Towards understanding dietary supplement use among recreational athletes on the basis of a complex, multifactorial model

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Summary
The possibilities for development in the food market are rather limited because the market is becoming saturated. At the same time, the changing values and lifestyle of consumers open new frontiers for development. A striking example of this is the case of dietary supplements (DS), functional foods. There is a mushrooming number of publications analysing the different causes and consequences of the increased use of DS, but we do not have an integral picture of the socio-economic forces behind this innovation success. The methodology of analysis used offers the possibility of a wide-range adaptation and application of a model. Based on a conceptual model of the system of factors that influences DS consumption, a closed-ended, anonymous survey was carried out with participation of 617 respondents (men 32 %, average age 26 years), in Hungary, as a result of which we have determined that 61 % of recreational athletes use at least one type of DS. There were no significant differences in terms of the socio-economic characteristic features of respondents. The role of factors influencing DS consumption was analysed through a structural equation model. Athletes engaging actively in recreational sports consider DS consumption per se as a precondition of an improvement in performance.

Keywords
closed-ended surveys; recreational athlete; planned behaviour model; structural equation modelling

The saturation of food markets is a well-documented fact in developed states [1] but in emerging economies, where purchasing power is relatively low, introduction of new product categories is a difficult task, too [2]. In Hungary, a Central-European country, where the purchasing power per capita is just 61 % of the average purchasing power of the EU member states and less than a half of that of the most developed Western European states [3], the market of dietary supplements (DS) has been increasing extremely rapidly during the last decade, from zero to a business worth nearly 100 million EUR. Similar processes have also been taking place in other European countries with moderate purchasing power [4]. The size of the DS market in Europe was estimated at 7.2 billion EUR in 2015 [5], which is more than 150 % of the food industry turnover of Slovakia [6]. It is an obvious contradiction that, on one hand, there are serious doubts concerning their utility [7], economic efficiency [8] and safety [9], and at the same time we are experiencing a rapid proliferation of these products.

An ever-increasing proportion of young recreational athletes try to become stronger and better-looking rapidly, with the help of DS [10, 11]. Despite the progress that was achieved in the last few decades in research into the socio-economic

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aspects of DS consumption, there still remain considerable gaps in our knowledge on the motivational factors, beliefs and perceptions of athletes, as well as on specific regional aspects of consumption. This can be explained by two facts:

1. The dietary (nutritional) supplement as a product-category is a rather obscure one, because it has no clear-cut definition. The European Union has been trying to define DS since 2002 [12], but the result has been only partially accepted as a suitable definition. For example, in the opinion of Knapik et al. [13] the legal definition provided by the Dietary Supplement Health and Education Act (DSHEA) of 1994 [14] could still serve today as the standard one.
2. If we wish to understand the system of factors influencing DS consumption, we have to go beyond the traditional, often over-simplified models, because DS consumption is a highly complex phenomenon, influenced by overlaps and interplay of a wide range of factors. Consumer behaviour in the field of sports products has been well studied in developed states, but our knowledge of consumers' reaction to these new products is rather limited. Another problem is that the majority of studies consider the phenomenon of the consumption of DS products as a one-dimensional phenomenon.

Literature review

DS are widely used at all levels of sport. The use of DS in elite and in Olympic athletes is largely studied, but there is a lack of descriptive data in the literature with regard to the frequency, types and motivational factors of DS use among recreational athletes. The prevalence of DS use is hard to determine as there is a lack of homogenity in DS use prevalences among elite and recreational athletes [13]. As DS use has grown in sports and exercise environments, it is very important to understand the motivational system behind the usage patterns of DS among recreational athletes. The reasons behind DS use are complex and there are several theoretical approaches to analyse factors associated with DS use. Studies showed that demographic variables, social and personal norms as well as attitudes could be considered as the most important factors in DS use patterns. The authors reviewed the literature and summarized some important primary research examples regarding models used to understand factors that influence DS consumption among leisure time exercisers (Tab. 1).

Potential risk of dietary supplement use

The line between DS and drugs is rather hard to draw in numerous cases. As the American Cancer Society's webpage points out: "drugs are viewed as unsafe until proven safe, whereas DS are viewed as safe until proven unsafe" [20]. DS consumption can lead to negative and also to positive health effects. Many supplements are promoted with no sound scientific foundation and the quality control in manufacturing is often inadequate. Besides the known adverse health outcomes from DS use, the increasing prevalence of DS consumption appears not to be associated with improve-

Tab. 1. Selection of primary research examples regarding factors associated with dietary supplement use.

Year	Country	Theoretical approach	Results	Reference
2015	Brazil	A conceptual model based on demographic factors, socio-economic factors, habits and concept	Self-perceiving body weight as below ideal, exercising for 7 to 12 months, spending more than 2 hours at the gym, and perceiving training as moderate or intense were associated with dietary supplement use	Lacerda et al. [15]
2014	Germany	In-depth interview and means-end chain analysis	Motivation for using dietary supplements: strive for appreciation amongst peers and by the opposite sex and reducing the risk of ineffective training	Eberhard and Fantapié Altobelli [16]
2013	Greece	A conceptual model based on measures of social physique anxiety, supplement use and related social cognition variables	Social physical anxiety, past supplement use, attitudes and personal norms, predicted intentions to use dietary supplement	Tsochas et al. [17]
2012	Iran	A conceptual model based on sociodemographic factors, physical activity level, eating attitudes and the Stunkard Figure Rating Scale	Moderate or high physical activity level, smoking, gender, eating attitude and age were associated with dietary supplement use	Saeedi et al. [18]
2012	United Kingdom	Prototype/willingness model	The perceived prototypes of performance enhancing supplement users were related to motivation to succeed, confidence, commitment, temperament, reliability and sociability	Whitaker et al. [19]

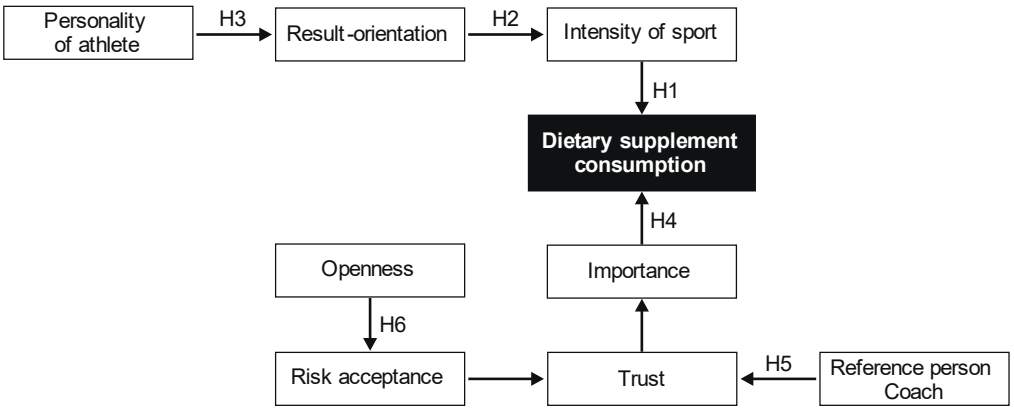

Fig. 1. Conceptual model of the system of factors influencing dietary supplement consumption.

Hypotheses: H1 – the intensity of sports is proportional with dietary supplement consumption, H2 – sports intensity is also determined by the level of motivation in the case of recreational athletes, H3 – the motivation level is significantly influenced by personality characteristics of the athlete, H4 – dietary supplement consumption is influenced by the putative importance of these products, H5 – the level of trust in personal trainers and in reference persons increases faith or trust in dietary supplement, H6 – openness towards technological innovations increases the level of acceptance of the risk necessarily attached to dietary supplement consumption.

ment in public health. According to DICKINSON and MACKAY, the usage of DS is one component of striving after a healthier lifestyle [21]. Another study found that taking DS may lead to engagement in health-risk behaviour through the illusory sense of invulnerability [22].

The novelty of our research is two-fold:

1. In the last few decades, numerous aspects of DS consumption were studied but so far we have no comprehensive view on the forces and motivating factors that prompt consumers to increase their consumption of these products. In the current research, we applied a comprehensive approach to set up a complex model which, by confirmative factor analysis, tested the inter-dependence of various factors that influence DS consumption.
2. Our research was carried out in Hungary. This Central-European country has a rather limited purchasing power and it can be considered as a "typical" post-socialist country.

Hypothesis development

We considered DS consumption to be the result of complex factors (drivers). Our hypotheses concerned the interrelationships of these factors. The goal of the current article is not primarily the "reconstruction" of previous results. The paper is rather based on a series of validated questionnaires and other methodological tools to set up a "big picture" on the system of factors influencing DS consumption. It has been proven that, based on the application of an ordered set of research hypotheses established on the basis of in-depth analysis of previous research activities, a qualitatively new, holistic system can be constructed. The hypotheses to be tested were as follows:

H1 – the intensity of sports is proportional with DS consumption,
H2 – sports intensity is also determined by the level of motivation in the case of recreational athletes,
H3 – the motivation level is significantly influenced by personality characteristics of the athlete,
H4 – DS consumption is influenced by the putative importance of these products,
H5 – the level of trust in personal trainers and in reference persons increases faith or trust in DS,
H6 – openness towards technological innovations increases the level of acceptance of the risk necessarily attached to DS consumption.

The conceptual model of investigations is summarized in Fig. 1.

The aim of our research is threefold:

1. based on a large-scale survey, to obtain a broad and relatively comprehensive picture of the current situation regarding DS consumption among recreational athletes under conditions of a post-transition or relatively new market economy,
2. based on a relatively large number of measurable variables (responses), to apply a complex structural equation model offering a system of factors (drivers) determining or influencing consumer behaviour concerning DS,

3. the overwhelming majority of former studies focused on direct influencing factors of DS consumption, however, as we have seen this is not enough to understand the complexity of factors determining this consumer behaviour pattern.

That is why our research firstly attempts to put DS consumption into a broader context, to lay down the foundations of a long-range, new health-communication policy to prevent the over-use of DS, and thus to decrease the potential risk of DS consumption.

MATERIALS AND METHODS

Questionnaire development

We developed a questionnaire, consisting mainly of Likert-scale questions. In terms of the collection of data concerning the categories of DS, we followed the approach of the seminal papers of AUSTIN et al. [23]. In line with the results of previous investigations of CONNER et al. [24], we considered the DS consumption as an extremely complex phenomenon, determined by a wide array of factors. The basis of our model was the theory of planned behaviour of CONNER et al. [24], which has been widely used for testing predictors of health-related behaviours [25]. A set of questions was asked to determine the pre-supposed importance of DS consumption (behavioural beliefs). Normative beliefs were measured by two sub-groups: the role of reference persons and peers, and the role of personal trainers, in behaviour. Among factors that facilitate or inhibit DS consumption, the most important is trust in the declared effect of these products. Openness of athletes is a decisive factor in risk acceptance. This is the reason why we applied a four-item scale to measure the attitude of consumers towards innovations in general. Intensity of sports was measured by the frequency of sports-activity: the weekly number of hours spent doing sports, and participation in sports-competitions. On the basis of the literature, we supposed that extroversion is an important factor in the case of recreational athletes. This is supported by the results of GARCÍA-NAVEIRA and RUIZ-BARQUÍN [26]. The scales and the basic questions are summarized in Tab. 2.

Ethical approval

All steps of research from conceptual planning to data collection were supervised by the ethical committee of Szent István University (Budapest, Hungary).

Recruitment

Our target group was recreational athletes. In line with the opinion of MALINZAK et al. [27], a recreational athlete is a person who does some sports activity three times per week or less, but does not follow a professionally designed training schedule.

Questionnaire administration

There were two sources of completed questionnaires: 275 completed questionnaires were obtained from a total of nine personal trainers in eight gyms in five cities of Hungary. These participants helped our work for a small reward. They sent the questionnaires to their guests via e-mail. Other 342 appraisable questionnaires were obtained through e-mail from recreational athletes, who helped our work voluntarily. They were informed about our research project via the Facebook-pages of the gyms. Participants were required to be at least 18 years of age to complete the questionnaire, and only respondents who reported taking at least one DS within the past year were eligible to complete the survey. Respondents indicated which supplements they had used from a list of common DS; in addition they also had the option to indicate “other” and list any other products used.

Data collection procedure

Participants completed an online questionnaire hosted on a server of Szent István University, as designed by the authors for this study, which requested demographic information and information on physical activity as well as current and potential use of DS. The survey instrument contained items adapted from similar surveys conducted previously. Information on motivation, beliefs, advice, supplement sources and knowledge of supplement contamination was assessed using closed-ended questions. To answer these questions, recreational athletes were asked to choose from multiple options.

Participants

A sample of 617 adults from all over the country participated in the study, the majority of whom were female (68.8 %). An age limit was imposed, as respondents had to be between 18 and 35 years of age. The average age of respondents was 26 years (standard deviation 4.4). The majority (53 %) were town-dwellers, with half of them doing some kind of sports activity on a daily basis. The proportion of respondents with secondary education was 40 %, while respondents with at least a Bachelor of Science or Bachelor of Art

Tab. 2. Level of acceptance of various statements concerning dietary supplement consumption.

Statement	Abbreviation	Average	*SD*
Supposed importance of dietary supplement (Cronbach alpha: 0.85)			
For us, athletes, DS consumption is a necessity	NECESSARY	3.22	0.97
I doubt that without DS consumption my goals could be achieved in the short run	SHORT RUN	3.04	0.87
DS consumption offers the possibility to achieve better results in a shorter time	EFFICIENCY	2.96	1.02
Without DS use one can't achieve good results	PERFORMANCE	3.69	0.79
Without DS consumption I won't be able to achieve my desired sport-results in the future	FUTURE RESULTS	2.89	0.82
Without DS consumption I won't be able to achieve my desired shape in the future	FUTURE SHAPE	3.03	1.04
I think that if I gave up the consumption of DS, my sporting-performance would decrease	PERFORMANCE DECREASE	2.93	1.05
I will get the desired social recognition factor if I consume DS	FASTER	2.99	0.98
I think that DS consuming athletes are more successful than others	SUCCESS	2.98	0.99
Openness of respondent (Cronbach alpha: 0.74)			
I have many friends	SOCIAL	2.91	1.11
I am cooperative	COOPERATIVE	3.03	0.68
I like novelties	NOVELTIES	3.04	0.76
Generally, I appreciate other people's attempts, even if they fail	ACCEPTOR	3.19	0.79
Risk-acceptance (Cronbach alpha: 0.77)			
I can imagine that DS consumption could lead to unwanted side effects, but such is life	SIDE EFFECTS	3.27	1.32
Sometimes I worry about a too high level of DS consumption, but I do everything to achieve the desired results	RISK	2.75	1.28
Trust (Cronbach alpha: 0.83)			
If DS consumption could have adverse effects, it would not be available for sale legally.	SAFE	3.32	1.22
DS consumption is safe and harmless	HARMLESS	3.37	1.29
The long-term consumption of DS does not cause unwanted health effects	LONG-TERM EFFECTS	3.21	1.11
Personal trainer's influence (Cronbach alpha: 0.89)			
My personal trainer has advised me to use DS	COACH ADVICE	2.84	0.98
My personal trainer helps me to choose the appropriate DS	COACH HELP	3.21	0.88
In the opinion of my personal trainer, regular DS consumption is necessary for me	COACH INFLUENCE	3.50	0.76
In the opinion of my personal trainer, DS consumption will improve my performance	COACH ENCOURAGE	2.78	1.02
Reference persons' influence (Cronbach alpha: 0.829)			
My friends and peers consume DS	PEERS CONSUMPTION	3.25	1.11
The performance of my peers has been improved by consumption of DS	PEERS PATTERN	3.08	1.20
I often see that even the top-athletes consume DS	TOP ATHLETES PATTERN	3.47	1.31
Extroversion (Cronbach alpha: 0.93)			
I have ambitions of being at the centre of attention	FOCUS	3.00	0.72
I am often at the centre of society	POPULARITY	3.21	1.10
It does not take me much time to start getting involved in social activities at my new workplace.	EXTROVERT	3.02	0.82

The table only contains data from directly measured variables, included in the final model. Scale: 1 – absolutely do not agree, 5 – fully agree).
DS – dietary supplement, *SD* – standard deviation.

degree were over-represented. Educational qualification of respondents was defined according to the International Standard Classification of Education (ISCED) [28]. Typically, their occupation was working (55 %) or studying (29 %). Half of the respondents were engaged in some sports activity at least twice a week, and one third regularly participated in sports competitions (Tab. 3).

Tab. 3. Characteristic features of respondents.

Age	
Average age of respondents	26.2 years
Gender (distribution)	
Male	32.2 %
Female	67.8 %
Place of residence (distribution)	
Village	7.1 %
Town	53.3 %
Capital city	26.7 %
Weekly frequency of sports activity	
I do not do sports on a weekly basis	3.9 %
On some occasions	34.5 %
Practically on a daily basis	50.5 %
Average time, spent with sports per week	6.38 h
Highest accomplished qualification level (distribution)	
Elementary school, vocational school	9.0 %
Secondary school	40.0 %
Bachelor of Sciences/Bachelor of Arts	40.0 %
Typical activity (distribution)	
Working	54.9 %
Studying	28.6 %
Other	4.7 %

Tab. 4. Frequency of dietary supplement use.

Type of dietary supplement	Frequency of consumption [%]
Vitamins or mineral supplements	64.3
Proteins	45.5
Carnitine	21.2
Isotonic drinks	18.0
Carbohydrates	14.9
Muscle gainer shakes	10.2
Pre-workout formulas	10.2
Weight control formulas	9.0
Taurine	8.6
Others	4.7

Statistical analysis

Structured equation modelling was used to determine the relationship between different motivational factors and DS consumption. In the model, different latent (hidden) motivational factors were determined by attitude-scale variables, measured on a five-point Likert scale. The structural modelling was carried out using lavaan software [29], following the guidelines of KLINE [30]. DS consumption was calculated as a product of frequency of intake and the number of DS product categories consumed, excluding vitamin and mineral supplements, consumption of which was practically general. The validity of scales was tested by Chronbach alpha.

RESULTS

Analysing the socio-demographic characteristics of the respondents, it was obvious that students studying in the capital city, with a higher-than-average qualification in the family, were over-represented in the sample. This could be considered as a positive fact, because it has been well documented over the last few decades that consumers living in Budapest with an above-average socio-cultural background are in a better position to influence attitudes toward DS than the general public.

The majority of respondents consumed DS on a regular basis (Tab. 4). The most important DS products were vitamins and mineral supplements. Nearly two-thirds of the respondents consumed these products daily. Protein powder supplements were consumed by nearly half of the respondents, and L-carnitine consumption was also rather high. We were unable to prove a significant difference in DS consumption according to the place of residence, qualification and income position of respondents. This was supported by the fact that when applying the ANOVA tests, we were unable to prove significant differences between DS consumption, as a dependent variable, and the place of residence (four levels), qualification (four levels) and income position (five levels) of respondents by various tests.

The basic statistics of attitude responses (Likert scale) are summarized in Tab. 2. Distribution of values followed normal distribution. The coefficient of variation (*CV*) was 35–45 %, with the exception of statements regarding the importance of an aesthetic body, where *CV* was 8–12 %. Analysis of Cronbach alpha values of different scales suggested an acceptable level of scale reliability.

In the hypothesis-testing phase, we were able to fit a model, which fitted relatively well. The model presented in Tab. 5 and Fig 2 was accepted. We applied the above-mentioned approach since it fitted well as evalueted by chi-square test, root mean square error of approximation (*RMSEA*) of 0.056, goodness of fit index (*GFI*) of 0.980 and comparative fit index (*CFI*) of 0.86, according to generally accepted standards of structural equation model fitting of BYRNE [31], and the results were well interpretable.

Empirical results supported the majority of hypotheses. There was a relatively loose correlation between the extrovertedness and the results orientation, but there was a strong, significant relationship between the results orientation, as a motivational factor, and the intensity of sports activity. On the other hand, openness of athletes towards technological innovations will increase the level of risk acceptance and boost the trust in new solutions in sports nutrition. Level of trust will be influenced by reference persons and, to a lesser degree, by the trainer.

The two most important factors of DS consumption were the supposed importance of these products to sports performance, and sports intensity. Sports intensity is considerably influenced by results orientation, which is a function of the extroverted personal characteristic of a respondent [26]. Our results showed a high level of extroversion within the majority of responding recreational athletes. From this it followed that, in the case of respondents, intensive sports activity could be considered as a per se factor, promoting the use of DS: athletes engaging actively in sports activities, even at a recreational level, did not weigh the necessity of DS products, but rather considered them a natural pre-requisite of athletic success (Fig. 2). As a summary, it can be stated that the consumption of DS products has gained popularity in Hungary. We were unable to prove a significant difference from the point of view of the place of residence of respondents and the consumption of these products by chi-square test.

Tab. 5. Unstandardized and standardized regression coefficients of confirmatory factors.

Factor	Regression coefficient	
	UNSTD	STD
Extroversion		
FOCUS	1.00	0.34
EXTROVERT	1.62	0.45
POPULARITY	1.29	0.31
Results orientation		
SOCIAL	1.00	0.20
COOPERATIVE	1.46	0.09
NOVELTIES	2.72	0.11
ACCEPTOR	1.17	0.09
Risk acceptance		
SIDE EFFECT	1.00	0.23
RISK	0.07	0.09
Trust		
SAFE	1.45	0.55
HARMLESS	1.23	0.74
LONG-TERM EFFECTS	1.22	0.75
Reference persons		
PEERS CONSUMPTION	1.00	0.52
PEERS PATTERN	1.74	0.85
TOP ATHLETES PATTERN	1.09	0.56
Personal trainer		
COACH ADVICE	0.95	0.84
COACH HELP	0.82	0.80
COACH INFLUENCE	0.92	0.88
COACH ENCOURAGE	1.00	0.91
Sport intensity		
Frequency of physical activity	1.00	0.59
Time spent with sport (hours)	9.38	0.74
Competition	0.75	0.55
Supposed importance of dietary supplements		
NECESSARY	1.00	0.60
PERFORMANCE	1.05	0.61
FUTURE SHAPE	1.01	0.64
FUTURE RESULTS	1.25	0.80
PERFORMANCE DECREASE	1.26	0.75
FASTER	1.25	0.53
SUCCESS	1.26	0.65
EFFICIENCY	0.83	0.58

UNSTD – unstandardized, STD – standardized.

DISCUSSION

The current article provides data on a case study of DS consumption in Hungary. Our goal was to apply a complex structural equation model characterizing a system of factors determining or influencing consumer behaviour concerning DS. The supposed importance of DS was considerably influenced by the level of trust. This latent factor was based on the effect of personal trainers

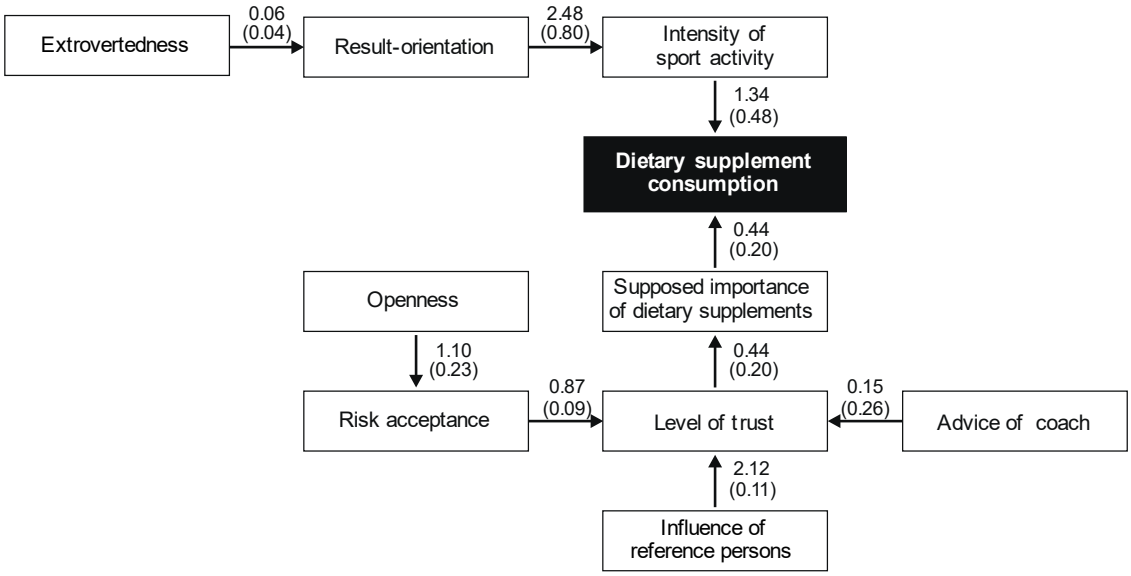

Fig. 2. Structural equation of factors influencing consumption of dietary supplements.

Regression coefficients between factors are given (standardized values are given in brackets).

and reference persons. These findings support the opinion of Saeedi [32] concerning the extremely high influence of personal trainers. In Tehran, it was crucial for 44.6 % of fitness club participants to be advised about DS, and their primary source of information was their personal trainer. Our results highlight the importance of the effect of peers in the case of adults, supporting the results of actor Denham [33]. It is important to emphasize that the effect of personal trainers is much higher than that of reference persons. In the latter category, the behaviour of top athletes is extremely important. This effect is extensively emphasised by the promotional campaigns of DS producers. Another important influencing factor of DS use is risk acceptance, which is considerably determined by the openness of respondents. This fact is in line with the results of risk-research literature [34]. Our results show the high proliferation of DC consumption among recreational athletes, but as can be seen from the model, there is a relatively low level of consciousness concerning DS consumption. A considerable number of athletes saw these products as a necessary requirement for success. Eberhard and Fantapié Altobelli [16] proved that one of the motivations of DS consumption was reduction of the risk of ineffective training. The results of this study highlighted that one of the most important factors of DS consumption is sport intensity. Lacerda et al. [15] and Saeedi et al. [18] also proved that moderate or high physical activity level and the mean time (in terms of hours) spent in a gym were associated with DS.

CONCLUSIONS

It can be stated that, based on the analysis of complex system of factors, taking into consideration the social and psychologic aspects, DS consumption is a relatively new phenomenon in dietary patterns of recreational athletes. According to our results there is a significant relationship between the influence of personal trainers, sport intensity, level of risk acceptance, trust in various sources of information and the DS use of recreational athletes. The prevalence of DS consumption is increasing among recreational athletes, but there is a lack of authentic or unbiased sources of information, which is why it is necessary to create and develop new platforms and fora for constructive, multilateral dialogues between different stakeholders, namely, medical science, sport science as well as social science specialists, public (e.g. sport clubs, coaches, influencers), nutraceutical industry and consumers (recreational athletes). In parallel with this, it is necessary to develop high quality educational materials aiming at better understanding the effect of DS consumption on athletes' physiological condition and performance as well as to encourage critical thinking of consumers in relation to aggressive promotional campaigns of DS producers and retailers. A good example of this is the "Safeyou" project [35]. Based on the specific role of trainers in the information-flow process, it would be important to upgrade the knowledge level of personal trainers on sports nutrition in general and on the effects

and side-effects of DS in particular. It would be highly desirable to outline a joint action plan with a detailed roadmap for consumer communication with specific emphasis on the demand in Central and Eastern European countries. From the point of view of increasing the efficiency of communication, the wide-ranging application of mobile communication devices is a key factor. The intense use of community sites and mobile devices is a characteristic feature of the new generation of consumers. As we have seen, there is a high tendency towards extroversion among recreational athletes and this increases their accessibility through interactive means of communication.

To the best of our knowledge this is the first comprehensive model of DS consumption based on an enhanced theory of planned behaviour model, but this should be considered as a first step to understand the system of factors influencing DS consumption by recreational athletes. The main limitation of the current study was the relatively small number of participants, consequently this research cannot be considered representative in terms of the number of recreational athletes in Hungary. However, results are similar to other significant studies in assessing the factors associated with DS use. The most important pathway of further research should be as follows: in-depth analysis of influence of traditional and community media on DS consumption, determination of influence of differences in socio-cultural environment and qualitative analysis of personal experience on consumption. The DS consumption is a highly complex issue, having social and medical aspects. That's why co-ordinated, international efforts are needed to collect more reliable information for working out a modern regulatory and consumer education framework.

Acknowledgements

This research was supported by the ÚNKP-19-4-DE-147 New National Excellence Program of the Ministry for Innovation and Technology and by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences as well as by EFOP-3.6.3-VEKOP-16-2017-00005 Program for promotion of young talents.

REFERENCES

1. Wood, S. – McCarthy, D.: The UK food retail 'race for space' and market saturation: A contemporary review. International Review of Retail, Distribution and Consumer Research, *24*, 2014, pp. 121–144. DOI: 10.1080/09593969.2013.839465.
2. Clapp, J. – Scrinis, G.: Big food, nutritionism, and corporate power. Globalizations, *14*, 2017, pp. 578–595. DOI: 10.1080/14747731.2016.1239806.
3. Adjusted gross disposable income of households per capita. In: Eurostat [online]. Luxembourg : European Commission, 2018, last update 15 May 2020 [cited 17 December 2019]. <https://ec.europa.eu/eurostat/web/products-datasets/-/sdg_10_20>
4. Lotrean, L. M. – Stan, O. – Lencu, C. – Laza, V.: Dietary patterns, physical activity, body mass index, weight-related behaviours and their interrelationship among Romanian university students – trends from 2003 to 2016. Nutricion Hospitalaria, *35*, 2018, pp. 375–383. DOI: 10.20960/nh.1296.
5. Trends and developments in sports nutrition. In: Euromonitor International [online]. London : Euromonitor International, Feb. 2015 [cited 15 January 2020]. <http://www.euromonitor.com/trends-and-developments-in-sports-nutrition/report>
6. Data & Trends: European Food and Drink Industry, 2014–2015. In: FoodDrinkEurope [online]. Brussels : FoodDrinkEurope, 2015. <https://www.fooddrinkeurope.eu/uploads/publications_documents/Data_and_Trends_2014-20151.pdf>
7. Guallar, E. – Stranges, S. – Mulrow, C. – Appel, L. J. – Miller, E. R.: Enough is enough: stop wasting money on vitamin and mineral supplements. Annals of Internal Medicine, *159*, 2013, pp. 850–851. DOI: 10.7326/0003-4819-159-12-201312170-00011.
8. Raffensperger, J. F.: The economic value of dietary supplements. In: Gerald, J. – Watson, R. – Preedy, V. (Eds.): Nutrients, Dietary Supplements, and Nutriceuticals. Totowa : Humana Press, 2011, pp. 41–53. ISBN: 978-1-60761-307-7. DOI: 10.1007/978-1-60761-308-4_4.
9. Sax, J. K.: Dietary supplements are not all safe and not all food: How the low cost of dietary supplements preys on the consumer. American Journal of Law Medicine, *41*, 2015, pp. 374–394. DOI: 10.1177/0098858815591523.
10. Tavani, A. – Colombo, P. – Scarpino, V. – Zuccaro, P. – Pacifici, R. – La Vecchia, C.: A survey of dietary supplement use among Italian sporting club athletes. Nutrafoods, *13*, 2014, pp. 29–34. DOI: 10.1007/s13749-014-0003-8.
11. Mazzeo, F. – Santamaria, S. – Monda, V. – Tafuri, D. – Dalia, C. – Varriale, L. – De Blasio, S. – Esposito, V. – Messina, G. – Monda, M.: Dietary supplements use in competitive and non-competitive boxer: An exploratory study. Biology and Medicine, *8*, 2016, ID 1000294. DOI: 10.4172/0974-8369.1000294.
12. Directive 2002/46/EC of the European Parliament and of the Council of 10 June 2002 on the approximation of the laws of the member states relating to food supplements. Official Journal of European Communities, *45*, 2002, *L183* pp. 51–57. ISSN: 0378-6978. <http://data.europa.eu/eli/dir/2002/46/oj>
13. Knapik, J. J. – Steelman, R. A. – Hoedebecke, S. S. – Austin, K. G. – Farina, E. K. – Lieberman, H. R.: Prevalence of dietary supplement use by athletes: sys-

tematic review and meta-analysis. Sports Medicine, *46*, 2016, pp. 103–123. DOI: 10.1007/s40279-015-0387-7.
14. Dietary Supplement Health and Education Act of 1994 Public Law 103-417 103rd Congress. In: National Institutes of Health [online]. Bethesda : National Institutes of Health, 2002. <https://ods.od.nih.gov/About/DSHEA_Wording.aspx#sec3>
15. Lacerda, F. M. – Carvalho, W. R. – Hortegal, E. V. – Cabral, N. A. – Veloso, H. J.: Factors associated with dietary supplement use by people who exercise at gyms. Revista de Saúde Publica, *49*, 2015, article 63. DOI: 10.1590/S0034-8910.2015049005912.
16. Eberhard, D. – Fantapié Altobelli, C.: Buying motives for anabolic supplements – An analysis among German recreational athletes. International Journal of Human Movement and Sports Sciences, *2*, 2014, pp. 75–84. DOI: 10.13189/saj.2014.020501.
17. Tsochas, K. – Lazuras, L. – Barkoukis, V.: Psychosocial predictors of nutritional supplement use among leisure time exercisers. Performance Enhancement and Health, *2*, 2013, pp. 17–23. DOI: 10.1016/j.peh.2013.02.001.
18. Saeedi, P. – Taib, M. N. M. – Saad, H. A.: Differences in sociodemographic, health-related, and psychological factors in users and nonusers of nutritional supplements in fitness club participants in Tehran, Iran. International Journal of Sport Nutrition and Exercise Metabolism, *22*, 2012, pp. 323–330. DOI: 10.1123/ijsnem.22.5.323.
19. Whitaker, L. – Long, J. – Petróczi, A. – Backhouse, S. H.: Athletes' perceptions of performance enhancing substance user and non-user prototypes. Performance Enhancement and Health, *1*, 2012, pp. 28–34. DOI: 10.1016/j.peh.2012.03.002.
20. Valentine, A. A. – Schumacher, J. R. – Murphy, J. – Ma, Y. J.: Dietary supplement use, perceptions, and associated lifestyle behaviors in undergraduate college students, student-athletes, and ROTC cadets. Journal of American College Health, *66*, 2018, pp. 87–97. DOI: 10.1080/07448481.2017.1377205.
21. Dickinson, A. – MacKay, D.: Health habits and other characteristics of dietary supplement users: a review. Nutrition Journal, *13,* 2014, article 14. DOI: 10.1186/1475-2891-13-14.
22. Chiou, W. B. – Yang, C. C. – Wan, C. S.: Ironic effects of dietary supplementation: illusory invulnerability created by taking dietary supplements licenses health-risk behaviors. Psychological Science, *22,* 2011, pp. 1081–1086. DOI: 10.1177/0956797611416253.
23. Austin, K. G. – Price, L. L. – McGraw, S. M. – Lieberman, H. R.: Predictors of dietary supplement use by U.S. Coast Guard personnel. PLoS One, *10*, 2015, e0133006. DOI: 10.1371/journal.pone.0133006.
24. Conner, M. – Kirk, S. F. L. – Cade, J. E. – Barrett, J. H.: Why do women use dietary supplements? The use of the theory of planned behaviour to explore beliefs about their use. Social Science and Medicine, *52*, 2001, pp. 621–633. DOI: 10.1016/S0277-9536(00)00165-9.
25. McEachan, R. C. R. – Conner, M. – Taylor, N. J. – Lawton, R. J.: Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. Health Psychology Review, *5*, 2011, pp. 97–144. DOI: 10.1080/17437199.2010.521684.
26. García-Naveira, A. – Ruiz-Barquín, R.: The personality of the athlete: a theoretical review from the perspective of traits. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte, *13*, 2013, pp. 627–645. ISSN: 1577-0354. <http://cdeporte.rediris.es/revista/revista51/artpersonalidad337.htm>
27. Malinzak, R. A. – Colby, M. S. – Kirkendall, D. T. – Yu, B. – Garrett, W. E.: A comparison of knee joint motion patterns between men and women in selected athletic tasks. Clinical Biomechanics, *16*, 2001, pp. 438–445. DOI: 10.1016/S0268-0033(01)00019-5.
28. International Standard Classification of Education ISCED 2011. Montreal : UNESCO Institute for Statistics, 2012. ISBN: 978-92-9189-123-8. <http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf>
29. Rosseel, Y.: lavaan: An R package for structural equation modeling and more. Journal of Statistical Software, *48*, 2012, pp. 1–36. DOI: 10.18637/jss.v048.i02.
30. Kline, R. B.: Principles and practice of structural equation modeling 2nd edition. New York : Guilford Press, 2004. ISBN: 978-1593850753.
31. Byrne, B. M.: Structural equation modeling with Mplus: Basic concepts, applications, and programming. New York : Routledge, 2011. ISBN: 978-1848728394.
32. Saeedi, P. – Nasir, M. T. M. – Hazizi, A. S. – Vafa, M. R. – Foroushani, A. R.: Nutritional supplement use among fitness club participants in Tehran, Iran. Appetite, *60,* 2013, pp. 20–26. DOI: 10.1016/j.appet.2012.09.011.
33. Denham, B. E.: Athlete information sources about dietary supplements: A review of extant research. International Journal of Sport Nutrition and Exercise Metabolism, *27*, 2017, pp. 325–334. DOI: 10.1123/ijsnem.2017-0050.
34. Frewer, L. J. – Fischer, A. R. H. – Brennan, M. – Bánáti, D. – Lion, R. – Meertens, R. M. – Rowe, G. – Siegrist, M. – Verbeke, W. – Vereijken, C. M. J. L.: Risk/benefit communication about food-a systematic review of the literature. Critical Reviews in Food Science and Nutrition, *56*, 2016, pp. 1728–1745. DOI: 10.1080/10408398.2013.801337.
35. Petróczi, A. – Norman, P. – Brueckner, S.: Can we better integrate the role of anti-doping in sports and society? A psychological approach to contemporary value-based prevention. In: Rabin, O. – Pitsiladis, Y. (Eds): Acute topics in anti-doping. Medicine and Sport Science, vol. 62. Basel : Karger, 2017, pp. 160–176. DOI: 10.1159/000460726.

Received 3 March 2020; 1st revised 24 April 2020; accepted 18 May 2020; published online 4 June 2020.