Psychological, Social Environmental, and Physical Environmental Variables in Explaining Physical Activity in Korean Older Adults

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PSYCHOLOGICAL, SOCIAL ENVIRONMENTAL, AND PHYSICAL ENVIRONMENTAL VARIABLES IN EXPLAINING PHYSICAL ACTIVITY IN KOREAN OLDER ADULTS

KEYWORDS: Physical activity; Social ecological model; Older adults

ABSTRACT: The current study investigated the direct and indirect paths of psychological, social environmental, and physical environmental variables in explaining physical activity among Korean older adults. A total of 401 adults aged 65 years old or older (M_{age} = 75.17 years, SD = ±7.24) were recruited from the Nowon district of northern Seoul. Standardized scales were used to measure physical activity and its related social ecological variables. The results indicated that physical activity was significantly correlated with self-efficacy, perceived benefits, perceived barriers, family support, friend support, availability of facilities, and quality of facilities. All of psychological, social environmental, and physical environmental variables had a significant direct path to explain physical activity. In addition, self-efficacy and perceived benefits significantly mediated the relationship between family support and physical activity, and while the relationship between availability of facilities and physical activity was substantially mediated by perceived barriers. The current study implies that application of the social ecological model is warranted to provide a more concrete association of the contextual factors to explain physical activity and to design a more effective intervention for promoting physical activity among older adults.

It is clearly witnessed that the population aged 65 or older is rapidly growing in the world and people with age are suffering from various health risks and diseases (Federal Interagency Forum on Aging-Related Statistics 2008; Statistics Korea, 2014). Physical activity is one of the significant health behaviors to prevent an increase in chronic diseases related to aging (Struck and Ross, 2006; Vogel et al., 2009). Recent studies indicate that many older adults around the world do not meet the physical activity recommendation to obtain health benefits (Eurobarometer, 2010; U.S. Centers for Disease Control and Prevention, 2010). Given that physical activity is important for older adults' health and however, few of them are participating in enough physical activity to maintain health benefits, the promotion of physical activity in this age group is needed (U.S. Centers for Disease Control and Prevention, 2012; Van Cauwenberg et al., 2014).

Traditionally, efforts aimed at promoting older adults' physical activity have focused on applying the educational and counseling programs without fully considering various significant factors associated with their physical activity (American College of Sports Medicine, 2004). In Korea, particularly, many physical activity studies have primarily aimed at the

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socioeconomic characteristics (i.e., gender, age, and income etc.) or psychological variables (i.e., self-efficacy, belief, attitude etc.) (Kim et al., 2010; Renner, Spivak, Kwon, and Schwarzer, 2007). However, these studies have rendered little physical activity research on identifying significance of social and physical environment. In this regard, it is well documented that factors affecting physical activity of older adults can derive from psychosocial and environmental domain (Fleury and Lee, 2006). Given its complex nature, the multiple influences of physical activity, such as psychological, social, and environmental variables, must be considered in a comprehensive framework (Martinez et al., 2012).

The social ecological model suggests that physical activity is influenced by an interaction of psychological (self-efficacy, perceived benefits, and perceived barriers etc.), social environmental (i.e., social support from family and friends, social norm, and social networks etc.), and physical environmental (i.e., availability and accessibility to exercise facilities and perceived qualities and safety of facilities etc.) (Sniehotta et al., 2013).

In the last decade, a large number of studies carried out physical activity research based on a social ecological model and indicated that psychological, social environmental, and physical environmental variables are directly associated with physical activity (Brownson, Hoehner, Day, Forsyth, and Sallis, 2009; Carlson et al., 2011). Although social ecological model specifies a direct relationship between one's environment and behavior, it is also important to understand the role of mediators in the relationship between environmental factors and physical activity. For example, though many empirical studies have shown a direct relationship of physical activity with social and physical environments, the strength of this association has been shown to be attenuated in the presence of psychological variables (i.e., self-efficacy, perceived benefits, and perceived barriers) (Kim and Cardinal, 2010). However, a few studies have investigated the mediating role of psychological variables on relationship between environmental variables and physical activity (De Meester, Van Dyck, De Bourdeaudhuij, Deforche, and Cardon, 2013; Ishii, Shibata, and Oka, 2013). Additionally, it should be paid attention that not only the available research has been mostly undertaken in western societies as indicated above, but also such research is very lacking in other cultures, such as Korea, where physical activity and its multiple level of influence among older adults have only recently gained attention. Therefore, the current study is carried out to identify 1) the relationships of psychological, social environmental and physical environmental variables with physical activity, and 2) a mediating effect of psychological variables on the relationships between social and physical environmental variables and physical activity.

Method

Participants

A total of 401 adults aged 65 years old or older (*Mage* = 75.17 years, *SD* = ±7.24, *range* = 65-97 years old) were recruited from the Nowon district of northern Seoul. Dissemination sources for participant recruitment included the following: (*a*) a press release issued through the district office, (*b*) recruitment flyers posted on the websites of community wellness centers, and (*c*) recruitment leaflets inserted in a community newsletter. The recruitment period lasted one month, and the potential participants who expressed an interest in the study during this time were added to a waiting-list database. In the description of the study, it was emphasized that those who currently exercise, those who currently do not exercise, and those who are not interested in exercising were all encouraged to participate in the project. In this stage, also, older adults who are disabled and ill were ineligible to participate in the study (*n* = 7). Of the 450 older adults who expressed an interest in participating in the study, 401 individuals (89.1% *retention rate*; *male* = 125, *female* = 276) provided their consent forms and completed the survey. The study was approved by the Research Committee of the Seoul National University of Science and Technology.

Measures

For measuring self-confidence of the participants with regard to undertaking physical activity, Bandura's (1997) exercise self-efficacy scale was revised into Korean, and used in this study. The scale consists of 18 items with a five-point scale ranging from1 (cannot do) to 5 (certain can do). Individuals rated their confidence that they could perform exercise routines regularly (i.e. three or more times a week) under the various circumstances described (e.g. "when I am traveling", "it is raining or snowing"). A two-week, test-retest reliability was performed, resulting in a reliability coefficient of .77 (Kang and Kim 2011). In addition, Construct validity was examined based on

the results of a factor analysis and supported (Kim and Kosma, 2012).

To assess perceived benefits and barriers of physical activity the decisional balance scale for exercise developed by Plotnikoff, Blanchard, Hotz, and Rhodes (2001) was revised into Korean, and applied in the study. This five-point scale consisted of 10 items (i.e., five perceived benefits and five perceived barriers), and participants were asked to indicate how important each statement was to them with regard to their decision of whether or not to exercise. Response rates ranged between 1 ("strongly disagree") and 5 ("strongly agree"). An example of a perceived pro item is "It would be easier for me to perform routine physical tasks if I exercised regularly" and an example of a perceived con item is "I would have less time for my family and friends if I exercised regularly." A two-week, test–retest reliability was performed, resulting in a reliability coefficient of .89 for perceived benefits and .88 for perceived barriers (Kang and Kim 2011). In addition, based on a factor analysis, construct validity of this measure was supported (Kim and Kosma, 2012).

For social environmental variables relating to physical activity the social support scale for physical activity developed by Sallis, Grossman, Pinski, Patterson, and Nader (1987) was translated into Korean (Yang, Lee, Kim and Hyun 2005), and used in the study. The revised scale consists of 24 items (i.e., 12 items relating to family support and 12 items around friend support), and participants respond to statements such as "my family members are supportive of me being physically active" or "I have friends who exercise with me", with 5-point response rates ranging between 1 ("never") and 5 ("very often"). The internal consistency of the scale was established from 46 older adults who were not participated in the current study (α = .85 for family, α = 88 for friends). In addition, a two-week, test-retest reliability resulted in a reliability coefficient of .83 for family support and .89 for friends support (Yang et al. 2005). Based on a factor analysis, construct validity of this measure was supported (Kim and Kosma, 2012).

To measure participant perception of neighborhood environment in relation to physical activity the physical environment scale for physical activity developed by Stahl et al. (2001) was translated into Korean (Yang et al. 2005), and used in the study. The revised scale consists of the two sub-scales (availability of physical activity facilities and quality of physical activity

facilities) with five items (three for availability and two for quality). The study participants were asked to indicate how they perceived each statement, such as "my neighborhood has facilities (i.e., park, jogging path, and fitness center) for engaging in physical activity"; or "my residential area provides a safe and good quality of environment and facilities (i.e., adequate lighting and well-maintained bike lane and sport equipment) for being physically active, with 5-point response rates ranging between 1 ("not true at all") and 5 ("definitely true"), and the internal consistency of the scale was established among a middle-aged sample (α = .89) and a college sample (a = .78). A two-week, test-retest reliability was performed, resulting in a reliability coefficient of .91 (Yang et al. 2005). In addition, based on a factor analysis, construct validity of this measure was supported (Kim and Kosma, 2012).

A leisure time exercise questionnaire (LTEQ) developed by Godin and Shephard (1985) was revised into Korean and used in the study to assess habitual weekly physical activity behaviors. Participants reported how many times during a typical week they took part in strenuous (e.g., activities that require hard physical effort and cause large increases in breathing or heart rate such as running, vigorous cycling etc.), moderate (e.g., activities that require moderate physical effort and cause small increases in breathing or heart rate such as fast walking, easy swim etc.), and mild (e.g., activities that require moderate physical effort and cause small increases in breathing or heart rate such as yoga, golf etc.) physical activity for more than 15 minutes. Scores were calculated by multiplying each reported activity session by its metabolic equivalent (*MET)* value and adding the result [*MET score = (strenuous × 9) + (moderate × 5) + (mild × 3)*]. Before applying the LTEQ to the current study, In order to apply LTEQ to this study, Banville, Desrosiers, and Genet-Volet's methodology was applied (2000). This methodology resulted in measure that appeared to be both culturally appropriate and psychometrically sound. In the initial stage, the LTEQ was translated into Korean and this measure was then back-translated without referring to the original English version. This process was carried out by both the study investigator and two Korean students with doctoral degrees from US institutions. The LTEQ (original measure, translated Korean measure, and back-translated English measure) was compared and evaluated to reconcile any differences observed. Finally, the measure was administered

to two Korean scholars familiar with physical activity and exercise psychology for additional scale modifications following their feedback. Through this process, content validity suitable to the purposes of the study was established. In addition, the two-week, test-retest Cronbach's α reliability coefficient for the Korean version of the LTEQ was .86 (Kim and Cardinal 2010). Construct validity of the Korean LTEQ was supported by correlation with an accelerometer in the previous study (*Spearman's rho* = .77) (Kim 2011).

Data analysis

Descriptive statistics (i.e., means, standard deviations, and frequencies) were used to summarize participant characteristics. Correlation analysis was conducted to identify the correlations among the study variables. Then, structural equation modeling (SEM) was conducted to test the direct, indirect, and mediated associations of psychological, social environmental, and physical environmental variables with physical activity. SEM is an extension of the general linear model, in which variables are assumed to have an additive linear relationship (Tabachnick and Fidell, 1989), and it enables to test a series of regression equations simultaneously (Hoyle, 1995). Unlike regression analysis, where the independent variables are equally assumed to be measured perfectly, SEM assumes that all variables measured have some measurement error and are accounted for in the explanatory model. This study used maximum likelihood estimation, the $\chi 2$ statistic, a comparative

fit index (CFI), Tuker-Luwis index (TLI), and the root mean square error of approximation (RMSEA). Furthermore, the squared multiple correlation (R2) associated with the latent variable of physical activity was used to evaluate the effectiveness of the model in explaining the variance observed in the participants' physical activity. In the model, physical activity was represented by the participants' MET score, and all other latent variables were measured by various numbers of items for self-efficacy, perceived benefits, perceived barriers, friend support, family support, availability, and quality of facilities. This proposed model was tested not only to identify the direct path of the social ecological variables on physical activity, but also to explore the mediating effect of psychological variables in explaining the relationship of social and physical environmental variables with physical activity. All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) Win 20.0 and Analysis of Moment Structure (AMOS) 20.0.

Results

Correlation between physical activity and the social ecological variables
Physical activity was significantly correlated with self-efficacy ($r = .40$), perceived benefits ($r = .27$), family support ($r = .25$), friend support ($r = .25$), availability ($r = .21$), quality ($r = .15$), and perceived barriers ($r = .11$).

Table 1.

Correlations Between all of the Study Variables

Variable	1	2	3	4	5	6	7	8
Physical activity(1)		.40	.27	.11	.25	.25	.21	.15
Self-efficacy(2)			.44	-.20	.29	.45	.36	.30
Perceived benefits(3)				-.11	.22	.33	.20	.22
Perceived barriers(4)					.01	-.11	-.29	-.15
Family support(5)						.36	.19	.13
Friend support(6)							.37	.23
Availability (7)								.64
Quality (8)								
M	21.62	2.84	3.69	2.26	2.34	2.82	3.65	3.83
SD	14.91	.78	.74	.76	.84	.85	1.01	.93

$r \geq .11 = P<.05$; $r \geq .13 = P<.01$.

Relationships of psychological, social environmental, and physical environmental variables with physical activity

The SEM analysis produced significant association of physical activity with psychological variables (i.e. self-efficacy, perceived benefits, and perceived barriers), social environmental variables (i.e. friend support and family support), and physical environmental variables (i.e., availability of facilities and quality of facilities) to physical activity. Psychological variables were significantly associated with physical activity, with self-efficacy having the strongest direct path to physical activity ($\beta direct$ = .39 for self-efficacy, $\beta direct$ = .30 for perceived benefits, $\beta direct$ = -.20 for perceived barriers). In social environmental variables both family support ($\beta direct$ = .31) and friend support ($\beta direct$ = .14) had a significant direct path to physical activity; however, only the relationship between family support and physical activity was mediated by self-

efficacy ($\beta indirect$ = .10) and perceived benefits ($\beta indirect$ = .07). Additionally, social environmental variables were significantly associated with self-efficacy ($\beta direct$ = .43 for family support, $\beta direct$ = .28 for friend support) and perceived benefits ($\beta direct$ = .23 for family support, $\beta direct$ = .23 for friend support). In physical environmental variables availability ($\beta direct$ = .15) and quality ($\beta direct$ = .13) were significant to explain physical activity, and moreover the relationship between availability and physical activity was mediated by perceived barriers ($\beta indirect$ = .10). Availability had a direct path to self-efficacy ($\beta direct$ = .40) and perceived barriers ($\beta direct$ = -.36). An important part of any statistical procedure that builds models from data is to establish model fit. According to indices of global model fit, the proposed model had an excellent fit for exploring the relationship among psychological variables, social environmental variables, physical environmental variables, and physical activity ($\chi 2$ = 446.21, df= 169, p <0.01; CFI = 0.96, TLI = 0.95, $RMSEA$ = 0.04).
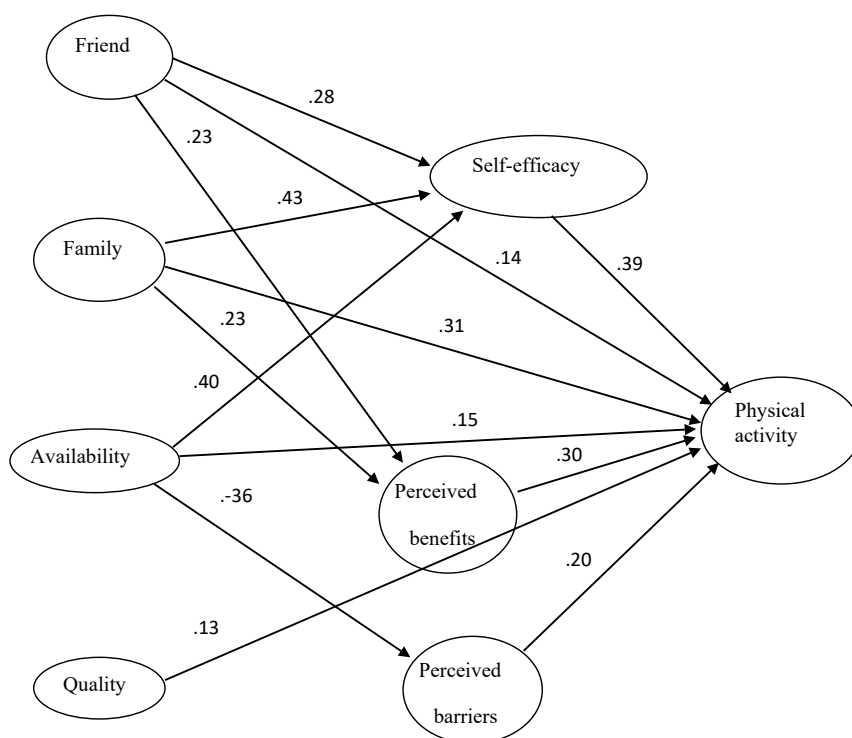

Figure 1. *Relationship of psychological, social environmental, and physical environmental variables with physical activity*
Note. Only statistically significant paths are included in this figure.

Discussion

The current study provides significant support for the social ecological model, which predicts interactions among multi-level of factors in explaining physical activity. The findings indicated that Korean older adults' physical activity was directly associated with psychological, social environmental, and physical environmental variables, and indirectly associated with family support through self-efficacy and perceived benefits and by availability of exercise facilities through perceived barriers. With regard to the relationships between the social ecological constructs and physical activity, structural equation analysis indicated that the proposed model provided a good fit to the data and was supported by similar studies carried out in western society, demonstrating physical activity is related to multiple factors and those factors are interacted to account for physical activity (Li et al., 2012; McNeill et al., 2006).

The current finding indicated that self-efficacy showed the largest relationship with Korean older adults' physical activity. It is plausible to explain that older adults with high self-efficacy are more likely to engage in physical activity, when facing with various obstacles. Additionally, they can be expected to feel much more prepared for physical activity and to regularly engage in actual physical activity than older adults with low self-efficacy (Kim and Cardinal, 2010). In addition, the current study identified that perceived benefits have positive relationship with physical activity. This finding is supported by previous studies, indicating that older adults with high perceived benefits might have engaged in physical activity on a regular basis and therefore that either they have already experienced various health benefits from regular physical activity or that they are currently experiencing such benefits (Carlson et al., 2011). While, perceived barriers are negatively related to physical activity in this study. This can be explained that older adults who are not currently active might not be likely to experience health-related benefits from physical activity (ThØgersen-Ntoumani, 2009).

For social environmental variables, the current study indicated that family support had positively significant relationship with physical activity and this finding is supported by previous studies (Mendes de Leon et al., 2009). It is plausible to interpret that older adults are more likely to be active when they could be supported by their family (Van Cauwenberg et al., 2014). Particularly, the significance of family support to physical activity might be understood if we consider the cultural and normative nature of Korean society. Although this particular society has been rapidly changed and westernized in many sectors, a family-centered social climate is still widely reflected in the lifestyle of Koreans (Kim and Kosma, 2012).

Moreover, both availability and quality of exercise facilities had a positively direct impact on older adults' physical activity. This finding is supported by previous studies (Van Cauwenberg et al., 2011). It is plausible to interpret that physical environment might have a critical role to initiate or sustain active lifestyle in older adults as bodily functional limitations have been generally rapidly increased in this age group. For example, if an older adult has the well maintained exercise facilities or parks within easy distance, he or she is more likely to engage in physical activity.

Investigating a mediating role of psychological variables on the relationship of social and physical environmental variables with physical activity is also important interest of the current study. In our study, self-efficacy and perceived benefits significantly mediated the relationship between family support and physical activity, and these findings are supported by previous studies (Ishii, Shibata, and Oka, 2010; McAuley, Jerome, Elavsky, Marquez, and Ramsey, 2003). It can be explained that older adults who have strong support from their family are more likely to possess high self-confidence to engage in physical activity and show high level of actual participation. In addition, it is plausible to explain that older adults' spouse, son, and daughter might have exercised or be currently regular exercisers and hence they might already have experienced or be currently experiencing various benefits from engaging in physical activity. Such positive perceptions toward physical activity of the family supporters can be perhaps naturally shared with older adults in their daily life. The current finding also indicated that the relationship between availability of facilities and physical activity is significantly mediated by perceived barriers. There have been very limited studies on how perceived barriers affect the effects of availability on physical activity, however, available research supported this finding, demonstrating that environmental factors had indirect path to physical activity through pros and cons (Ishii et al., 2010). Therefore, further study is needed to focus on exploring an objective causal interaction among those variables.

The study has several limitations that should be

considered for further study. This proposed model identified the significance of multi-level factors to explain physical activity, but causal interpretations cannot be made without caution due to the nature of the cross-sectional design of the current study. The measures used in the study underwent a systematic translation and validation procedure. However, they relied on self-report format, which may result in some bias from item interpretation, recall, and social desirability.

The strength of the current study is that it carried out physical activity research among less studied Korean older adults based on a broader framework including psychological, social environmental, and physical environmental variables because most of studies have been primarily conducted using various psychological theories in western societies. Therefore, the current study implies that application of the social ecological model is warranted to provide a more concrete association of the contextual factors to explain physical activity and to design a more effective intervention for promoting physical activity among older adults.

VARIABLES PSICOLÓGICAS, SOCIOAMBIENTALES Y FÍSICOAMBIENTALES EN LA EXPLICACIÓN DE LA ACTIVIDAD FÍSICA EN ADULTOS MAYORES COREANOS

RESUMEN: El presente estudio investigó los efectos directos e indirectos de las variables psicológicas, socioambientales y físicoambientales para explicar la actividad física entre los adultos mayores de Corea. Un total de 401 adultos de 65 años de edad o más (Medad = 75,17 años, DT = ± 7,24) fueron reclutados del distrito de Nowon, en el norte de Seúl. Se utilizaron escalas estandarizadas para medir la actividad física y sus variables sociales y ecológicas. Los resultados indicaron que la actividad física estaba significativamente correlacionada con la autoeficacia, los beneficios percibidos, las barreras percibidas, el apoyo familiar, el apoyo a los amigos, la disponibilidad de instalaciones y la calidad de las instalaciones. Todas las variables ambientales psicológicas, sociales, ambientales y físicas tenían un efecto directo significativo para explicar la actividad física. Además, la autoeficacia y los beneficios percibidos mediaron de forma significativa la relación entre el apoyo familiar y la actividad física, y mientras que la relación entre la disponibilidad de instalaciones y la actividad física estaba sustancialmente mediada por las barreras percibidas. El presente estudio implica que la aplicación del modelo socio-ecológico se justifica para proporcionar una asociación más concreta de los factores contextuales para explicar la actividad física y diseñar una intervención más eficaz para promover la actividad física entre los adultos mayores.

VARIÁVEIS AMBIENTAIS PSICOLÓGICAS, SOCIAIS E AMBIENTAIS FÍSICAS NA EXPLICAÇÃO DA ATIVIDADE FÍSICA EM ADULTOS MAIS COREANOS

KEYWARDS: Atividade física; Modelo social ecológico; Adultos mais velhos

RESUMO: O presente estudo investigou os caminhos diretos e indiretos das variáveis ambientais psicológicas, sociais, ambientais e físicas na explicação da atividade física entre idosos coreanos. Um total de 401 adultos com 65 anos de idade ou mais (Mage = 75,17 anos, DP = ± 7,24) foram recrutados no distrito de Nowon, no norte de Seul. Escalas padronizadas foram utilizadas para medir a atividade física e suas variáveis sociais e ecológicas. Os resultados indicaram que a atividade física estava significativamente correlacionada com auto-eficácia, benefícios percebidos, barreiras percebidas, apoio familiar, apoio amigo, disponibilidade de instalações e qualidade das instalações. Todas as variáveis ambientais psicológicas, sociais, ambientais e físicas tiveram um caminho direto significativo para explicar a atividade física. Além disso, a auto-eficácia e os benefícios percebidos mediaram significativamente a relação entre apoio familiar e atividade física, e enquanto a relação entre a disponibilidade de instalações e a atividade física era substancialmente mediada por barreiras percebidas. O presente estudo implica que a aplicação do modelo sócio-ecológico é justificada para proporcionar uma associação mais concreta dos fatores contextuais para explicar a atividade física e para projetar uma intervenção mais efetiva para promover a atividade física entre os adultos mais velhos.

References

American College of Sports Medicine (2004). Physical activity programs and behavior counseling in older adult populations. *Medicine and science in sports and exercise, 36*, 1997-2003. doi: 10.1249/01. MSS.0000145451.08166.97.

Bandura, A. (1997). Self-efficacy: The exercise of control. New York: Freeman.

Banville, D., Desrosiers, P., and Genet-Volet, Y. (2000). Journal of Teaching in Physical education, 19 (374-387).

Brownson, R. C., Hoehner, C. M., Day, K., Forsyth, A., and Sallis, J. F. (2009). Measuring the built environment for physical activity: state of the science. American *Journal of Preventive Medicine, 36(4S)*, S99-S123. doi: 10.1016/j.amepre.2009.01.005.

Carlson, J. A., Sallis, J. F., Conway, T. L., Saelens, B. E., Frank, L. D., Kerr, J., Cain, K. L., and King, A. C. (2011). Interactions between psychosocial and built environment factors in explaining older adults' physical activity. *Preventive Medicine, 54*, 68-73. doi: 10.1016/j.ypmed.2011.10.004.

De Meester, F., Van Dyck, D., De Bourdeaudhuij, I., Deforche, B., and Cardon, G. (2013). Do psychosocial factors moderate the association between neighborhood walkability and adolescents' physical acitiviy. *Social Science and Medicine, 81*, 1-9. doi: 10.1016/j.socscimed.2013.01.013.

Eurobarometer. (2010). Sport and physical activity available on: *http://ex.europa.ed/public_opinion/archivews/ebs/ebs_334_en.pdf.*

Federal Interagency Forum on Aging-Related Statistics. (2008). Older Americans 2008: Key Indicators of Well-Being. Retrieved January 1, 2010, from *http://www.agingstats.gov/agingstatsdotnet/Main_Site/Data/Data_2008.aspx.*

Fluery, J. and Lee, S.M. (2006). The social ecological model and physical activity in African American women. *American Journal of Community Psychology, 37*, 129-140. doi: 10.1007/s10464-005-9002-7.

Godin, G., and Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Science, 10*, 141-146.

Hoyle, R. H. (1995). *Structural equation modeling: concepts, issues, and application*. NY: Thousand Oaks, CAL Sage. doi: 10.2307/2988418.

Ishii, K. Shibata, A., and Oka, K. (2010). Environmental, psychological, and social influences on physical activity among Japanese adults: Structural equation modeling analysis. *International Journal of behavioral Nutrition and Physical Activity, 7*, 61-68. doi:10.1186/1479-5868-7-61.

Kang, S.J. and Kim, Y. H. (2011). Effect of individual, social, and environmental variables on physical activity in older adults. Korean Journal of Sport Psychology, 22, 113-124.

Kim, K. E., Park, W. B., Oh, M. K., Kang, E. K., Lim, J. Y., Yang, E. J., Lim, J. Y., and Paik, N. J. (2010). The effect of physical performance and physical activity on quality of life in older people: The Korean longitudinal study on health and aging. *Journal of Korean Geriatric Society, 14*, 212-220. doi: 10.4235/jkgs.2010.14.4.212.

Kim, Y. H. and Cardinal, B. J. (2010). Psychosocial correlates of Korean adolescents' physical activity behavior. *Journal of Exercise Science and Fitness, 8*, 97-104. doi: 10.1016/s1728-869x(10)60015-9.

Kim, Y. H. and Kosma, M. (2012). Psychosocial and environmental correlates of physical activity among Korean older adults. *Research on Aging, 35*, 750-767. doi: 10.1177/0164027512462412.

Kim, Y. T. (2011). *The validity and reliability of the 7-day recall physical activity questionnaire*. Unpublished Master Thesis, Shila University, Korea.

Li, K. G., Seo, D. C., Torabi, M., Peng, C. Y. J., Kay, N. S., and Kolbe, L. J. (2012). Social-ecological factors of leisure-time physical activity in Black adults. *American Journal of Health Behavior, 36*, 797-810. doi:10.5993/ajhb.36.6.7.

Martinez, S. M., Ayala, G. X., Patrick, K., Arredondo, E. M., Roesch, S., and Elder, J. (2012).Associated pathways between neighborhood environment, community resource factors, and leisure-time physical activity among Mexican-American adults in San Diego, California. *American Journal of Health Promotion, 26*, 281-288. doi: 10.4278/ajhp.100722-quan-249.

McAuley, E., Jerome, G. J., Elavsky, S., Marquez, D. X., and Ramsey, S. N. (2003). Predicting long-

term maintenance of physical activity in older adults. *Preventive Medicine, 37*, 110-118. doi: 10.1016/s0091-7435(03)00089-6.

McNeill, L. H., Wyrwich, K. W., Brownson, R. C., Clark, E. M., and Kreuter, M. W. (2006). Individual, social environmental, and physical environmental influences on physical activity among Black and White adults: A structural equation analysis. *Annals of Behavioral Medicine, 31*, 36-44. doi: 10.1207/s15324796abm3101_7.

Mendes de Leon, C. F., Cagney, K. A., Bienias, J. L., Barnes, L. L., Skarupski, K. A., Scherr, P. A., and Evans, D. A. (2009). Neighborhood social cohesion and disorder in relation to walking in community-dwelling older adults: A multilevel analysis. *Journal of Aging and Health, 21*, 155-171. doi: 10.1177/0898264308328650.

Plotnikoff, R. C., Blanchard, C., Hotz, S. B., and Rhodes, R. (2001).Validation of the decisional balance scales in the exercise domain from the transtheoretical model: a longitudinal test. *Measurement in Physical Education and Exercise Science, 5,* 191–206. doi: 10.1207/s15327841mpee0504_01.

Renner, B., Spivak, Y., Kwon, S. K., and Schwarzer, R. (2007). Does age make a difference? Predicting physical activity of South Koreans. *Psychology and Aging, 22*, 482-493. doi: 10.1037/0882-7974.22.3.482.

Sallis, J. F., Grossman, R. M., Pinski, R. B., Patterson, T. I., and Nader, P. R. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine, 16*, 825-836. doi: 10.1016/0091-7435(87)90022-3.

Sniehotta, F., Gellert, P., Witham, M. D., Donnan, P. T., Crombie, I. K., and McMurdo, M. E. T. (2013). Psychological theory in an interdisciplinary context: psychological, demographic, health-related, social, and environmental correlates of physical activity in a representative cohort of community-dwelling older adults. *International Journal of Behavioral Nutrition and Physical Activity, 10*, 106-115. doi: 10.1186/1479-5868-10-106.

Stahl, T., Rütten, A., Nutbeam, D., Bauman, A., Kannas, L., Abel, T., Lüschen, G., Rodríguez Diaz, J. A., Vinck, J., and van der Zee, J. (2001). The importance of the social environment for physically active lifestyle: results from an international study. *Social Science & Medicine, 52*, 1-10. doi: 10.1016/s0277-9536(00)00116-7.

Statistics Korea (2014). *2014 Statistic for elderly*. Statistics Korea.

Struck, B, D., and Ross, K. M. (2006). Health promotion in older adults: Prescribing exercise for the frail and home bound. *Geriatrics, 61*, 22-27.

Tabachnick, B. G. and Fidell, L. S. (1985). *Using multivariate statistics*. New York: Harper & Row.

ThØgersen-Ntoumani, C. (2009). An ecological model of predictors of stage of change for physical activity in Greek older adults. *Scandinavian Journal of Medicine & Science in Sports, 19*, 286-296. doi: 10.1111/j.1600-0838.2007.00751.x

U.S. Centers for Disease Control and Prevention.(2012). U.S. Physical activity statistics.Available on *http:// apps.nccd.cdc.gov/brfss/age.asp?cat=PA&yr=2009&qkey=4418&state=US.*

U.S. Centers for Disease Control and Prevention.(2010). U.S. Physical activity statistics. Available on *http:// apps.nccd.cdc.gov/PASurvaillance/DemoCompareResultV.asp?year=2007&State=0&Cat=1&CI=#result.*

Van Cauwenberg, J., De Bourdeaudhiij, I., De Meester, F., Van Dyck, D., Salmon, J., Clarys, P., and Deforche, B. (2011). Relationship between the physical environment and physical activity in older adults: A systematic review. *Health and Place, 17*, 458-469. doi: 10.1016/j.healthplace.2010.11.010.

Van Cauwenberg, J., De Donder, L., Clarys, P., De Bourdeaudhiij, I., Buffel, T., De Witte, N., Dury, S., Verté, D., and Deforche, B. (2014). Relationship between the perceived neighborhood social environment and walking for transportation among older adult. *Social Science & Medicine, 104*, 23-30. doi: 10.1016/j.socscimed.2013.12.016.

Vogel, T., Brechat, P. H., Leprètre, P. M., Kaltenbach, G., Berthel, M., and Lonsdorfer, J. (2009). Health benefits of physical activity in older adults: a review. *International Journal of Clinical Practice, 63*, 303-320. doi: 10.1111/j.1742-1241.2008.01957.x.

Yang, J. K., Lee, J. H., Kim, Y. H., and Hyun, S. K. (2005). Relationship between psychological and social variables of explaining exercise behavior in adults. *Korean Journal of Sport Science, 17*, 119-130.