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USE AND ABUSE OF DIETARY SUPPLEMENTS FOR ADOLESCENTS – RESULTS OF A SURVEY AMONG HUNGARIAN RECREATIONAL ATHLETES

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Consumption of dietary supplements (DS) has been showing a persistent, rapidly growing tendency all over the world. A new branch has been created on the borderline of food and pharmaceutical industries. It is a general tendency that the policy and regulation towards the products of this branch are lagging far behind the practice. This is an especially important problem with adolescents. To work out an efficient regulatory framework, we have to have an adequate picture on consumer behaviour and attitudes towards these products. Based on literature analysis of two focus group interviews, we have developed a motivational model on usage of DS, which has been tested during a direct-question survey involving more than 500 respondents. Our results have proven that the consumption of DS is proliferated among young recreational athletes. One quarter of them consumes proteins, one tenth L-carnitine at least 2–3 times a week. The most important motivational factor is the improvement of sport performance. The level of confidence in these products is considerably influenced by peers and trainers. The propensity to underestimate the potentially adverse consequences of these products is high.

Keywords: attitude-scale, consumer behaviour, motivation research, nutritional supplements

Since last decades of the 20th century there is a rapid development in consumption of dietary supplements (APPLEGATE & GRIVETTI, 1997). In some estimations, the turnover of dietary supplements has increased eightfold in the last two decades (DALIRI & LEE, 2015). The DS consumption is one of the most innovative and dynamic part of food production (KUMAR et al., 2015; SAEEDI et al., 2016). The most important sub-segment of DS is products for athletes (KNAPIK et al., 2016).

There is no generally accepted, clear-cut definition of sport-nutrition supplements. According to the more than 20 years old definition of US Food and Drug Administration “A DS is a product intended for ingestion that contains a dietary ingredient intended to add further nutritional value to (supplement) the diet”. A dietary ingredient may be one, or any combination, of the following substances: a vitamin; mineral; an herb or other botanical; an amino acid; a dietary substance for use by people to supplement the diet by increasing the total dietary intake; a concentrate, metabolite, constituent, or extract. DS elements may be found in many forms such as tablets, capsules, softgels, gelscaps, liquids, or powders.” (FDA, 2015).

As we see, it is a specific contradiction, that the development and production of DS is one of the most dynamic part of the food science and industry, though we hardly know anything about this market, because (a) these products are no subjects of compulsory

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notification (PETRÓCZI et al., 2011; WALLACE, 2015); (b) the lack of a strict definition leads to over- or underreporting of supplement consumption in the surveys (RADIMER et al., 2004). Low level of knowledge of this market is well reflected in seminal paper of DORSCH and BELL (2005), who estimate the DS consumption at adolescent athlete segment by a rather wide interval: from 10% to 75%.

Prevalence of supplement use among young athletes is not as clearly documented as the consumption of these products among adult and elite athletes (Table 1), however, the knowledge of this segment is extremely important, because (a) there is an extremely large performance motivation at this generation (RUSSELL & SYMONDS, 2015), which increases the propensity to consume these products (BARKOUKIS et al., 2015); (b) the risk-perception of this generation is relative low, that is why there is a risk of abuse of these products (BACKHOUSE et al., 2013).

Table 1. Results of analysis on consumption of DS by adolescents

Author	Year	Participants	Main study findings
DOUGLAS & DOUGLAS	1984	943 athletes	Female athletes had better knowledge of nutrition but poorer food practices than males. Significant relationships between sport forms, seasons, and nutrition knowledge and food practices. Positive relationship between the number of sport seasons and nutrition knowledge and food practice scores, sport participation may be a catalyst for learning about nutrition.
KOCEJA & ELLIS	1995	507 athletes	Lack of knowledge on DS: need for sport supplement education for high school students.
DORSCH & BELL	2005	12–19-year adolescents	The most important DS: multivitamin and mineral products, protein-products and keratein. Motivations: improvement of performance and nice body.
McDOWALL	2007	review of 27 articles	Supplement usage in child and adolescent athlete population is widespread with the most frequently used supplement being a form of vitamin/mineral supplement.
ALVES & LIMA	2009	meta-analysis of 52 articles (1997–2008)	Most important motivation is to achieve the “ideal body.” Other drivers: to increase immunity, prevent diseases, improve athletic performance. The most frequently used DSs: proteins, amino acids, beta-hydroxyl-beta-methylbutyrate, microelements, carnitine, creatine, vitamins, caffeine, and bicarbonate.

As a summary it can be stated, that the DS intake is a blind spot of nutraceutical consumption research all over the world (KALRA, 2003), but this is especially true for Central-East European emerging economies: out of 330 publications, retrieved from Scopus® system, for search key-words “nutritional supplements” and “adolescents” and “sport” just 7 articles were dealing with this consumer segment (SCOPUS, 2016).

The novelty of the present article is the specificity of target group, geographic region, and the complex, quantitative model, applied for understanding the system of factors influencing the consumption of DS.

Hypothesis development

Based on literature review as well as focus-group interviews we have formulated five research hypotheses.

H₁: In line with results of numerous surveys, the most important driver of DS consumption is the improvement of sport-performance.

H₂: The general proliferation of healthy lifestyle contributes to performance and appearance enhancing substances consumption.

H₃: In line with general theory of risk-acceptance the under-estimation of potential risk of DS consumption increases the intensity of usage.

H₄: As it is proven by general adolescent nutritional behaviour results, H_{4a} the positive feedback from peers and H_{4b} from trainers increase the propensity of consumption.

H₅: There is a direct, positive effect of attitudes towards the sport as a physical activity on DS consumption.

1. Methods

1.1. Preliminary investigations

Based on critical analysis of literature, two focus-group interviews had been organized with participation of amateur (recreational), adolescent athletes. One focus group has been organized in Budapest (capital of Hungary), one in Szeged (4th largest city of Hungary, with considerable agglomeration). In the first focus group there had been 9, in the second 7 participants in age bracket of 14–18 years. The focus group members have been recruited on a voluntary base. The interviews have taken place in the room of a secondary school. After the interviews, the participants got a small present, in form of a book-voucher. The catalogue of questions applied in the interviews has been shown to a competent specialist in field of research ethics. He has determined, that the intended questions do not touch such problems (e.g. use of illegal performance enhancement drugs) that made it necessary to take specific permission from any committee or from the parents. The moderator of the interviews has been one of the authors of the current article. The interviews have been documented by tape recording, after the written permission of participants and their parents. Based on tape recordings, a verbatim transcript has been prepared for further content analysis.

1.2. Measures

In design of this questionnaire we have followed the guidelines of preparation of structural equation modelling (HOYLE, 2012): each of latent “hidden” variables have been estimated on base of at least two directly measured variables. Five attitude-related groups of questions have been developed for measuring the attitude towards the sport; perceived importance of sources of information on DS use; presumptive role of DS to preserve as well as improve the current health status, and risk perception. In construction of attitude-scales we have applied close-ended questions, measured on 1–5 Likert scale (1: strongly disagree; 5: strongly agree). This scale is widely applied in Hungarian education system, from elementary to doctoral schools.

Based on literature and focus group interviews a test-questionnaire had been developed. Based on preliminary testing with participation of 26 respondents, the final version of the questionnaire had been finalised and distributed among secondary school students.

1.3. Recruitment

Based on good partnership of Szent István University with a wide range of secondary schools, directors of 11 secondary schools had been asked to administer the filling out of the questionnaires in their schools. Out of these partner institutions 7 have been supplying 91% of questionnaires, suitable for statistical evaluation. Four of these have been general secondary schools, three vocational high schools, situating in different parts of Budapest.

A criterion of participation in the survey had been the active participation in a recreational sport, beyond the compulsory sport activity in the school.

1.4. Ethical aspects

Taking into consideration the age of respondents, we have discussed the content of questionnaire with one ethical specialist. To avoid any ethical concerns, we have omitted any allusion to illegal drugs or to family economic status.

1.5. Participants

The total number of respondents has been 569. Out of these questionnaires, 517 has been considered as suitable for evaluation. The most important characteristic features of respondents are summarised in Table 2.

Table 2. Characteristic features of respondents

Gender (distribution, %)	
Male	56.0
Female	44.0
Place of living (distribution, %)	
Village	10.0
Town	23.3
Capital	66.6
Hours, spent with sport in a week (mean)	6.9 (SD: 1.3)
Age of respondents (mean)	17.1 (SD: 2.7)
Highest accomplished qualification level of mother (distribution, %)	
Vocational school	1
High school	32
BSc	57
Highest accomplished qualification level of father (distribution, %)	
Vocational school	15
High school	23
BSc	61

Analysing the table, it is obvious, that in the sample the students learning in the capital, having a higher-average qualification in the family have been over-represented. As a general, this can be considered as a positive fact, because “two-step flow of communication” is well documented in the last decades (e.g. KATZ, 1957), that consumers living in the centrum, with an above-average socio-cultural background have a better position to influence the attitudes of the general public towards DS.

The majority of respondents have a rather intense relation with sport: the number of daily hours spent by sport activity is nearly one.

1.6. Statistical data analysis

The intensity of DS consumption has been quantified by multiplying the estimated frequency of different DSs with the number of product-types of DS consumed.

Results have been analysed by structural equation modelling. For this purpose Lavaan package of R software (ROSSEEL, 2012) has been used.

2. Results and discussion

Nearly one quarter of respondents consumes DS on a daily base, ca. 20% consumes at least one of these products at least twice in a week (Table 3). Share of occasional supplement-users is 8%, roughly half of the respondents never takes such products. Our results are in line with data of ŠTERLINKO GRM and co-workers (2012).

Table 3. Frequency of DS consumption (in % of respondents)

Frequency	Multivita- mins	Proteins	Weight control products	L-carnitine	Weight loss products	Taurine	Sport-gels
Never	52	63	85	77	88	81	89
At least once in a month	3	6	1	5	2	7	1
Once in a week	10	4	5	8	3	5	4
2–3 times in a week	11	7	2	3	3	2	2
Practically daily	23	19	7	7	4	5	3

The most frequently applied nutritional supplements are multivitamins. Distribution of protein concentrate consumption can be characterised by a bi-modal distribution: the majority of respondents never uses these products, but nearly one fifth of respondents consumes them on a daily base.

Obviously, the consumption of DS has gained an important part of nutrition intake of adolescents, that is why it is important to know the motivational base of consumption.

To understand the role of factors influencing the DS consumption we have developed a system of latent variables, based on direct-measurable variables. The basic statistical indicators of direct measured variables are summarised in Table 4.

Analysing Tables 4, it is obvious that the majority of respondents attaches a relatively high importance to healthy lifestyle, and the competitiveness is not considered as an important motivational factor. This fact highlights that the sample is dominated by recreational athletes.

Table 4. Basic statistical values of items and scales, measuring the latent variables

Likert-scale statement	Short name	Cronbach alpha	Mean	Standard deviation
Item means Item variances				
Scale, measuring the attitude towards the sport (SPORTATTITUDE)				
I regularly take place at competitions	COMPETITION	0.84	2.16	1.51
I do sport to be fit	FITT	3.37	3.94	1.48
I have fun in sport	HAVE FUN	2.15	3.63	1.45
I do sport to lose weight	WEIGHT LOSS		2.68	1.58
I do sport in order to achieve good appearance	GOOD APPEARANCE		3.93	1.36
I do sport to be healthy	HEALTH		3.91	1.39
I enjoy to do sport in community	SOCIAL		3.34	1.44
Scale, measuring the importance of sources of information (ADVICE)				
Effect on consumption: friends	FRIENDS	0.81	1.97	1.37
Effect on consumption: peers	PEERS	1.82	1.96	1.52
Effect on consumption: fitness instructor	INSTR	1.82	1.95	1.49
Effect on consumption: coach	COACH		1.65	1.21
Effect on consumption: advertisement	ADVERT		1.61	1.10
Scale, measuring the presumptive role of DS to improve the current status (NECESSARY TO ACHIEVE IMPROVEMENT)				
To achieve better shape	APPEARANCE	0.82	1.96	1.52
Performance enhancement	PERFORMANCE	2.39	2.02	1.49
Necessary for health preservation	NECESSITY	2.06	2.31	1.39
Achieve better results at competitions	CHANCE ENHANCEMENT		3.28	1.32
Scale, measuring the presumptive role of DS to preserve the current status (NECESSARY FOR STABILITY)				
It is necessary for keeping up health	HEALTH	0.79	2.52	1.77
Meal replacement	MEALREPLACEMENT	2.13	2.02	1.49
Disease prevention	PREVENTION	1.42	1.67	1.23
To cover the daily required intake	DAILY INTAKE		1.84	1.38
Scale, measuring the risk perception (RISK)				
These products are harmless	HARMLESS	0.72	2.97	1.43
These product are regularly controlled	CONTROLLED	2.78	2.48	1.31
		1.88		

The most important sources of information are friends, other sources have a relatively low influence. Of course, it should be taken into consideration, that the role of advertisement is under-estimated in case of such type of questionnaires (KIM, 1992).

In hypothesis-testing phase, when we have tried to analyse the relationship between latent variables and DS consumption, numerous models have been considered. We have accepted the model, presented in Figure 1, because it has an acceptable fit quality and the

results have been well interpretable, and in our research this approach has been applied. Of course, on base of Modification Indices a more sophisticated, better fitting model could have been achieved, but we have taken the advice of BYRNE (2010), according to whom “if a model fits well, the further modifications may simply be fitting small characteristics of the sample.”

The most important indicators of model fitting are summarised in Table 5.

Table 5. Model fit evaluation

Index	Model value	Cutoff value by HOOPER et al. (2008)
Chi-Square test	1342	
Chi-Square/DF ratio	5.31	<3 ^a
RMSEA (root mean square error of approximation)	0.062	<0.07
Goodness of Fit index	0.93	>0.95
Standardised root mean square residual (SRMR)	0.07	<0.08
Comparative Fit Index (CFI)	0.93	>0.95
Tucker-Lewis Index (TLI)	0.92	>0.90 ^a
Bentler-Bonett Normed Fit Index (NFI)	0.96	>0.95

^a HU and BENTLER, 1999

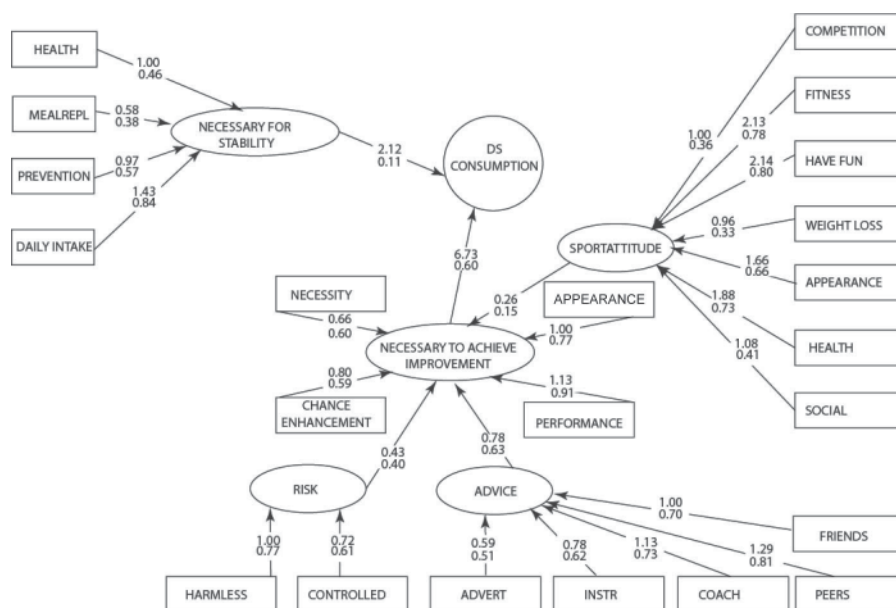


Fig. 1. Structural equation model of factors influencing DS consumption. Upper numbers indicate unstandardised coefficients, the lower ones mark standardised regression coefficients

According to HU and BENTLER (1999), who empirically examined various cut-offs for many of these measures, to minimize Type I and Type II errors under various conditions, one should use a combination of one of the above relative fit indices and the SRMR (good models <0.08) or the RMSEA (good models <0.06)

Results show that there are two main factors of consumption: the improvement of sport-performance and the motivation for healthy lifestyle. In this way, H₁ and H₂ hypotheses have been proven. It should be emphasized, that DS consumption shows a much more intense direct dependence on desire to improve sport performance than for healthy living. The risk-acceptance is relatively high, and this plays an important role in motivation of DS consumption (hypothesis H₃). In line with our previous expectations, we have been able to prove a direct, positive relationship between DS consumption and the influence of peers, friends, coaches, instructors, and advertisements (hypothesis H₄). Interestingly, the advice from physicians had not shown significant relations with “ADVICE” latent variable. Contrary to the previous concepts, we have not been able to prove a significant, direct relationship between the attitudes towards the sport activities and DS usage, hypothesis H₅ has not been proven, because models, including a direct relationship between latent variables SPORTATTITUDE and DS consumption have shown a relative low level of fitting. This fact underscores that a considerable number of adolescent recreational athletes does not consider DS consumption as a necessary precondition of sport, at least on hobby level.

3. Conclusions

The results have underlined the rather high level of vulnerability of adolescent, recreational athletes. There is a considerable “push” effect of aggressive promotional campaigns of multinational nutrition firms, coaches, and instructors, and at the same time a considerable number of young recreational athletes consider the use of DS as means of performance improvement. From this follows that there is an urgent need for (1) a clear-cut, modern definition of DS, suitable for legislation; (2) an EU level regulation; (3) targeted educational programs for “local” opinion leaders, including coaches and trainees; (4) wide-range of adaptation of such methods and practices, which are based on combination of rigorous nutritional studies and latest methods of mobile-device applications with purpose of proliferation of nutraceutical knowledge among recreational athletes. Such projects are developed, e.g. in framework of EU project SafeYou (www.Safeyou.eu).

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