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LEISURE-TIME PHYSICAL ACTIVITIES: THE ANTHROPOLOGICAL BENEFITS AND HEALTH RISKS

TELESNA AKTIVNOST V PROSTEM ČASU: ANTROPOLOŠKE PREDNOSTI IN ZDRAVSTVENA TVEGANJA

Abstract

There is an evident lack of data concerning the influence of different leisure-time physical activities (LTPAs) on certain dimensions of anthropological status. The aim of this study was to group and identify the LTPAs taking into consideration the problems of potential anthropological benefits and health risks (benefit-risk), and define the benefit-risk factors discriminating between the observed groups of LTPA. In total, twenty LTPAs were measured on a set of nine variables (seven anthropological benefits and two health risk variables). Using cluster analysis, three homogenous groups of LTPAs are identified. Discriminant canonical analysis shows that the first group (monostructural-cyclic LTPAs) is characterised by low cardio-risk and a low risk of injury, but also high cardio-transformational possibilities. The second group (low energy demanding activities) is identified as low-risk LTPA, while the third group (polystructural activities) is identified as high risk – high anthropological benefit group. Possible explanations are discussed. The results of the present study should be used in future efficient and precise analyses of the transformational effects and in the health-risk screening of different LTPAs.

Key words: leisure-time physical activity, anthropological benefits, health risks

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Izvleček

Očitno je, da primanjkuje podatkov o vplivih različnih prostočasnih telesnih aktivnostih (LTPA) na določene dimenzije antropološkega stanja. S to raziskavo smo skušali: (1) razvrstiti in identificirati prostočasne telesne aktivnosti (LTPA) upoštevajoč probleme potencialnih antropoloških prednosti in zdravstvenega tveganja (prednost – tveganje); (2) definirati dejavnike prednost–tveganje z razlikovanjem med opazovanimi skupinami prostočasnih telesnih aktivnosti (LTPA). Skupno smo izmerili 20 prostočasnih telesnih aktivnosti v nizu devetih spremenljivk (sedem spremenljivk antropoloških prednosti in dve spremenljivki zdravstvenih tveganj). Z uporabo metode razvrščanja v skupine (cluster analysis) smo določili 3 homogene skupine prostočasnih telesnih aktivnosti (LTPA). Kanonska diskriminantna analiza je pokazala, da je za prvo skupino (enostrukturne – ciklične aktivnosti LTPA) značilno nizko kardiološko zdravstveno tveganje in nizka nevarnost poškodb, a hkrati visoka verjetnost tveganja kardioloških sprememb. Pri drugi skupini (nizko energijsko zahtevne aktivnosti) smo ugotovili, da je to skupina z nizkim tveganjem, tretja skupina (večstrukturne aktivnosti) pa je skupina z visokim tveganjem in velikimi antropološkimi prednostmi. V raziskavi so pojasnjene možne razlage. Rezultate raziskave je potrebno uporabiti v prihodnjih racionalnih in natančnih analizah o transformacijskih vplivih, kot tudi v zgodnje odkrivanje zdravstvenih tveganj pri prostočasnih telesnih aktivnostih.

Ključne besede: prostočasne telesne dejavnosti, antropološke prednosti, zdravstveno tveganje.

INTRODUCTION

Exercise sciences have developed a series of leisure-time physical activities (LTPAs) and most of them enjoy widespread popularity (Mull, Bayless, Ross, & Jamieson, 1997). It is evident that LTPAs are generally associated inversely with health risk factors (obesity, high blood pressure, arteriosclerosis etc.) and directly positively influence different anthropological dimensions (Haugland, Wold & Torsheim, 2003; Fransson, Alfredson, De Faire, Knutsson, & Westerholm, 2003; Nordstrom, Dwyer, Merz, Shircore, & Dwyer, 2003; Seto, 2003). However, these observations are mostly statistical and not empirical. For a complete definition and recognition of the transformational efficacy of a single LTPA, numerous experimental programmes have to be performed. However, some of the most popular LTPAs have been extensively investigated. For example, dance-based aerobics produce significant improvements in motor-status (Bobo & Yarbrough 1999), but also in the body-composition (lean body mass increase and/or body fat decrease) status of the participants (Sekulić, Rausavljević, & Zenić, 2003; Sekulić, Viskić-Štalec, & Rausavljević, 2003); while walk-run training improves cardio-respiratory status (Lemura, von Duvillard, & Mookerjee, 2000). Yet many LTPAs only have supposed effects, meaning that there is an evident lack of empirical data explaining the efficacy of LTPAs in terms of changes to different anthropological dimensions. The main reason for this can be found in the prime characteristic of LTPAs. If we define leisure-time activities as 'any kind of activity that is chosen willingly, regardless of whether it serves some useful purpose or fun' (Ljubić, 2003), the problem of the experimental study becomes clear. These activities are 'non-obligatory' (Mull, Bayless, Ross, & Jamieson, 1997), meaning that it is relatively hard to find a sample of subjects to participate in experimental studies aimed at defining the transformational efficacy of an investigated LTPA that include complicated and physically highly demanding testing procedures. Despite this, if a sample of subjects is actually found then the question is – what is to be studied? The authors of the present study believe that before any experiment the investigators should know the potential transformational effects of an individual LTPA. Due to the above, LTPA experiments have to be maximally rationalised, mainly regarding the selection of measuring procedures and tests.

Further, if we are to recommend any kind of LTPA to potential participants then we must also know the potential health risks. Experts even suggest that preventive efforts aimed at reducing sport and recreation related injuries should consider targeting high-risk activities (Conn, Annest, & Gilchrist, 2003).

The aim of the study is:

a) to group and identify the LTPAs, taking into consideration questions of the potential anthropological benefits and health risks; and
b) to define the benefit – risk factors discriminating between homogenous groups of LTPA programmes.

METHOD

Participants

Five experienced experts/evaluators (three graduate exercise scientists and two medical doctors) on the basis of the video-taped material and their own experience defined the results for each LTPA. Each expert had to have a minimum of 3 years' experience in the participation and/or management (health-management, organisation-management) in at least 30% of the sampled LTPAs (a minimum of seven LTPAs).

Instruments

The sample of the entities in the present study was twenty LTPAs. We observed the activities characterised by their potential positive influence (benefits) on some anthropological dimensions (cardio-vascular, strength, social etc), but also characterised by possible health risk factors. In total, the following twenty LTPAs were studied: aerobic dance, step aerobic, tae-bo aerobics, Pilates programme, yoga, cycling, walk-running (i.e., jogging), inline skating, mountaineering, endurance training using stationary equipment like treadmills, steppers, ergometers etc., resistance training, Alpine skiing, sailing, windsurfing, bowling, rafting, golf, traditional sports games like basketball, futsal (five-a-side football), handball etc., and racquet sports like badminton, tennis and squash.

The sample of variables consisted of nine variables. The possible anthropological benefits were studied using seven variables: cardio-respiratory, strength, motor co-ordination, flexibility and relaxation benefits, anthropometrical - body composition benefits, and socialisation benefits. Finally, the possible health risks were determined using two variables: the possible risk of cardio-respiratory obstructions, and the possible risk of muscle, tendon, joint and any other locomotor system injuries.

Procedure

The authors prepared video tapes with five minutes of recorded material of each LTPA analysed, where non-professionals (recreational athletes) demonstrated classical movement patterns of each LTPA sampled in this study. The material was recorded in the specific and usual environment for each single LTP activity. Based on the video-taped material and own experience five experienced experts/evaluators evaluated variables of each LTPA using 10-points Liker type scale, where 1 defined no benefit (or no risk) and 10 defined maximum benefit (or maximum risk). Although we tried to exclude any subjective errors in the measurement, we are aware of the possible subjectivity (as a metric problem), so we calculated the objectivity parameters (explained later).

Data processing

First, for the each observed benefit-risk variable an item analysis (objectivity) using a Cronbach alpha, average inter-item correlation coefficients and the standard error of measurement, were calculated. We defined 0.5 as the maximum SEM for an objectively measured variable. If the measurement of a single variable reached a satisfactory level of objectivity the average result of the five evaluators for each LTPA was calculated and observed as the final result. Thereafter, we calculated the descriptive statistics (mean, standard deviation, minimum and maximum) for each benefit-risk variable.

Next, by using cluster analysis (Ward's method based on Euclidian distances) a hierarchical tree was calculated, defining the homogenous groups of the LTPAs based on the benefit-risk variables' results. This allowed us to define the categorical variable - criterion - for the observed LTPAs. Using this criterion, we calculated the canonical discriminant analysis on the set of benefit-risk variables. All coefficients were considered significant at the 95% level of significance ($p<0.05$).

RESULTS

Table 1: Item analysis - analysis of the objectivity for the set of analysed variables

	α	IIR	SEM
cardio-respiratory benefit	0.92	0.74	0.28
strength benefit	0.85	0.60	0.39
co-ordination benefit	0.93	0.74	0.26
flexibility benefit	0.95	0.83	0.22
relaxation benefit	0.67	0.32	0.57
possibility of changes in body composition dimensions	0.86	0.61	0.37
socialisation benefits	0.87	0.59	0.36
risk of cardio-respiratory obstructions	0.84	0.61	0.40
risk of injury	0.82	0.60	0.42

Legend:
IIR average inter item correlation coefficient
SEM standard error of the measurement

As can be seen in Table 1, the standard error of measurement for the relaxation benefits exceeded the pre-defined maximum of 0.5. This mainly points to an absence of the correlation between the evaluators on the said variable. Therefore, the variable related to relaxation benefits is excluded from the following statistical procedures. The descriptive statistics for the remaining measured variables are presented in Table 2.

Table 2: Descriptive statistics of analysed variables

	Valid N	Mean	Minimum	Maximum	SD
cardio-respiratory benefit	20	5.88	1.20	9.20	2.50
strength benefit	20	4.66	1.80	9.80	1.84
co-ordination benefit	20	5.23	1.40	9.40	2.32
flexibility benefit	20	4.29	1.60	9.20	2.54
possibility of changes in body composition dimensions	20	5.69	2.20	9.20	2.07
socialization benefits	20	5.75	2.20	9.40	2.56
risk of cardio respiratory obstructions	20	4.55	1.20	8.40	2.19
risk of injury	20	5.55	1.20	9.80	2.54

Clustering of the sampled LTPAs was performed using the benefit-risk variables. In Figure 1, three homogenous groups of the LTPAs are observed. The A group consists of the monostructural cyclic activities (activities characterised by single-structural movements repeated in a cyclic pattern like walking, cycling and swimming). The B group consists of more complex LTPAs, all generally characterised by low metabolic cost (energy expenditure). The C group clusters the polystructural, high energy demanding activities (exercise programmes characterised by multi-structural movement patterns). According to the clustering presented here, we defined the categorical variable (i.e., group) and made a canonical discriminant analysis.

Both canonical roots (root 1 and root 2) reached a satisfactory level of significance ($p < 0.05$). Root 1 defines the differences between the A group and other two groups (B and C).

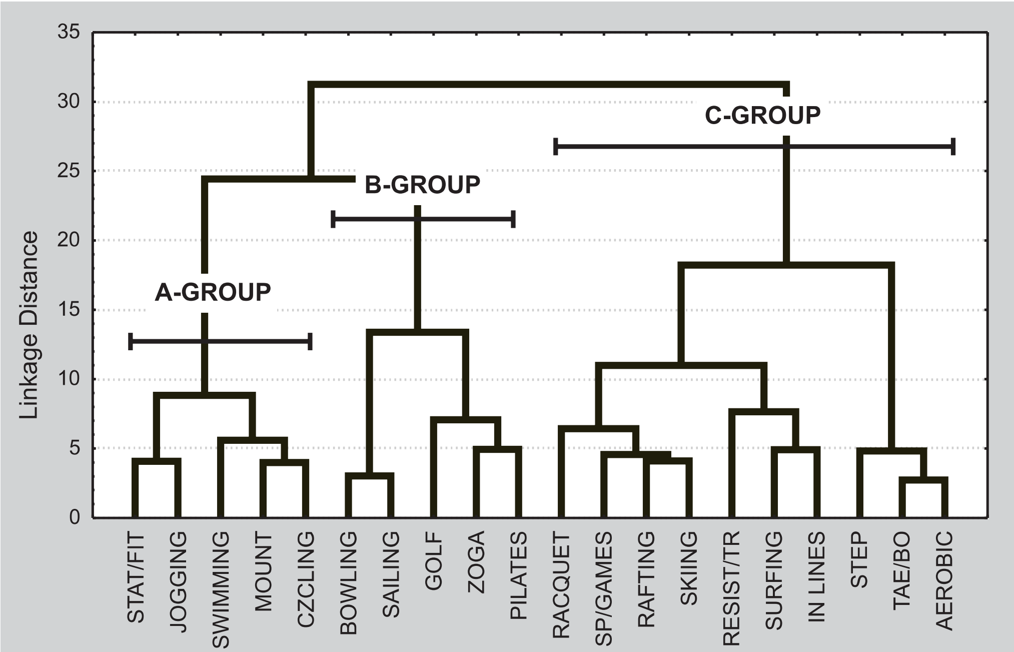

Figure 1: Homogenous groups of the analysed LTPAs: hierarchical tree calculated using cluster analysis

Legend:

stat-fit	endurance training using stationary equipment (e.g., treadmills, steppers, ergometers)
jogging	walk-run
mount	mountaineering
racquet	racquet sports (e.g., badminton, tennis, squash)
sp-games	traditional sport games (e.g., basketball, futsal i.e. five-a-side-football
resist-tr	resistance – weight training
in line s	inline skating
step	step aerobics
tae bo	tae bo aerobics
aerobic	dance aerobics

DISCUSSION

At the beginning of the experiment, the evaluators were instructed to define the potential relaxation (anti-stress) benefit of the sampled LTPAs on the variable *relaxation*. According to some experts and scientists, relaxation effects are one of the most important benefits of any leisure-time activity (Mull, Bayless, Ross, & Jamieson, 1997; Topp, 1989). The following explanation can be given for why the objectivity of the *relaxation* measurement failed. It is very hard to objectively measure what ensures a relaxation activity for different subjects (in this case the LTPA participants). For example, if one is familiar with dance routines and also likes loud modern music there is a great possibility that they would be relaxed after a dance aerobic exercise session. For example, positive relaxation effects of aerobic dance were observed in the participants – female collegiate students (Topp, 1989), but it is hard to expect that everyone

Table 3: Canonical discriminant analysis

	root 1	root 2
cardio-respiratory benefit	0.28	-0.63
strength benefit	-0.25	-0.29
co-ordination benefit	-0.41	-0.27
flexibility benefit	-0.18	0.15
possibility of changes in body composition dimensions	0.00	-0.41
socialisation benefits	-0.24	0.05
risk of cardio-respiratory obstructions	-0.13	-0.49
risk of injury	-0.27	-0.46
C: A group	4.62	-0.28
C: B group	-1.15	3.04
C: C group	-1.73	-1.38
can R	0.95	0.89
Wilks' Lambda	0.02	0.20
p	0.00	0.00

Legend:
root discriminant factor structure
C positions of the centroid
Can R canonical correlation coefficient
p level of significance

would share the same experience (for example, older people or those not so familiar with the dance routines and music). Probably, the same positive relaxation effect could be found in sailing (for people who enjoy the open sea, wind etc.), but there is no doubt that those who suffer from sea-sickness would not share the same opinion. Although physical activity has a beneficial influence on one's psychological balance (Burnik & Doupona Topič, 2003), it can be concluded that there is no possibility to objectively recommend an LTPA if relaxation (as one of the psychological-balance factors) is aimed at because the experience of relaxation is absolutely subjective and highly dependent on an individual's preferences (Burger, 2002; Ekkekakis, Hall, Van Landuyt, & Petruzzello, 2000).

The factor structure shows that the A group activities are dominant in the potential cardio-respiratory benefits compared to the activities clustered in B and C. This statement is not difficult to support if we note that the A group activities (e.g., cycling, swimming, jogging) are also known as '*cardio activities*' and mostly used especially for the purpose of improving one's cardio-respiratory status (Lemura, von Duvillard, & Mookerjee, 2000; Takeshima, Tanaka, Kobayashi, Watanabe, & Kato 1993). As previously stated, these are monostructural-cyclic activities, but they are also long-duration, continuous activities. All of them are characterised by the possibility of accurate control of the exercise workload, which is one of the most important parameters for the effective improvement of one's cardio-respiratory status (Wilmore & Costill, 1998). According to the discriminant root's structure, these LTPAs are also low-risk activities. Low cardio risk is evident because of the said accuracy of programming the exercise workload. Meanwhile, the low injury risk can be attributed to the relatively simple and natural movement patterns which are performed in constant, cyclic time, phases. Therefore, it is not surprising that most of these activities (A group) are extensively used for the training of older people (Takeshima et al., 1993), the disabled (Pachalski & Mekarski 1980) and people in different post-operative and rehabilitation phases (Braith & Edwards, 2000).

The discriminant analysis points to some of the potential benefits of the B and C group activities like motor co-ordination, strength and positive socialisation effects. The activities clustered in the B and C groups are complex – polystructural - and very specific because of the constant balance-problem (e.g., skiing, inline skating and windsurfing). If we define motor co-ordination as the integration of muscular movements necessary to execute a motor task smoothly (Mull, Bayless, Ross, & Jamieson, 1997), the need to carry out the different movement patterns and keep one's balance is an ideal stimulus for improving motor co-ordination. Accordingly, it is not hard to find papers dealing with some possible improvements in co-ordination as a result of participation in some polystructural activities (Bobo & Yarbrough, 1999; Cronin, McNair, & Marshall, 2001).

Physical activity in general is a way of communication, it helps people become self-confident, experience success, establish interpersonal relations and integrate into society (Pišot & Zurc, 2003). In terms of the problem of socialisation effects the study of Unger and Johnson (1995) is interesting. The authors defined social relationships and physical activity in health club members and concluded that exercise programmes involving some social interaction may be especially effective for single, divorced or widowed people. The B and C group activities are all characterised by the said social interaction compared to the A group where the absence of any social interaction is obvious (individually performed activities). Yet the B and C group activities are also high-risk activities. A possible explanation can be found in their pronounced dynamics (e.g., aerobics, wind-surfing), unstable position (e.g., skiing, in-line skating) and not infrequently the 'stop 'n go' character (e.g., racquet sports, sports-games), all generating the possibility of sustaining an injury along with disturbances in blood pressure and heart-rate dynamics. Numerous studies dealing with sports-recreation injuries confirm the above said. For example, Sonnery-Cottet and colleagues (Sonnery-Cottet, Edwards, Noel, & Walch, 2002; p. 558) stated that: 'tennis players, like participants in other overhead sports, are vulnerable to rotator cuff tears. In players who continue to play into their middle-age years, the incidence of such injuries increases'. Even more interesting is the study by Vogt and associates (Vogt, Brettmann, Pfeifer, & Banzer, 2001). The authors reported the relative risk of injury: in-line skating (percentage per 100 teaching units) was 14.3%. Basketball had an injury risk of 16.1%, handball 14.6% and other games 9.5%. In the same study there is no evidence of any injury incidence in monostructural-cyclic activities, which all largely agrees with the data presented in a paper by Conn, Annest and Gilchrist (2003).

The second discriminant root defines the differences between the B and C group activities. There is the evident domination of the C group in potential cardio-respiratory benefits, body composition changes, strength and co-ordination benefits. Obviously, the B group activities are relatively static (e.g., yoga, Pilates), and non-dynamic (e.g., golf, sailing, bowling), and all are characterised by low metabolic cost. For a simple comparison, Murase, Kamei and Hoshikawa (1989) defined 4-6 kcal/min as the average metabolic cost for golf, while Williford, Scharff-Olson and Blessing (1989) stated that the average energy expenditure of high intensity aerobics which entail using the large muscle groups can require 10 to 11 kcal/minute (up to three times more). Since the metabolic cost defines the energy expenditure, the more pronounced possibility of the C group activities on changes in body composition (body fat decrease and/or lean body mass increase) is clear (Sekulić, Furjan-Mandić, & Kondrič 2001). Finally, the high metabolic cost and characteristic dynamic movement patterns (characteristic of the C group) indicate more pronounced cardio risk and injury risk, which is not expressed in the B group. The only variable that does not explain any differences between the B and C group is *socialization,* probably because of the equal social interaction in both groups' LTPAs.

According to the presented and discussed results, the following benefit-risk structure of the sampled LTPAs can be identified:

a) Low risk, high cardio-beneficial activities with pronounced effects on body fat reduction: walk-run, mountaineering, swimming, cycling, endurance training using stationary equipment.
b) Higher risk, high-cardio-beneficial and motor beneficial activities with pronounced effects on transformations of body composition: dance-based aerobics, traditional sports games, polystructrural – energy-demanding activities (windsurfing, skiing, rafting), resistance training.
c) Low risk, socialisation activities: golf, sailing, Pilates, yoga, bowling.
d) The results presented and discussed herein should be used in future efficient and precise analyses of the transformational effects and in the health-risk screening of different LTPAs.

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