Table 3. *Cont.*

	***P* value for interaction term with BMI status**	
	Walking	**MVPA (excluding walking)**
	***P* value**	***P* value**
Crime safety at night (Safe)	0.85	0.73
Traffic safety (Safe)	0.65	0.55
Seeing people being active (Yes)	0.76	0.14
Aesthetics (Yes)	0.08	0.70
Connectivity of streets (Yes)	0.18	0.06
Maintenance of sidewalks (Good)	0.22	0.28
Maintenance of bike lanes (Good)	0.06	0.40
Traffic safety for bicyclists (Safe)	0.39	0.76
Crime safety during the day (Safe)	0.01**	0.69
Presence of destination (Yes)	0.99	0.75
Household car or auto bikes (One or more)	0.93	0.66

Adjusted by age, marital status, educational level, household income, employment status and BMI status. ** statistically significant ($p < 0.05$).

4. Discussion

In the present study, the perceived environmental attributes were significantly associated with PA among normal-weight and overweight Japanese men. The most important finding of the present study was that common environmental correlates of PA were observed between normal-weight and overweight men. Three environmental factors, good access to recreational facilities, seeing people being active, and presence of destination, were positively associated with meeting PA recommendation by either walking or MVPA (excluding walking). The results suggested that increasing the mix of utilitarian destination, supportive environment for seeing people being active, and convenience of accessing recreational facilities could encourage both normal-weight and overweight men to engage in sufficient PA for different purposes. In addition, these factors have been consistently revealed as environmental features related to PA among general populations in both Western countries and Japan [20,23,36-38]; this might strengthen the evidence for some common environmental features associated with PA among countries with different cultures and environments.

Conversely, access to public transport and safety from crime during the day were revealed as different environmental correlates of PA between normal-weight and overweight men based on likelihood ratio tests. This finding indicated that BMI status would be a potential moderator between the perceived environment and PA. Different environmental correlates of PA between socio-demographic subgroups have been examined in previous studies [22-26]. Different socio-demographic correlates of PA have also been reported among three BMI groups [27]. In addition, a previous study has observed that several perceived environmental factors (infrastructures, access to destinations, social environment and aesthetics) were associated with meeting the recommended PA level among overweight/obese women [22]. However, whether overweight men have different environmental correlates of PA than normal-weight men has not been discussed or analyzed as much as they have for women. A possible mechanism underlying the observed significance in perceived

good access to public transport among normal-weight men alone is that overweight men are less likely to walk or cycle for transport in their daily lives than normal-weight men, regardless of the accessibility of public transport within their neighborhoods. Regarding the significant contribution of safety from crime only among overweight and obese men, they might be more sensitive to the presence of crime than normal-weight men because they may more easily experience discriminative and stigmatic treatment in their growing stage [39]. Therefore, the perception of an unsafe neighborhood environment might have a negative influence on their PA.

The findings of the present study suggest that consideration of not only general environmental correlates but also unique environmental correlates of PA among overweight and obese populations promote PA more effectively among these populations when environmental approaches for PA interventions are developed. One effective strategy for future environmental interventions aimed at increasing PA levels is promoting or changing their awareness of these environmental correlates. In addition, intervention approaches for rearranging or improving these environmental variables could be beneficial. For these approaches, it might be necessary to establish partnerships and collaborations with different sectors or organizations [40]. For example, neighborhood safety could be improved by cooperating with local authorities in organizing community groups to prevent crime. Furthermore, it could also be effective to cooperate with different government departments and non-government agencies (e.g., transportation department, local government, and transportation agencies) to adjust the location of public transport or number of services for transport-related walking.

The finding of the study indicated that the perceived environment-PA association was more related to normal-weight men than overweight men; while 11 perceived environmental factors associated with PA were found in normal-weight men, only four factors were significantly associated with PA in overweight men. This finding has not been reported in previous studies. Two studies have emphasized a stronger influence of perceived PA environment on older adults than on younger adults [24], as well as adults with disabilities than those without disabilities [41]. There are two implications of this finding. First, compared with normal-weight men, the environmental correlates of PA in overweight men were not detected well using IPAQ-E. As a result, objective measurements should be utilized to further examine the association between environmental factors and meeting the PA recommendation, especially on the walking behavior of overweight men. The second implication is that other factors (such as psychosocial correlates) might be more strongly associated with PA in overweight men than in normal-weight men. Thus, future studies are needed to identify the multiple levels of correlates associated with PA among normal-weight an overweight men.

In accordance with results from previous studies [18,33], the association of environmental factors from the IPAQ-E results were more related with walking than MVPA (excluding walking) between both normal-weight and overweight men in the present study. These results implied that walking behavior might be influenced more by the neighborhood environment than other types of PA behaviors. For future studies, it might be important to examine other correlates of specific MVPA behaviors.

For overweight men, seeing people being active was the strongest perceived environmental factor positively associated with engaging in 150 minutes of MVPA (excluding walking) per week. In previous studies, seeing people being active has been reported as a positive environmental correlate of being physically active [22,36]. The implication of the result is that overweight groups may need more

social support to engage in MVPA (excluding walking), such as leisure-time PA, sports, and recreational activity [42-44].

Some limitations of the current study should be considered. First, the study had a cross-sectional design, making it impossible to determine causality. Second, the main measurements, which included BMI, environmental factors, and PA, were measured only by self-administrated questionnaires and could be subject to bias. The self-reported results may cause an underestimation of weight status [22] and an inaccurate estimation of PA time due to recall bias. Finally, the study has a limited ability to obtain representative samples because it relies on an internet-based survey. The respondents of internet-based surveys might have characteristics, such as younger, more educated, higher-income, having greater access to the internet, and more likely to respond to a survey, if they are interested in its contents or are attracted by the incentives offered for participation [45,46]. Thus, the results in the present study may be less applicable to those who have received less education and not applicable to the general population.

5. Conclusions

Both common and different environmental correlates of PA were observed among normal-weight and overweight men. The findings of the current study contribute evidence to the literature on moderators between environmental factors and PA. Findings from the present study suggested that developing different environmental intervention approaches might be needed to promote PA effectively for overweight populations compared with normal-weight populations. In addition, compared with normal-weight men, the perceived environmental correlates of PA in overweight men were not well defined. Future studies should consider examining multiple levels of correlates associated with different kinds of PA by utilizing both perceived and objective measurements among men with different BMI statuses.

Acknowledgements

The present study was supported by a Grant-in-aid from the Ministry of Health, Labour, and Welfare of Japan (Comprehensive Research on Prevention of Cardiovascular Diseases and Other Lifestyle Related Diseases: H20-Junkankitou-Ippan-001); Grant-in-aid for scientific research (C) 20500604 from the Japan Ministry of Education, Culture, Sports, Science, and Technology; Grants-in-Aid for Scientific Research (No. 20800054) from the Japan Society for the Promotion of Science; and Global COE Program "Sport Sciences for the Promotion of Active Life" from the Japan Ministry of Education, Culture, Sports, Science, and Technology.

References

1. Centers for Disease Control and Prevention (CDC). Differences in Prevalence of Obesity among Black, White, and Hispanic Adults-United States, 2006–2008. *MMWR* **2009**, *58*, 740-744.
2. Blanchard, C.M.; McGannon, K.R.; Spence, J.C.; Rhodes, R.E.; Nehl, E.; Baker, F.; Bostwick, J. Social Ecological Correlates of Physical Activity in Normal-Weight, Overweight, and Obese Individuals. *Int. J. Obes.* **2005**, *29*, 720-726.

3. Li, Z.; Bowerman, S.; Heber, D. Health Ramifications of the Obesity Epidemic. *Surg. Clin. North Am.* **2005**, *85*, 681-701.
4. Sturm, R. The Effects of Obesity, Smoking, and Drinking on Medical Problems and Costs. *Health Aff.* **2002**, *21*, 245-253.
5. U.S. Department of Health and Human Services. *The Surgeon General's Vision for a Healthy and Fit Nation*; Department of Health and Human Services, Office of the Surgeon General: Rockville, MD, USA, 2010.
6. Rennie, K.L.; Jebb, S.A. Prevalence of Obesity in Great Britain. *Obes. Rev.* **2005**, *6*, 11-12.
7. Yoshiike, N.; Seino, F.; Tajima, S.; Arai, Y.; Kawano, M.; Furuhata, T.; Inoue, S. Twenty-Year Changes in the Prevalence of Overweight in Japanese Adults: The National Nutrition Survey 1976–95. *Obes. Rev.* **2002**, *3*, 183-190.
8. Flegal, K.M.; Carroll, M.D.; Ogden, C.L.; Curtin, L.R. Prevalence and Trends in Obesity among US Adults, 1999–2008. *JAMA* **2010**, *303*, 235-241.
9. Kanazawa, M.; Yoshiike, N.; Osaka, T.; Numba, Y.; Zimmet. P.; Inoue, S. Criteria and Classification of Obesity in Japan and Asia-Oceania. *Asia Pac. J. Clin. Nutr.* **2002**, *11*, S732-S737.
10. *National Health and Nutrition Survey in 2008*; Ministry of Health, Labour and Welfare: Tokyo, Japan, 2008.
11. Kimm, S.Y.; Glynn, N.W.; Obarzanek, E.; Kriska, A.M.; Daniels, S.R.; Barton, B.A.; Liu, K. Relation between the Changes in Physical Activity and Body-Mass Index during Adolescence: A Multicentre Longitudinal Study. *Lancet* **2005**, *366*, 301-307.
12. Ness, A.R.; Leary, S.D.; Mattocks, C.; Blair, S.N.; Reilly, J.J.; Wells, J.; Ingle, S.; Tilling, K.; Smith, G.D.; Riddoch, C. Objectively Measured Physical Activity and Fat Mass in a Large Cohort of Children. *PLoS Med.* **2007**, *4*, 476-484.
13. Martinez-Gomez, D.; Ruiz, J.R.; Ortega, F.B.; Veiga, O.L.; Moliner-Urdiales, D.; Mauro, B.; Galfo, M.; Manios, Y.; Widhalm, K.; Béghin, L.; Moreno, L.A.; Molnar, D.; Marcos, A.; Sjöström, M. Recommended Levels of Physical Activity to Avoid an Excess of Body Fat in European Adolescents: The HELENA Study. *Am. J. Prev. Med.* **2010**, *39*, 203-211.
14. Ruiz, J.R.; Rizzo, N.S.; Hurtig-Wennlöf, A.; Ortega, F.B.; Wärnberg, J.; Sjöström, M. Relations of Total Physical Activity and Intensity to Fitness and Fatness in Children: The European Youth Heart Study. *Am. J. Clin. Nutr.* **2006**, *84*, 299-303.
15. Gutin, B.; Yin, Z.; Humphries, M.C.; Barbeau, P. Relations of Moderate and Vigorous Physical Activity to Fitness and Fatness in Adolescents. *Am. J. Clin. Nutr.* **2005**, *81*, 746-750.
16. Ekelund, U.; Sardinha, L.B.; Anderssen, S.A.; Harro, M.; Franks, P.W.; Brage, S.; Cooper, A.R.; Andersen, L.B.; Riddoch, C.; Froberg, K. Associations between Objectively Assessed Physical Activity and Indicators of Body Fatness in 9- to 10-y-old European Children: A Population-Based Study from 4 Distinct Regions in Europe (The European Youth Heart Study). *Am. J. Clin. Nutr.* **2004**, *80*, 584-590.
17. World Health Organization (WHO). *Global Strategy on Diet, Physical Activity and Health*, May 2004. Available online: http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf (accessed on 23 August 2010).

18. Inoue, S.; Murase, N.; Shimomitsu, T.; Ohya, Y.; Odagiri, Y.; Takamiya, T.; Ishii, K.; Katsumura, T.; Sallis, J.F. Association of Physical Activity and Neighborhood Environment among Japanese Adults. *Prev. Med.* **2009**, *48*, 321-325.
19. Sallis, J.F.; Owen, N. Ecological models of health behavior. In *Health Behavior and Health Education*, 3rd ed.; Glanz, K., Rimer, B.K., Lewis, F.M., Eds.; Jossey-Bass: San Francisco, CA, USA, 2002; pp. 462-484.
20. Saelens, B.E.; Handy, S.L. Built Environment Correlates of Walking: A Review. *Med. Sci. Sports Exerc.* **2008**, *40*, S550-S566.
21. Bamana, A.; Tessier, S.; Vuillemin, A. Association of Perceived Environment with Meeting Public Health Recommendations for Physical Activity in Seven European Countries. *J. Public Health (Oxf.)* **2008**, *30*, 274-281.
22. Santos, R.; Silva, P.; Santos, P.; Ribeiro, J.C.; Mota, J. Physical Activity and Perceived Environmental Attributes in a Sample of Portuguese Adults: Results from the Azorean Physical Activity and Health Study. *Prev. Med.* **2008**, *47*, 83-88.
23. Bengoechea, E.G.; Spence, J.C.; McGannon, K.R. Gender Differences in Perceived Environmental Correlates of Physical Activity. *Int. J. Behav. Nutr. Phys. Act.* **2005**, *2*, 12.
24. Shigematsu, R.; Sallis, J.F.; Conway, T.L.; Saelens, B.E.; Frank, L.D.; Cain, K.L.; Chapman, J.E.; King, A.C. Age Differences in the Relation of Perceived Neighborhood Environment to Walking. *Med. Sci. Sports Exerc.* **2009**, *41*, 314-321.
25. Hooker, S.P.; Wilson, D.K.; Griffin, S.F.; Ainsworth, B.E. Perceptions of Environmental Supports for Physical Activity in African American and White Adults in a Rural County in South Carolina. *Prev. Chronic Dis.* **2005**, *2*, A11.
26. Kamada, M.; Kitayuguchi, J.; Inoue, S.; Kamioka, H.; Mutoh, Y.; Shiwaku, K. Environmental Correlates of Physical Activity in Driving and Non-Driving Rural Japanese Women. *Prev. Med.* **2009**, *49*, 490-496.
27. Hallal, P.C.; Reichert, F.F.; Siqueira, F.V.; Dumith, S.C.; Bastos, J.P.; da Silva, M.C.; Domingues, M.R.; Azevedo, M.R.; Ekelund, U. Correlates of Leisure-Time Physical Activity Differ by Body-Mass-Index Status in Brazilian Adults. *J. Phys. Act. Health* **2008**, *5*, 571-578.
28. Foster, C.; Hillsdon, M.; Thorogood, M. Environmental Perceptions and Walking in English Adults. *J. Epidemiol. Community Health* **2004**, *58*, 924-928.
29. Craig, C.L.; Marshall, A.L.; Sjöström, M.; Bauman, A.E.; Booth, M.L.; Ainsworth, B.E.; Pratt, M.; Ekelund, U.; Yngve, A.; Sallis, J.F.; *et al.* International Physical Activity Questionnaire: 12-Country Reliability and Validity. *Med. Sci. Sports Exerc.* **2003**, *35*, 1381-1395.
30. Murase, N.; Katsumura, T.; Ueda, C.; Inoue, S.; Shimomitsu, T. International Standardization of Physical Activity Level: Reliability and Validity Study of the Japanese Version of the International Physical Activity Questionnaire (IPAQ) (Kosei no Shihyo) *J. Health Welfare Statistics* **2003**, *49*, 1-9, (in Japanese).
31. Haskell, W.L.; Lee, I.M.; Pate, R.R.; Powell, K.E.; Blair, S.N.; Franklin, B.A.; Macera, C.A.; Heath, G.W.; Thompson, P.D.; Bauman, A. Physical Activity and Public Health: Updated Recommendation for Adults from the American College of Sports Medicine and the American Heart Association. *Med. Sci. Sports Exerc.* **2007**, *39*, 1423-1434.

32. Bergman, P.; Grjibovski, A.M.; Hagströmer, M.; Sallis, J.F.; Sjöström, M. The Association between Health Enhancing Physical Activity and Neighbourhood Environment among Swedish Adults—A Population-Based Cross-Sectional Study. *Int. J. Behav. Nutr. Phys. Act.* **2009**, *6*, 8.
33. Santos, M.S.; Vale, M.S.; Miranda, L.; Mota, J. Socio-Demographic and Perceived Environmental Correlates of Walking in Portuguese Adults—A Multilevel Analysis. *Health Place* **2009**, *15*, 1094-1099.
34. Doerksen, S.E.; Motl, R.W.; McAuley, E. Environmental Correlates of Physical Activity in Multiple Sclerosis: A Cross-Sectional Study. *Int. J. Behav. Nutr. Phys. Act.* **2007**, *4*, 49.
35. *IPAQ (International Physical Activity Questionnaire)* Homepage. http://www.ipaq.ki.se/ (accessed on 1 July 2010).
36. Ishii, K.; Shibata, A.; Oka, K.; Inoue, S.; Shimomitsu, T. Association of Built-Environment and Physical Activity Recommended for Health Promotion among Japanese Adults (kenko kyoiku) *Jpn. J. Health Educ. Promot.* **2010**, *18*, 115-125, (in Japanese).
37. McCormack, G.R.; Giles-Corti, B.; Bulsara, M. The Relationship between Destination Proximity, Destination Mix and Physical Activity Behaviors. *Prev. Med.* **2008**, *46*, 33-40.
38. Hoehner, C.M.; Brennan Ramirez, L.K.; Elliott, M.B.; Handy, S.L.; Brownson, R.C. Perceived and Objective Environmental Measures and Physical Activity among Urban Adults. *Am. J. Prev. Med.* **2005**, *28*, 105-116.
39. *The Surgeon General's Vision for a Healthy and Fit Nation*; U.S. Department of Health and Human Services, Office of the Surgeon General: Rockville, MD, USA, 2010.
40. Global Advocacy Council for Physical Activity. *The Toronto Charter for Physical Activity: A Globe Call to Action.* Available online: http://www.globalpa.org.uk/ (accessed on 20 May 2010).
41. Christensen, K.M.; Holt, J.M.; Wilson, J.F. Effects of Perceived Neighborhood Characteristics and Use of Community Facilities on Physical Activity of Adults with and without Disabilities. *Prev. Chronic Dis.* **2010**, *7*, A105.
42. Strauss, R.S.; Rodzilsky, D.; Burack, G.; Colin, M. Psychosocial Correlates of Physical Activity in Healthy Children. *Arch. Pediatr. Adolesc. Med.* **2001**, *155*, 897-902.
43. Gesell, S.B.; Reynolds, E.B.; Ip, E.H.; Fenlason, L.C.; Pont, S.J.; Poe, E.K.; Barkin, S.L. Social Influences on Self-Reported Physical Activity in Overweight Latino Children. *Clin. Pediatr.* **2008**, *47*, 797-802.
44. Marquez, D.X.; McAuley, E. Social Cognitive Correlates of Leisure Time Physical Activity among Latinos. *J. Behav. Med.* **2006**, *29*, 281-289.
45. Rhodes, S.D.; Bowie, D.A.; Hergenrather, K.C. Collecting Behavioural Data Using the World Wide Web: Considerations for Researchers. *J. Epidemiol. Community Health* **2003**, *57*, 68-73.
46. Shibata, A.; Oka, K.; Harada, K.; Nakamura, Y.; Muraoka, I. Psychological, Social, and Environmental Factors to Meeting Physical Activity Recommendations among Japanese Adults. *Int. J. Behav. Nutr. Phys. Act.* **2009**, *28*, 60.