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AN ECOLOGICAL FRAMEWORK INCLUDING PERCEIVED HEALTH STATUS FOR PREDICTION OF PHYSICAL ACTIVITY IN GREEK ADULTS

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ABSTRACT

Introduction: This cross-sectional study examined an ecological framework including personal, health, psychosocial, and environmental determinants for prediction of physical activity (PA) in Greek adults. Material and Methods: The sample consisted of 684 physically active participants from the Municipality of Athens, 206 men and 478 women (39.16±13.52 years). PA was assessed with the International Physical Activity Questionnaire, which is composed of the walking PA, moderate PA, vigorous PA, and total PA indices. Physical (PCS) and psychological (MCS) health were evaluated using the SF-36 Health Survey, while personal, psychosocial, and environmental predictors were assessed by other valid questionnaires. Separate hierarchical regression analyses were conducted. Results: Findings showed that age, number of children, MCS, exercise self-efficacy, friend support for exercise, and family participation in exercise predicted walking PA, whereas moderate PA was associated with gender, family income, MCS, exercise self-efficacy, and neighbourhood environment. Finally, age, gender, PCS, MCS, exercise self-efficacy, attractiveness, and friend support for exercise predicted vigorous PA, while total PA was associated with gender, PCS, MCS, exercise self-efficacy, attractiveness, and friend support for exercise. Conclusions: These results demonstrated various personal, health, psychosocial, and environmental predictors of PA, indicating that an ecological framework could be useful in the design of PA interventions.
Key Words: personal, psychosocial, environmental, determinants

RESUMEN

Introducción: Este estudio transversal examina un marco ecológico que incluye determinantes personales, de salud, psicosociales y ambientales para la predicción de la actividad física (AF) en adultos griegos. Material y métodos: La muestra estuvo compuesta por 684 participantes físicamente activos de la ciudad de Atenas, 206 hombres y 478 mujeres (39.16±13.52 años). La AF fue evaluada mediante el Cuestionario Internacional de la Actividad Física, compuesto por AF de paseo, AF moderada, AF vigorosa e índices totales de AF. La salud tanto Física (F) como psicológica (PSC), han sido evaluadas mediante el SF-36, mientras que los predictores personales, psicosociales y ambientales han sido evaluados mediante otros cuestionarios validados. Se realizaron análisis de regresión jerárquicos separados. Resultados: Los resultados mostraron que la edad, el número de hijos, PSC, la autoeficacia en el ejercicio, el apoyo de los amigos en el ejercicio y la participación de la familia en el ejercicio predicen la AF de paseo, mientras que AF moderada está asociada con el género, los ingresos familiares, PSC, autoeficacia en el ejercicio y el contexto del vecindario. Finalmente, la edad, el género, F, PSC, autoeficacia en el ejercicio, el atractivo y el apoyo de amigos para el ejercicio predicen la AF vigorosa, mientras que la AF total está asociada con el género, F, PSC, autoeficacia, atractivo y apoyo de amigos en el ejercicio. Conclusiones: Estos resultados demostraron la existencia de varios indicadores personales, salud, psicología y ambientales de AF, indicando que un marco ecológico puede ser útil en el diseño de intervenciones de AF.
Palabras clave: personal, psicosocial, ambiental, determinantes

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INTRODUCTION

Data from recent studies suggest that physical activity (PA) is an effective strategy for the prevention and treatment of obesity, metabolic syndrome, cardiovascular diseases, as well as for the reduction of depression and mortality rates (Savela et al., 2010; WHO, 2010; Yates et al., 2010). Despite the apparent benefits of PA, two thirds of adult populations of the European countries do not meet sufficient PA levels for enhancing health (Sjostrom, Oja, Hagstromer, Smith, & Bauman, 2006). These findings have led to an increased scientific interest in investigating factors that predict adults' participation in PA (Van Dyck et al., 2010; Wendel-Vos, Droomers, Kremers, Brug, & Lenthe, 2007). In particular, recent studies have adopted an ecological framework in an attempt to identify a wide range of factors that predict adults' PA (Ishii, Shibata, & Oka, 2010; Pan et al., 2009). Regarding the ecological approach, PA behaviour is influenced by a complex interaction among personal, psychosocial, and environmental factors (Giles-Corti, Timperio, Bull, & Pikora, 2005; Wendel-Vos et al., 2007).

In accordance with personal socio-demographic factors, higher PA levels have been found in men than in women, as well as in younger compared to older adults (Pan et al., 2009; Santos, Silva, Santos, Ribeiro, & Mota, 2008; Thogersen-Ntoumani, 2009). Further, higher PA values have been reported in individuals with higher educational level than in those with lower educational level, and in widowed individuals compare to married (Pan et al., 2009; Thogersen-Ntoumani, 2009). Among personal health factors, perceived health status has been positively correlated with PA (Stronegger, Titze, & Oja, 2010). Specifically, high levels of perceived physical (PCS) and psychological (MCS) health status, and quality of life have been associated with high PA levels (Sarmiento et al., 2010; Sorensen, Sorensen, Skovgaard, Bredahl, & Puggaard, 2010). As far as the psychosocial determinants of PA were concerned, exercise self-efficacy, perceived positive aspects of PA, intention, attraction, and social support for exercise behaviour from friends and family have been reported as positive predictors of adults' participation in PA (Ishii et al., 2010; Pan et al., 2009; Thogersen-Ntoumani, 2009; Van Dyck et al., 2010). Specifically, exercise self-efficacy has been identified as the most important predictor of PA (Ishii et al., 2010). Finally, with regard to environmental determinants, on the one hand access to sidewalks, parks, neighbourhood facilities, and exercise equipment at home, while on the other hand safety and satisfaction with neighbourhood's infrastructure and aesthetics have been positively associated with PA (Ishii et al., 2010; Pan et al., 2009; Stronegger et al., 2010; Van Dyck et al., 2010).

Several researchers adopting the ecological approach have examined a number of personal, psychosocial, and environmental variables in an attempt to better predict PA, compare to PA variance explained by these predictors in

isolation (Ishii et al., 2010; Van Dyck et al., 2010). However, much of the studies examining ecological frameworks of PA prediction have been restricted to estimating health status using one to four items, which are unlikely to capture several PCS and MCS health concepts (Soares, Simoes, Ramos, Pratt, & Brownson, 2010; Stronegger et al., 2010; Thogersen-Ntoumani, 2009). Additionally, other studies that have assessed PA following an ecological perspective neither estimated health (Ishii et al., 2010; Pan et al., 2009; Van Dyck et al., 2010), nor examined psychosocial factors (Sarmiento et al., 2010; Soares et al., 2010; Stronegger et al., 2010). Finally, Haase, Steptoe, Sallis, and Wardle (2004) have found that PA determinants may differ depending on economical, cultural, and geopolitical characteristics of populations from different countries. Therefore, it is possible that the relative importance of PA predictors may differ from one country to another country. With regard to Greek population, an ecological model of PA determinants has been assessed in older adults (Thogersen-Ntoumani, 2009). However, no data are available for adults ranging in age from 18 to 65 years old. In line with this, there is a lack of research evaluating only physically active adults and not sedentary individuals. Therefore, the purpose of the current study was to examine an ecological framework including groups of personal, health, psychosocial, and environmental factors for prediction of various PA indices in a sample of Greek physically active adults, aged 18 to 65 years old. Considering the aforementioned bibliography, the most important personal, health, psychosocial, and environmental predictors of PA were selected.

METHOD

Participants

A request form for the study was sent to the Municipality of Athens. The application explained the study's purpose requesting for men and women, ranging in age from 18 to 65 years old. In total, 752 volunteers, 212 men and 540 women, who regularly participated in various exercise programs in the Municipality's Sport Facilities, accepted the invitation to participate in the study and signed a consent form. Due to listwise deletion both of missing values and univariate and multivariate outliers, 684 participants, 206 (30.12%) men and 478 (69.88%) women, with a mean age of 39.16 years (*SD* = 13.52 years) were used for the analyses.

Assessments

PA evaluation. PA was assessed with the International Physical Activity Questionnaire (IPAQ) short form (Craig et al., 2003). The IPAQ-short form had seven days recall period and consisted of six items measuring exercise frequency and duration and one item about sedentary behaviour. The six items

assessed the following PA indices: walking PA, moderate PA, vigorous PA, and total PA (Craig et al., 2003). The PA indices are expressed in MET - minutes per week and are calculated as duration X frequency per week X MET intensity. The validity and reliability of the IPAQ are well established (Craig et al., 2003). These findings were verified for the Greek version of the IPAQ (Papathanasiou et al., 2010; Papathanasiou et al., 2009).

Personal socio-demographic predictors. Age, gender, educational level, civil status, number of children, type of job, and income were recorded. Participants were asked to indicate their educational status with response options: elementary school, secondary school, pre-university studies, professional school, bachelor studies, master / PhD studies. These responses reflected the Greek educational system. In terms of civil status, participants were grouped into four categories: single, married, divorced, widowed. In addition, based on number of children, participants were stratified into the following groups: none, 1 child, 2 children, 3-4 children, > 4 children. Further, participants were asked to indicate their profession with response options including unemployed, workless (household etc.), job in private sector, job in public sector, independent job, and retired. Finally, based on monthly self-reported income, participants were stratified into the following groups that reflected the Greek economical situation: < 1000 €, 1000 - 2000 €, 2000 - 4000 €, > 4000 € (per month).

Personal health predictors. Health status was estimated using the Short Form 36 (SF-36) Health Survey, which is a valid and reliable questionnaire (Keller et al., 1998; Ware, Kosinski, & Dewey, 2000). The SF-36 Health Survey consists of 36 questions that assess eight first-order factors: physical functioning, role disability due to physical problems (physical role), bodily pain, general health perceptions (general health), vitality, social functioning, role disability due to emotional problems (emotional role), and mental health. The eight first-order factors estimate two second-order factors that were used in the current statistical analyses: PCS and MCS. In particular, the first four first-order factors constitute the PCS factor, whereas the latter four first-order factors assess the MCS factor. First-order factors scores were transformed into a scale ranging from 0 to 100, whereas PCS and MCS second-order factors were scored using standardization and norm-based methods with a mean of 50 and a standard deviation of 10 (Ware et al., 2000). Higher values represent better health. Recent studies found high validity and reliability for the Greek version of the SF-36 Health Survey (Anagnostopoulos, Niakas, & Pappa, 2005).

Psychosocial predictors. Seven psychosocial variables were included: exercise self-efficacy, social support from family (two factors), social support from friends, PA attraction, and perceived positive (PROS) and negative (CONS) aspects of PA.

In particular, exercise self-efficacy was assessed using a five-item Self-Efficacy Scale (Marcus, Selby, Niaura, & Rossi, 1992). This scale was designed to estimate one's confidence in his/her ability to persist with exercising under the following adverse situations: tired, bad mood, not having time, on vacation, and raining or snowing. The validity, as well as the internal consistency (α = 0.76), and test-retest reliability (r = 0.90) coefficients of this scale are well established (Marcus et al., 1992). Previous study demonstrated that the Greek version of this scale had sufficient factorial validity, and reliability (α = 0.83-0.87, *ICC* = 0.96 0.92-0.98 95% CI) (Theodoropoulou & Karteroliotis, 2012).

Additionally, family support for exercise was estimated with the Family Support for Exercise Behaviour Scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). This scale was consisted of 15 items (my family exercised with me, gave me encouragement to stick with my exercise program e.t.c.). Further, the Greek version of this scale consisted of 12 items that constituted both the "family support for exercise" and "family participation in exercise" factors. Sallis et al. (1987) found satisfactory construct validity, as well as internal consistency (α = 0.91), and test-retest reliability (r = 0.77). Recent study demonstrated satisfactory construct validity, internal consistency (α = 0.85-0.91), and test-retest reliability (*ICC* = 0.93, 0.86-0.96 95% CI) for the Greek version of this scale (Theodoropoulou, Karteroliotis, & Stavrou, 2014).

Friend support for PA was assessed using the Friend Support for Exercise Behaviour Scale (Sallis et al., 1987) that consisted of five items. Participants were asked if their friends exercised with them, offered to exercise with them, gave them helpful reminders to exercise, gave them encouragement to stick with their exercise program, and changed their schedule so they could exercise together. The construct validity, internal consistency (α = 0.84), and test-retest reliability (r = 0.79) were satisfactory. Recent study indicated good validity, internal consistency (α = 0.86-0.91), and test-retest reliability (*ICC* = 0.90, 0.81-0.95 95% CI) for the Greek version of this scale (Theodoropoulou et al., 2014).

In addition, PA attraction was assessed with the five-item "Attraction" factor from the Leisure Involvement Scale. An example of items is "exercise is very important to me", and "I really enjoy exercise" (Kyle & Mowen, 2005). The validity, and internal consistency (α = 0.79-0.87) were acceptable. In line with this, the Greek version of the Leisure Involvement Scale was valid, and reliable (α=0.82-0.92) (Theodorakis, Panopoulou, & Vlachopoulos, 2007).

Finally, perceived PROS and CONS aspects of PA were estimated with the Decisional Balance Scale (DBS) (Marcus, Rakowski, & Rossi, 1992). Particularly, the PROS factor was composed of ten items such as "I would have more energy for my family and friends if I exercised regularly". The CONS factor consisted of six items such as "I think I would be too tired to do my daily work after exercising". Plotnikoff, Blanchard, Hotz, and Rhodes (2001) found good validity,

and internal consistency (α = 0.79-0.71) for this scale. Finally, the Greek version of the DBS was valid, and reliable (α = 0.81-0.84) (Karteroliotis, 2008).

Environmental predictors. Neighbourhood environment was assessed with a valid Neighbourhood Environment Scale including five items: I possess home fitness equipment, my neighbourhood provides facilities for PA, my neighbourhood provides a safe and well-maintained environment for PA, I have access to enjoyable scenery when engaging in PA, and I frequently observe other people exercising (Ishii et al., 2010). Previous study indicated that this scale was valid, and reliable (α = 0.84-0.86, *ICC* = 0.87, 0.76-0.93 95% CI) (Theodoropoulou & Karteroliotis, 2012).

Ethical approval, study design, and procedure

This cross-sectional study was approved by the University's ethical committee, and was carried out from February to May of 2012. An experienced and trained research group visited the sport facilities and informed individuals about the study. The participants who were interested in taking part in the study signed the consent form and completed the questionnaires.

Statistical Analyses

The sample size was calculated by a priori analysis for multiple regression, according to the following criteria: (a) 17 predictors, (b) a statistical power of 90%, (c) a confidence interval of 95%, and (d) a small effect size of 0.04 (Soper, 2013). Further, initial analysis indicated non-normal distributions for the values of the PCS, MCS, and PA variables. Therefore, the values were transformed with logarithmic functions to solve the problem of non-normal distributions. Means, medians, standard deviations, frequencies, sums, and % rates were used.

A preliminary examination of associations of the personal, health, psychosocial, and environmental variables with the four PA indices was conducted using the Spearman r coefficient. Variables that were significantly associated with the PA indices were used as predictors in the hierarchical regression analyses. In particular, separate hierarchical regression analyses were conducted to explore personal, health, psychosocial, and environmental predictors of the PA indices. This kind of analysis was used so as to group personal, health, psychosocial, and environmental predictors into four separate steps, while controlling group's effect. The order of the steps was based on the ecological theory. In the first step, age, gender, educational level, civil status, number of children, type of job, and income were entered as predictors. In the second one, the PCS and MCS health factors were entered as predictors. In the third step, the psychosocial variables were predictors, whereas in the fourth one, the neighbourhood environment was added as a predictor. The four PA

indices were the dependent variables. The *R* square change coefficient, which is the improvement in *R* square when a second predictor is added, was used for assessing the fit of the steps. To identify predictors of the PA indices, β and *t* coefficients were used. A *p* value of < 0.05 was considered statistically significant. Statistical analyses were performed with the SPSS Version 17.0 software.

RESULTS

Preliminary analyses

The results of a priori sample size analysis showed that the number of participants should be 632 to detect a small effect size of 0.04, with alpha level of 0.05, and statistical power level of 0.90. Descriptive statistics of 684 participants (mean age ± *SD* in years = 39.16 ± 13.52) that took part in the study are presented in Table 1. According to total PA index, 2.19% of sample participated in light intensity PA, 72.95% participated in moderate PA, while 24.85% participated in vigorous PA. The mean value of sedentary life was 5.57 hours per day (*SD* = ± 3.02 hours). Additionally, 21.76% of participants lived in northern Athens, 19.42% lived in southern Athens, 39.12% lived in central Athens, 8.54% lived in western Athens, and 11.16% lived in eastern Athens, indicating a good spreading of sample in Athens.

TABLE 1
Participants' socio-demographic characteristics.

Characteristics	***n***	***%***
Gender		
Men	206	30.1
Women	478	69.9
Educational level		
Elementary school	11	1.6
Secondary school	34	4.9
Pre-university studies	190	27.8
Professional school	103	15.1
Bachelor – University studies	282	41.2
Master / PhD studies (post-graduate)	64	9.4
Civil status		
Single	324	47.4
Married	310	45.3
Divorced	40	5.9
Widowed	10	1.4
Number of children		
None	352	51.5
1	94	13.7
2	201	29.4
3-4	33	4.8
> 4	4	0.6
Type of job		
Unemployed	178	26.0
No job (household etc.)	41	6.0
Job in private sector	176	25.7
Job in public sector	122	17.8
Independent job	86	12.7
Retired	81	11.8
Monthly income (euros)		
< 1000	214	31.4
1000-2000	263	38.6
2000-4000	146	21.4
> 4000	59	8.6

Finally, Table 2 shows the significant bivariate associations among personal, health, psychosocial, and environmental variables and the PA indices. More specifically, the largest correlations were found among the following variables: (a) gender and vigorous PA, (b) age and vigorous PA, (c) number of

children and vigorous PA, (d) civil status and vigorous PA, (e) exercise self-efficacy and total PA, (f) exercise self-efficacy and vigorous PA, and (g) gender and total PA. The variables, which were significantly associated with the PA indices (Table 2), were entered as predictors in hierarchical regression analyses.

TABLE 2
Spearman correlations among personal, health, psychosocial, and environmental variables and PA indices.

Personal, health, psychosocial, and environmental variables	PA Indices			
	Walking PA	Moderate PA	Vigorous PA	Total PA
Gender	0.05	**0.10****	**-0.40****	**-0.27****
Age	**0.19****	0.07	**-0.38****	**-0.22****
Type of job	**0.08***	0.02	**-0.14****	0.06
Family income	**0.10****	**0.12****	**0.11***	**0.15****
Marital status	0.01	0.03	**-0.30****	**-0.21****
Number of children	**-0.17****	0.00	**-0.33****	**-0.25****
Educational level	0.01	0.04	0.07	0.04
PCS	0.01	0.01	**0.18****	**0.14****
MCS	**0.12****	**0.15****	**0.18****	**0.20****
Exercise self-efficacy	**0.10***	**0.14****	**0.28****	**0.30****
Friend support for exercise behaviour	**0.11****	0.02	**0.15****	**0.15****
Family participation in exercise	**0.09***	0.03	0.01	0.05
Family support for exercise behaviour	0.02	0.02	0.01	0.01
PA attraction	0.06	**0.14****	**0.23****	**0.27****
PROS	0.05	**0.08***	0.05	**0.11****
CONS	**-0.08***	**-0.11****	-0.01	-0.06
Neighbourhood environment	0.05	**0.09***	0.07	**0.11****

Note. PA = physical activity; PCS = physical health; MCS = psychological health; PROS = positive aspects of PA; CONS = negative aspects of PA
** p < 0.05 ** p < 0.01*

Main Analyses

Hierarchical regression analyses were applied, in which personal predictors were entered in the first step, whereas PCS and MCS were entered in the second one. In the third step, psychosocial predictors were entered together, while in the fourth one neighbourhood environment was entered (Table 3).

TABLE 3
Results of Hierarchical Multiple Regression predicting the four PA indices.

Predictors	PA Indices							
	Walking PA		Moderate PA		Vigorous PA		Total PA	
	β	*t*	*β*	*t*	*β*	*t*	*β*	*t*
Step 1								
Gender (be a woman)	0.02	0.43	**0.10***	2.25	**-0.28****	-7.42	**-0.20****	-4.84
Age	**0.18****	2.91	0.07	1.48	**-0.26****	-4.64	-0.08	-1.33
Family income	0.07	1.29	**0.10***	2.55	0.04	1.05	-0.08	1.61
Number of children	**-0.16****	-2.67	-0.05	-0.87	-0.04	-0.78	-0.09	-1.85
Step 2								
PCS	0.04	0.98	0.02	0.44	**0.10***	2.82	**0.10***	2.65
MCS	**0.11****	2.94	**0.08***	2.07	**0.08***	2.21	**0.15****	4.08
Step 3								
Exercise self-efficacy	**0.10***	2.43	**0.10***	2.52	**0.20****	5.79	**0.24****	6.41
Friend support for exercise behaviour	**0.12****	3.09	0.01	0.07	**0.10****	3.07	**0.11****	3.23
Family participation in exercise	**0.08***	2.03	0.01	0.02	0.01	0.04	0.03	0.78
PA attraction	0.06	1.37	0.07	1.53	**0.15****	4.09	**0.15****	3.74
Step 4								
Neighbourhood environment	0.02	0.44	**0.09***	2.30	0.03	0.93	0.05	1.32

Note. PA = physical activity; PCS = physical health; MCS = psychological health.
** p < 0.05 ** p < 0.01*

Predictors of walking PA. The results indicated that all groups of predictors accounted for 8% of the variance in walking PA. Walking PA was significantly predicted from personal predictors ($F_{(6, 673)} = 3.60$, R^2 change = 0.03, $p < 0.01$), PCS and MCS health ($F_{(8, 671)} = 3.86$, R^2 change = 0.01, $p < 0.01$), psychosocial predictors ($F_{(14, 665)} = 3.95$, R^2 change = 0.03, $p < 0.01$), and environmental predictors ($F_{(16, 663)} = 3.50$, R^2 change = 0.01, $p < 0.01$). In particular, as shown in Table 3, number of children *(β* = -0.16, $p < 0.01$*)* was significant negative predictor of walking PA, whereas age *(β* = 0.18, $p < 0.01$*)*, MCS *(β* = 0.11, $p < 0.01$*)*, exercise self-efficacy *(β* = 0.10, $p < 0.05$*)*, friend support for exercise behaviour *(β* = 0.12, $p < 0.01$*)*, and family participation in exercise *(β* = 0.08, $p < 0.05$*)* were significant positive predictors of walking PA.

Predictors of moderate PA. The analysis revealed that the entire model accounted for 8% of the variance in moderate PA. Personal predictors ($F_{(6, 673)} = 2.88$, R^2 change = 0.03, $p < 0.05$), PCS and MCS health ($F_{(8, 671)} = 2.71$, R^2 change = 0.01, $p < 0.05$), psychosocial predictors ($F_{(14, 665)} = 3.01$, R^2 change = 0.03, $p < 0.01$), and environmental predictors ($F_{(16, 663)} = 3.05$, R^2 change = 0.01, $p < 0.01$) significantly predicted moderate PA. Specifically, moderate PA had the following significant predictors: (a) be a woman *(β* = 0.10, $p < 0.05$*)*, (b) family income *(β* = 0.10, $p < 0.05$*)*, (c) MCS *(β* = 0.08, $p < 0.05$*)*, (d) exercise self-efficacy *(β* = 0.10, $p < 0.05$*)*, and (e) neighbourhood environment *(β* = 0.09, $p < 0.05$*)*.

Predictors of vigorous PA. The statistical results demonstrated that the entire predictors accounted for 35% of the variance in vigorous PA. Vigorous PA was significantly predicted from the first block of personal predictors ($F_{(6, 673)} = 32.76$, R^2 change = 0.23, $p < 0.01$), the second one of health ($F_{(8, 671)} = 26.35$, R^2 change = 0.01, $p < 0.01$), the third block of psychosocial predictors ($F_{(14, 665)} = 23.87$, R^2 change = 0.10, $p < 0.01$), and the fourth one of environmental predictors ($F_{(16, 663)} = 21.84$, R^2 change = 0.01, $p < 0.01$). More specifically, as Table 3 presents, be a woman *(β = -0.28, $p < 0.01$),* and age *(β = -0.26, $p < 0.01$)* were significant negative predictors of vigorous PA. Further, PCS *(β = 0.10, $p < 0.05$)*, MCS *(β = 0.08, $p < 0.05$)*, exercise self-efficacy *(β = 0.20, $p < 0.01$)*, PA attraction *(β = 0.15, $p < 0.01$)*, and friend support for exercise behaviour *(β = 0.10, $p < 0.01$)* significantly and positively predicted vigorous PA.

Predictors of total PA. The analysis showed that the entire model accounted for 28% of the variance in total PA. Total PA was significantly predicted from personal predictors ($F_{(6, 673)} = 13.54$, R^2 change = 0.11, $p < 0.01$), health ($F_{(8, 671)} = 13.11$, R^2 change = 0.03, $p < 0.01$), psychosocial predictors ($F_{(14, 665)} = 16.75$, R^2 change = 0.13, $p < 0.01$), and environmental predictors ($F_{(16, 663)} = 15.28$, R^2 change = 0.01, $p < 0.01$). Particularly, total PA was significantly predicted from the following variables: (a) be a woman *(β = -0.20, $p < 0.01$),* (b) PCS *(β = 0.10, $p < 0.05$)*, (c) MCS *(β = 0.15, $p < 0.01$)*, (d) exercise self-efficacy *(β = 0.24, $p < 0.01$)*, (e) PA attraction *(β = 0.15, $p < 0.01$)*, and (f) friend support for exercise behaviour *(β = 0.11, $p < 0.01$)*.

Discussion and Conclusions

The current study constituted the first attempt of examining the associations among personal, health, psychosocial, and environmental predictors and various PA indices in a sample of Greek physically active adults aged 18 to 65 years old. In particular, an ecological framework of predictors of PA was assessed including PCS and MCS health. This is a contribution to literature, because other studies that examined ecological approaches of PA prediction either were restricted to assessing health using one to four items, as well as not including PCS and MCS (Soares et al., 2010; Stronegger et al., 2010; Thogersen-Ntoumani, 2009), or did not estimate perceived health (Ishii et al., 2010; Pan et al., 2009; Van Dyck et al., 2010).

In this study, several variables significantly predicted PA. In particular, the entire groups of variables accounted for low percentages of the variance in walking, and moderate PA. Further, the entire model accounted for medium percentages of the variance in vigorous and total PA. The differences among the above PA indices in type, intensity, frequency, and duration could explain the conflicting results in explained variance. Similarly, in previous studies, the differences among various PA indices explained the conflicting findings about

either the mediators of PA (Ishii et al., 2010) or the PA psychological effects (Netz, Wu, Becker, & Tenenbaum, 2005). Further, a possible explanation for low to medium percentages of the variance in PA found in this study may be that Greece is a Mediterranean country with unique characteristics in terms of PA, lifestyle, and economical status (Haase et al., 2004). Specifically, the prevalence of exercise and lifestyle PA, and economical development are lower in Mediterranean than North-Western European countries, indicating that the variance in PA could be explained from cultural and economical characteristics of Greece.

With regard to personal variables, personal predictors accounted for high percentages of the variance in PA, verifying the results of previous studies (Thogersen-Ntoumani, 2009). It seemed that increasing age and be a woman were associated with low PA levels, showing that PA specialists should focus on enhancing PA of these groups. In terms of health status, Greek adults feeling healthy participated in high PA levels. However, health status accounted for a small amount of the variance in PA, indicating that health perceptions are not strong predictors of PA participation in Greek adults. A possible explanation is that due to cultural and economical reasons, Greek adults tend to live in cities with health systems of low quality. Therefore, their personal value systems that affect decisions for PA or other behaviours do not usually include health perceptions.

In contrast to personal factors, psychosocial variables accounted for higher percentages of the variance in PA. Furthermore, this study indicated that Greek adults feeling confident to overcome adverse situations for being physically active had high PA levels. These findings are in agreement with the results of previous studies (Ishii et al., 2010; Thogersen-Ntoumani, 2009; Van Dyck et al., 2010). The aforementioned findings demonstrated the importance of adopting the Social Cognitive theory, whose self-efficacy is a concept, to promote PA. In particular, PA specialists could attempt to increase exercise self-efficacy of Greek adults, so as to enhance PA participation. One of the ways to increase self-efficacy is to create successful experiences during PA. Further, in this study, high levels of social support for PA, and PA attraction were associated with high levels of PA participation, indicating that social models could be used in promoting PA. Specifically, the use of social models for enhancing PA may be important for Greek adults that live in a collectivist country, in which social variables highly determine behaviours.

Moreover, the current study demonstrated that neighbourhood environment accounted for the lowest percentages of the variance in PA. This finding could be partly explained from the fact that only five items were used for the neighbourhood environment assessment. Additionally, it seems reasonable that the PA behaviour most likely to be influenced by environment

is walking compare to PA taking place indoors. Further, according to a recent study, which examined an ecological model of PA prediction, the main positive effects of neighbourhood environment on PA was indirect through personal, and psychosocial factors (Ishii et al., 2010). However, the current results about neighbourhood environment were adjusted for these factors. Therefore, the association between environment and PA may be confounded by personal or psychosocial variables.

Finally, this study had several limitations that need to be reported. First, due to the cross-sectional nature of the study, it was impossible to infer causality. Second, the sample participated in PA, was not representative, and the results could not be generalized to the entire Greek population. Third, PA assessment was self-reported and problems associated with common method variance should be considered. Fourth, neighbourhood environment evaluation contained neither perceived satisfaction with environment nor objective measures through geographical information systems technology. Despite the apparent limitations, this study had some advantages that should be considered. Particularly, a key feature of this study was the ecological framework of PA including assessment of PCS and MCS health. Health determinants were evaluated using the SF-36 Health Survey that assesses several PCS and MCS concepts (Keller et al., 1998; Ware et al., 2000). The results of this multilevel Survey could both enhance the understanding of PA prediction from a variety of health determinants, and fill in the lack of research of previous studies, which did not estimate PCS and MCS or excluded health. Further, no such study has been carried out in the Greek adult population that culturally differs from populations commonly used in this area of research.

In conclusion, this paper demonstrated the relevance of adopting an ecological framework in promoting PA among Greek adults. Considering the limitations of this study, future studies should be carried out to examine ecological models of PA with longitudinal data for better understanding the factors that enhance participation in PA. Finally, similar studies using objective measures of PA and neighbourhood environment would be of considerable value.

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