) were within 5, 10, 20 or 30 minutes walk of their home. Scales were created for aesthetics (e.g. my neighborhoods is generally free from litter), trees (e.g. trees give shade for the sidewalks in my neighborhoods), hills (e.g. the streets in my neighborhood are hilly, making it difficult to walk), traffic (e.g. there is so much traffic along the street I live on that it makes it difficult to walk) and speed safety (e.g. most drivers exceed the posted speed limits), visibility of other people (e.g. walkers on the streets can be easily seen by people in their homes), crime safety (e.g.), pedestrian facilities (e.g. there are sidewalks on most streets in my neighborhood) and number of destinations within a 20 minute walk. Scales were dichotomized around the mean to create perceived low and high walkable neighborhood indicators to simplify interpretation of the interaction under investigation.

Objective neighborhood walkability was measured using a “Walkability Index” using environmental data derived from Geographic Information Systems (GIS) (Frank et al., 2009) provided by the San Diego Association of Goverments. Participants' home addresses were geocoded and a one mile network buffer around their residence was created. Environmental data layers were obtained from the local county government and processed using ArcGIS 9.1 software (ESRI Redlands). Values for the following variables were transformed to z-scores that were summed to create a walkability score for each participant's buffer: Net residential density (number of residential units /residential acreage); Street connectivity (Number of 3-leg or greater intersections / acreage of buffer); Land use mix (Evenness of 7 land uses: office, residential, commercial, vacant, industrial, parks & recreation, institutions); Retail floor area ratio (Ratio of retail building square footage to area of parcel). The walkability index was calculated as follows: [(2 × z-intersection density) + (z-net residential density) + (z-retail floor area ratio) + (z-land use mix)]. This index or very similar ones have been significantly related to physical activity in multiple studies (Frank et al. 2005, Frank et al. 2009). Only the scores for participants who had walking data available at 12 months were considered, and the index across both samples was dichotomized around the mean to create a comparable category of low and high neighborhood walkability to ease interpretation of the interaction terms.

Participants reported standard demographic characteristics such as race, ethnicity, age and education level at baseline. Race was dichotomized into non Hispanic white or not and education level into completed college degree or not.

Analyses

Chi square and t-tests tested differences in availability of data at 12 months across the samples for the key variables. The distribution of minutes walking per day was examined for skewness & kurtosis. For the main analyses, repeated measures ANCOVA models were employed. This model allows assessment points to be included as a "time" variable and provides a statistical test of comparisons over time as a main effect and as part of interaction effects. The baseline and 12 month walking minutes were entered as the 'time" variable. The intervention or control designation was entered as the "group" variable and the categorized walkability index or NEWS scores were the other independent variable. The demographic variables were entered as covariates. The model tested for a main effect of time, group, and walkability. Within the same model, we also tested an interaction for time × group, time × walkability, and walkability × group. Finally, a three way time × walkability × group interaction was tested. This investigated whether changes in walking over time varied among intervention and control participants living in high vs low walkable neighborhoods. Analyses were conducted separately for the male and female study samples. The same statistical model was specified for each perceived environment scale separately.

Results

Data were available at the 12 month time point for 70% of the male sample and 71% of the female sample. T-tests indicated there was no significant difference in baseline walking minutes or GIS based walkability scores in those with and without data available in the female sample. In the male sample, older men were more likely to have 12 month data compared to younger men (44.5 vs 42.4 years old, $p < .05$). Chi square tests found no difference in those with and without 12 month data by education or intervention group. However, non Hispanic white men were more likely to have 12 month data than Hispanic men (72.8% vs 62.8%, $p < .05$). Table 1 & 2 shows means and percentages for the variables used in the current analyses for the male and female control and intervention samples with 12 month data available.

Figure 1 presents the findings for the repeated measures ANCOVA for the male sample. Statistically significant model effects included a main effect for time ($F(1)=4.0$, $p=.047$, $eta^2 = .013$), an interaction between time and walkability ($F(1)=5.7$, $p=.018$, $eta^2 = .019$) and a time × group × walkability index interaction ($F(1)=4.6$, $p=.032$, $eta^2 = .015$). The figure shows that men in the intervention group living in low walkable neighborhoods (scores below the mean on the GIS based walkability index) increased their daily walking time by 29 minutes from baseline to twelve months compared to those in the intervention group living in high walkable neighborhoods who decreased their walking overtime by about 10 minutes. Those in the control group in both neighborhood types did not increase their walking time.

There were no statistically significant effects for the female sample model but the results were in the same direction. Women in the intervention group living in low walkable neighborhoods increased their daily walking time the most (by 7 minutes) from baseline to twelve months compared to those in the intervention group living in high walkable neighborhoods or those in the control group.

There were no significant interactions for the nine perceived environment variables in the male sample. In the female sample, there were interactions between time and traffic safety ($F(1)=13.9$, $p=.001$, $eta^2 = .048$) and between time and traffic speed safety ($F(1)=9.6$, $p=.002$, $eta^2 = .033$). Figures 2 and 3 show that women who perceived their environment to be less safe from volume of car traffic or speed of traffic decreased their daily walking time. Women who perceived their neighborhood to be safer from car traffic increased their walking time by 22 minutes per day over the study period and women who perceived the speed of traffic in their neighborhood to be safer increased their walking by 17 minutes. These finding were independent of intervention condition.

Discussion

In predominantly suburban San Diego County, those living in less walkable neighborhoods, measured objectively by geocoded land use features, appeared to benefit from the intervention more than those in more walkable neighborhoods. This relationship was in the same direction in men and women, but only statistically significant in the male sample. Previous researchers have hypothesized that individual level interventions will be more effective when the person's neighborhood and other environments are high in resources and low in barriers related to walking (King et al. 2006). We also anticipated that those living in more walkable neighborhoods in the intervention group would walk more. The results are still interpretable within the ecological model of behavior change. Those living in more walkable neighborhoods walked more at baseline and those who were learned ways to overcome barriers, including neighborhood environments, increased their walking. The possible ceiling effect of residing in a walkable neighborhood on walking is interesting. That is, those already walking did not increase their walking further. Walking was only one target behavior of the interventions, which may mean that individuals entering the study already benefiting from living in a walkable neighborhood may have focused their efforts on changing other behaviors such reducing dietary fat intake. In addition, we do not know where participants walked, and those in less walkable residential neighborhoods may have had accessed to alternative locations, which the intervention encouraged them to use.

Although these results were in an unexpected direction, both samples demonstrated the same relationships, those in less walkable neighborhoods walked more. The three way interaction we tested to detect this effect was only significant in the male sample. This should not be interpreted as women responding differently to men in this context, as the direction of the relationship was the same. The lack of significance is likely due to sample size (as the studies were not powered to detect such differences), lack of variance in walkability and walking and differences in the interventions. The women's study included walking as target behavior, but did not provide pedometers and step goals to increase walking as the men received. Walking increased by 12 minutes a day in the men, but only increased by 4 minutes in the women. Additional differences may have arisen from the recruitment strategies; women were recruited through their physician and men from the community. Although the women were recruited through 4 clinic sites, there was no clustering of their residential addresses around these sites.

The findings that participants walked more if they lived in more walkable communities reflects the large body of cross-sectional literature on this topic (Heath et al., 2006; Sallis & Kerr, 2006; TRB-IOM, 2004). There are very few prospective studies for comparison. Though a few studies provide support for the ecological model principle of interactions across levels of influence, there are no clear patterns from the published studies thus far (King et al. 2006; Sallis et al. 2007). Present findings for the moderating effect of neighborhood walkability are in contrast to a previous study that perceived neighborhood safety moderated physical activity interventions (King et al. 2006). In a finding somewhat consistent with King et al (2006), women in the present study were more likely to increase their physical activity over time if they perceived better safety from traffic, though traffic safety did not moderate the effect of the intervention.

The current findings indicate both built and social environment factors can be a barrier to walking, but behavior change interventions can encourage walking even in less supportive environments. Other studies have shown that awareness of physical activity resources and safe walking routes can improve physical activity levels (Rosenberg et al. 2008; Reed et al. 2008). Present results suggest multi-level interventions are worth pursuing, because different types of evidence indicated individual, social, and built environmental variables explained change in walking over one year.

Limitations

Measurement of the walking outcome was a limitation of the study. While there is evidence the IPAQ overestimates physical activity (Rzewnicki et al., 2003) and accelerometers are generally preferred for measuring physical activity, different types of activity such as walking can not yet be identified from accelerometer data. Self-reported walking was the outcome for this study because walking is the most common type of activity and previous studies have shown the relationship between walkability and physical activity most clearly for walking behavior (Owen et al., 2004; Saelens & Handy, 2008). Study participants were not recruited to purposively maximize variability in walkability, so walkability effects on walking may be underestimated. The findings may not generalize to other geographic locations that are not predominately suburban with a temperate climate.

Though the interventions were similar in content for women and men, there were some differences. The women's study did not include pedometers as an intervention tool to self-monitor walking behavior, and the women's website was less extensive in terms of the frequency of goal setting for behavior change (monthly vs. weekly, respectively). This may account for the smaller difference in the amount of women's walking between the treatment and control group compared to the effect of the intervention on men's walking.

Multiple statistical tests (10 in each sample) were conducted which inflates the type I error rate. However, because this was considered an exploratory secondary analysis of existing data, no adjustment to the type I error rate was made. This increased chance of spurious significance tests means the results should be interpreted with caution and need to be replicated in other studies.

While this study improves upon cross sectional analyses of built environment correlates of activity, this prospective intervention trial was not designed a priori to test for interactions between the intervention and walkability. Such a study would need to be powered to detect a three way interaction and include purposeful variation in walkability in the study sampling.

Strengths of the study include data selected from two parallel randomized trials of overweight men and women with matching GIS and self-reported measures of the environment. The literature on environmental correlates of physical activity has been criticized for its reliance on cross-sectional studies (TRB-IOM, 2005). This prospective study provides initial evidence that the built and social environment can impact efforts to change walking behavior in overweight and obese men and women.

Conclusions

This study findings suggest that a behavior change intervention helped overweight men living in less walkable neighborhoods to overcome environmental barriers to walking. Those in more walkable neighborhoods, with higher baseline walking levels, did not increase their walking, suggesting a possible ceiling effect. Among overweight women, regardless of intervention condition, those with high levels of perceived traffic safety were more likely to increase their walking over one year. Present results support the need to develop and evaluate multi-level physical activity interventions that target changes in individuals, social environments, and built environments, but men and women may respond differently to specific components.

References

Craig CL, Marshall AL, Sjostrom M, et al. International Physical Activity Questionnaire, 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381–95. [PubMed: 12900694]

De Bourdeaudhuij I, Sallis JF, Saelens BE. Environmental correlates of physical activity in a sample of Belgian adults. Am J Health Promot 2003;18:83–92. [PubMed: 13677966]

Foster C, Hillsdon M, Cavill N, Bull F, Buxton K, Crombie H. Interventions that use the environment to encourage physical activity. National Institute for Health and Clinical Excellence. 2006

Frank LD, Schmid TL, Sallis JF, Chapman JE, Saelens BE. Linking Objective Physical Activity Data with Objective Measures of Urban Form. American Journal of Preventive Medicine 2005;28(Suppl2):117–125. 2. [PubMed: 15694519]

Frank LD, Sallis JF, Saelens BE, Leary L, Cain K, Conway TL, Hess PM. The development of a walkability index, Application to the Neighborhood Quality of Life Study. British Journal of Sports Medicine. 200910.1136/bjsm.2009.058701

Heath GW, Brownson RC, Kruger J, et al. the Task Force on Community Preventive Services. The effectiveness of urban design and land use and transport policies and practices to increase physical activity, a systematic review. J Phys Act Health 2006;3:55–76.

King AC, Toobert D, Ahn D, Resnicow K, Coday M, Riebe D, Garber CE, Hurtz S, Morton J, Sallis JF. Perceived environments as physical activity correlates and moderators of interventions in five studies. American Journal of Health Promotion 2006;21:24–35. [PubMed: 16977910]

Leslie E, Saelens B, Frank L, et al. Residents' perceptions of walkability attributes in objectively different neighbourhoods, a pilot study. Health Place 2005;11:227–236. [PubMed: 15774329]

Owen N, Humpel N, Leslie E, Bauman A, Sallis JF. Understanding environmental influences on walking, Review and research agenda. American Journal of Preventive Medicine 2004;27:67–76. [PubMed: 15212778]

Reed J, Malvern L, Muthukrishnan S, Hardy R, King L. An ecological approach with primary-care counseling to promote physical activity. J Phys Act Health 2008;5(1):169–83. [PubMed: 18209262]

Rosenberg D, Kerr J, Sallis JF, Patrick K, Moore DJ, King A. Feasibility and outcomes of a multilevel place-based walking intervention for seniors, a pilot study. Health and Place 2009;15(1):173–9. [PubMed: 18502164]

Rzewnicki R, Vanden Auweele Y, De Bourdeaudhuij I. Addressing over-reporting on the International Physical Activity Questionnaire (IPAQ) telephone survey with a population sample. Public Health Nutr 2003;6:299–305. [PubMed: 12740079]

Saelens BE, Handy S. Built environment correlates of walking, a review. Med Sci Sports Exerc 2008;40:550–566.

Saelens BE, Sallis JF, Black JB, Chen D. Neighborhood-based differences in physical activity, an environment scale evaluation. Am J Public Health 2003;93:1552–1558. [PubMed: 12948979]

Sallis J, Kerr J. Physical Activity and the Built Environment. President's Council on Fitness and Sport, Research Digest 2006;7:4.

Sallis JF, Cervero RB, Ascher W, et al. An ecological approach to creating more physically active communities. Ann Rev Public Health 2006;27:297–322. [PubMed: 16533119]

Sallis JF, King AC, Sirard JR, Albright CL. Perceived environmental predictors of physical activity over 6 months in adults, activity counseling trial. Health Psychol 2007;26:701. [PubMed: 18020842]

Sallis, JF.; Owen, N.; Fisher, EB. Ecological models of health behavior. In: Glanz, K.; Rimer, BK.; Viswanath, K., editors. Health Behavior and Health Education, Theory, Research, and Practice. 4th. San Francisco: Jossey-Bass; 2008.

Transportation Research Board-Institute of Medicine. Examining The Evidence. Washington., DC: National Academies Press; 2005. Does The Built Environment Influence Physical Activity?.

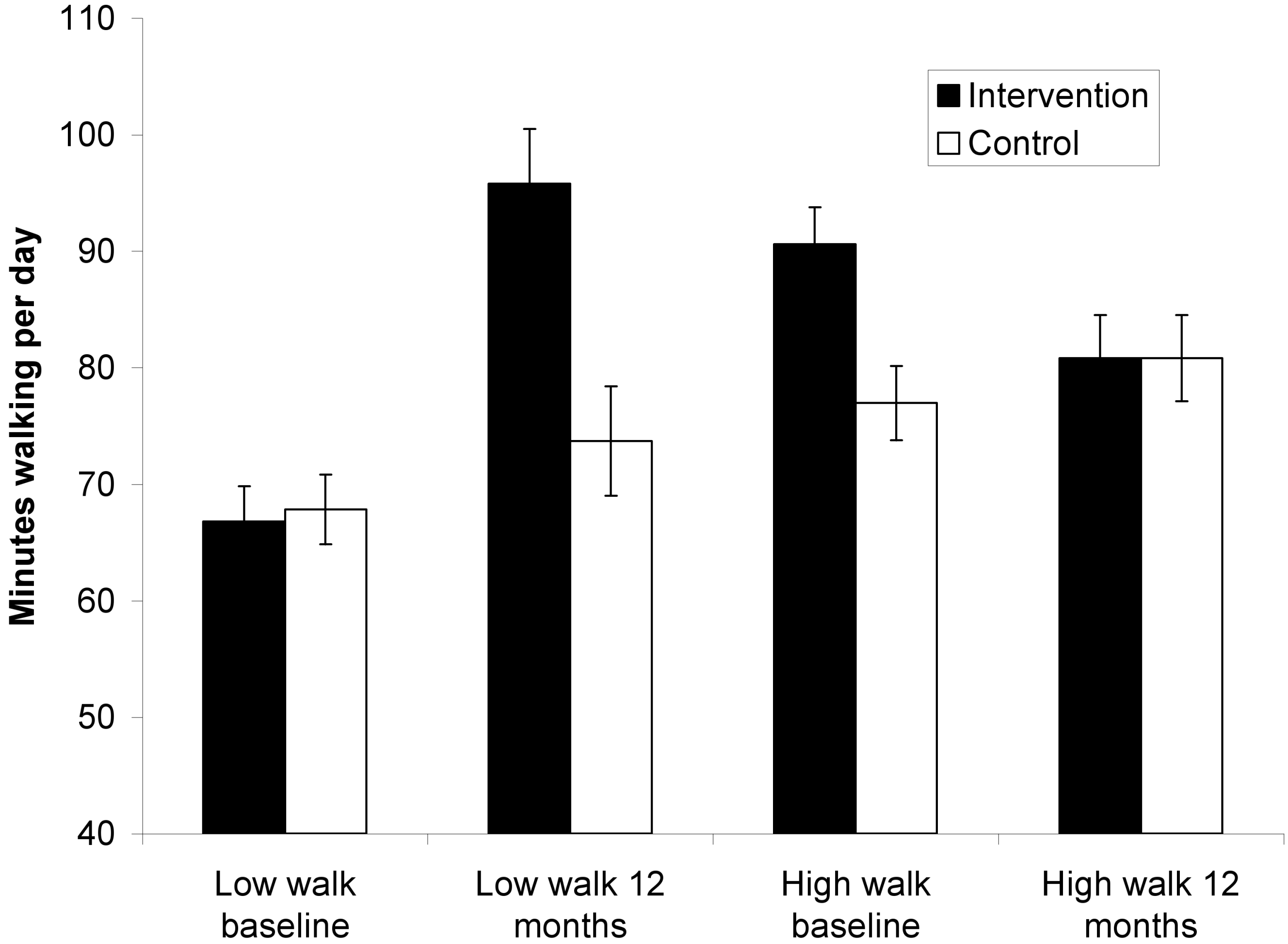

Figure 1.

Presents the significant (p<.03) three way interaction between walkability and intervention group over time in the male sample. The change over time in all groups was significant (p<.05), and the change over time by walkability was significant (p<.02).

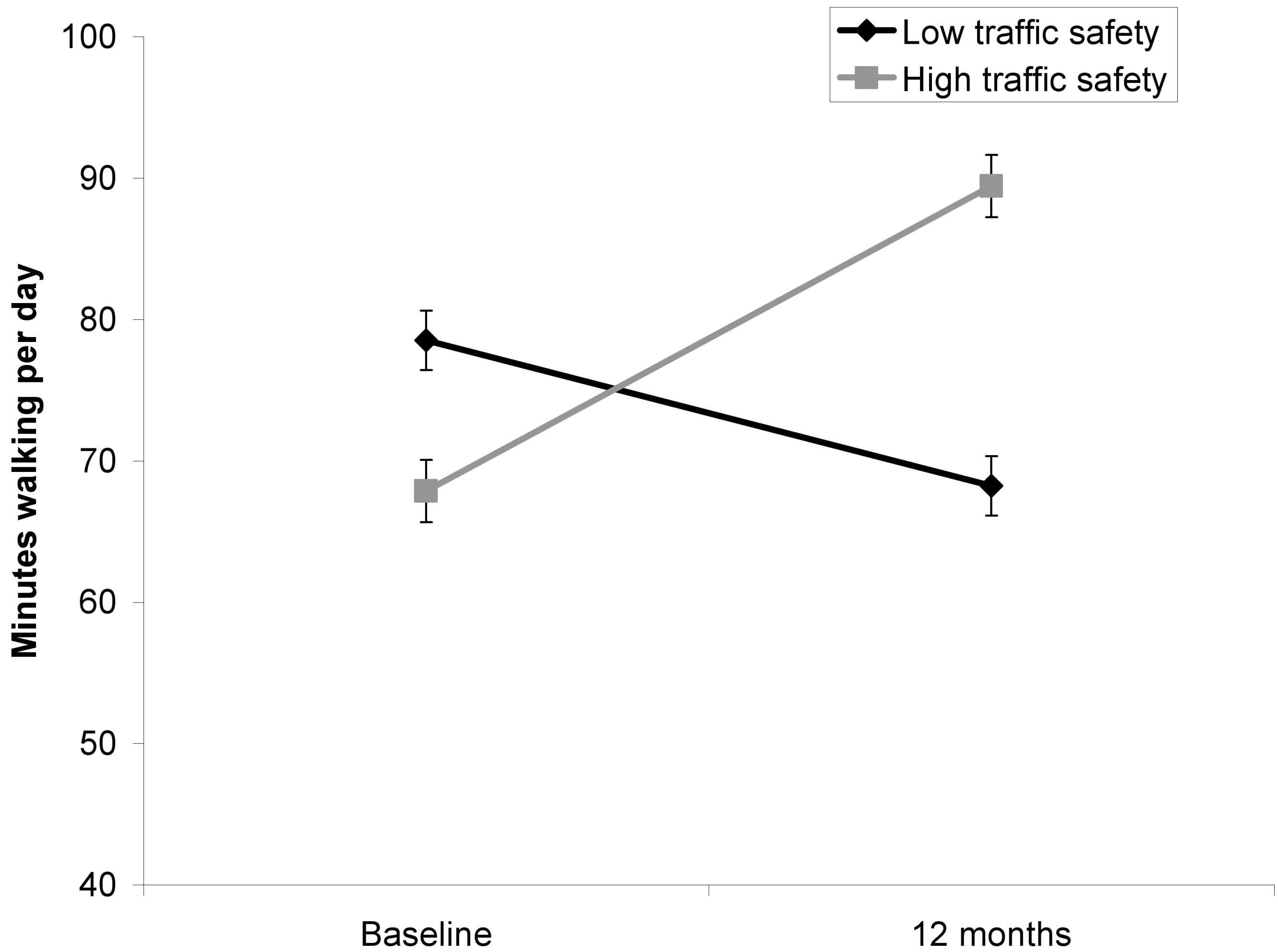

Figure 2.
Significant (p=.001) two way interaction between traffic volume safety and time in women

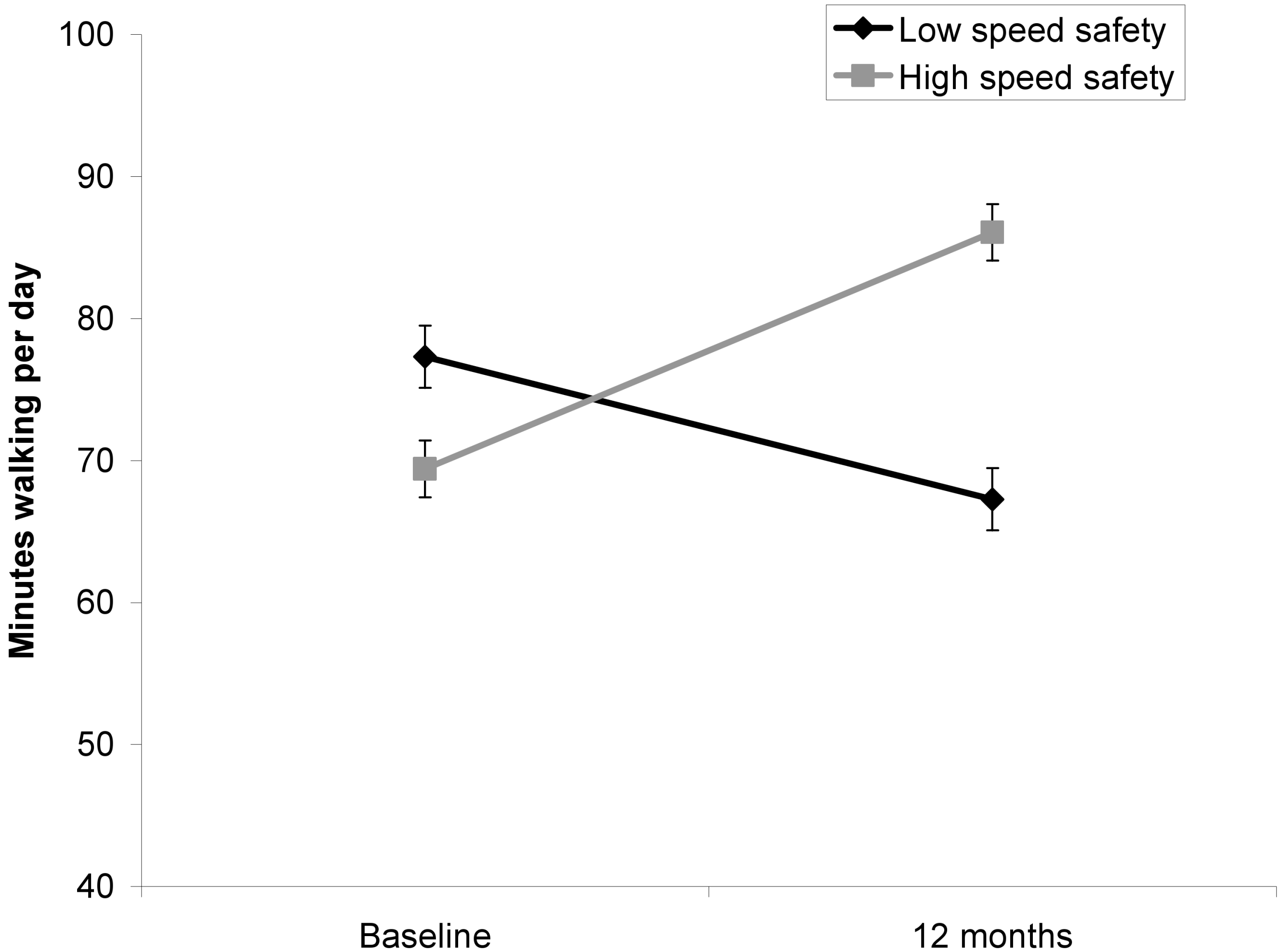

Figure 3.
Significant (p=.002) two way interaction between traffic speed safety and time in women

Table 1

Characteristics of male control and intervention participants with data available at baseline and 12 months

	Control N=155	Intervention N=154	P value
% with college degree	67.7%	63.6%	.45
% non Hispanic white	69.7%	77.9%	.10
Mean (SD) age	43.0 (7.2)	46.0 (8.0)	.08
Mean (SD) body mass index	33.9 (4.0)	33.7 (4.0)	.98
Mean (SD) baseline minutes walking per day	69.4 (61.3)	75.7 (63.6)	.44
Mean (SD) 12 month minutes walking per day	75.9 (63.0)	92.2 (60.9)	.91
Mean (SD) GIS-based walkability score (based on a sum of z-scores)	0.40 (5.4)	-0.34 (5.4)	.71
Mean (SD) score for NEWS aesthetics scale	2.9 (.73)	3.0 (.68)	.25
Mean (SD) score for NEWS trees scale	2.9 (.86)	2.8 (.85)	.81
Mean (SD) score for NEWS hills scale	2.7 (.93)	2.7 (1.02)	.06
Mean (SD) score for NEWS traffic safety scale	2.8 (.63)	2.8 (.56)	.20
Mean (SD) score for NEWS speed safety scale	2.7 (.85)	2.7 (.82)	.68
Mean (SD) score for NEWS visibility of other people scale	2.6 (.67)	2.5 (.64)	.70
Mean (SD) score for NEWS crime safety scale	3.5 (.61)	3.5 (.58)	.25
Mean (SD) score for NEWS pedestrian facilities scale	2.9 (.69)	2.8 (.71)	.81
Mean (SD) number of destinations within a 20 minute walk	7.2 (4.6)	6.8 (4.6)	.57

Table 2

Characteristics of female control and intervention participants with data available at baseline and 12 months

	Control N=146	Intervention N=140	P value
% with college degree	43.2%	50.0%	.25
% non Hispanic white	63.0%	55.7%	.21
Mean (SD) age	41.4 (7.8)	41.9 (7.8)	.03
Mean (SD) body mass index	32.6 (4.6)	31.5 (4.4)	.75
Mean (SD) baseline minutes walking per day	74.4 (64.6)	73.0 (63.0)	.73
Mean (SD) 12 month minutes walking per day	74.3 (64.6)	80.1 (64.9)	.41
Mean (SD) GIS-based walkability score (based on a sum of z-scores)	0.01 (5.4)	0.20 (5.1)	.86
Mean (SD) score for NEWS aesthetics scale	3.0 (.74)	3.0 (.71)	.82
Mean (SD) score for NEWS trees scale	2.9 (.93)	2.8 (.85)	.26
Mean (SD) score for NEWS hills scale	2.9 (.94)	2.7 (1.0)	.26
Mean (SD) score for NEWS traffic safety scale	2.8 (.71)	2.6 (.72)	.96
Mean (SD) score for NEWS speed safety scale	2.8 (.89)	2.7 (.94)	.52
Mean (SD) score for NEWS visibility of other people scale	2.6 (.74)	2.5 (.74)	.56
Mean (SD) score for NEWS crime safety scale	3.3 (.61)	3.3 (.58)	.46
Mean (SD) score for NEWS pedestrian facilities scale	2.9 (.72)	2.8 (.81)	.66
Mean (SD) number of destinations within a 20 minute walk	6.5 (4.3)	6.4 (4.5)	.25