Exercise dependence and eating disorders among adolescents and adults: prevalence, psychological correlations and interconnections

Doctoral School of Psychology
Program in Personality and Health Psychology

Head of the Doctoral School and Program: Prof. Dr. Attila Oláh, Csc, professor

Supervisor: Prof. Dr. Zsolt Demetrovics, DSc, professor

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Dr. Mária Hoyer, PhD., associate professor

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THEORETICAL BACKGROUND

The aim of my dissertation is to analyse exercise dependence and eating disorders as well as the relationship between these two areas from a number of perspectives. A prevalence study formed part of the investigations of these two disorders using representative samples in Hungary; psychological correlates were revealed and variables identified, through which both exercise dependence – and its primary and secondary forms, in particular – and eating disorders show similarities or can be distinguished from one another. In this context I would like to get an answer for the question whether primary exercise dependence can be considered an independent disorder.

Research on physical exercise has left no doubt that regular sporting activities performed with appropriate intensity clearly contribute to maintaining and improving physical and psychological health in every age group (Blair et al., 1989; Royal College of Physicians, 1991; United States Department of Health and Human Services, 1996; Lotan, Merrick & Carmeli, 2005; Biddle, Gorely & Stensel, 2004; Piko & Keresztes, 2006). However, as Morgan (1979) first pointed out, physical exercise may also turn into an addiction, which, like other addictions, does not aid in maintaining health; indeed, it may even be hazardous to one’s health. By now research on exercise dependence as a form of behavioural addiction (Demetrovics & Kun, 2007; Demetrovics & Kun, 2010; Kurimay & Demetrovics, 2006) has practically become an independent academic field. Although exercise dependence does not form part of diagnostic systems, criteria can clearly be identified (Griffiths, 1996, 1997, 2002), which help us to draw the line between recreational sport and exercise addiction (Berczik et al, 2014a). Researchers have created a number of measurement tools to examine the phenomenon. A number of surveys have been conducted to measure the incidence of exercise dependence; however, this area poses a serious challenge, since such surveys have used a number of different measurement tools and measured highly divergent, often small populations. Mónok et al. (2012) carried out the only nationally representative survey examining exercise dependence up to now.

As for the aetiology of the phenomenon, some researchers have emphasised biological factors (Thompson & Blanton, 1987; de Vries, 1981; Cousienau et al., 1977), while others have stressed psychological factors. Of the latter, affect regulation hypothesis (Hamer & Karageorghis, 2007), theories focusing on the role of reinforcement (Bozarth, 1994) and the cognitive appraisal hypothesis (Szabo, 1995) all stand out. Of the further possible psychological correlations of exercise dependence, certain authors place emphasis on the role of self-esteem (Hausenblas & Giacobbi, 2004; Rudy & Estok, 1983; Tucker, 1982; Tucker & Maxwell, 1992), heightened level of anxiety (Spano, 2001), obsessive-compulsive functioning (Davis et al., 1995) or dissatisfaction with body image (Hurst et al., 2000; Pope et al., 1997).

The last area, dissatisfaction with body image, leads us to the second major topic discussed in the dissertation, eating disorders, and points to the problem of the coincidence of exercise dependence and eating disorders, thus constituting the third area of inquiry of the study.

The area of eating disorders has been investigated on a number of occasions due to the prevalence and variety of eating disorders and the serious health risks involved. Changes introduced to the DSM-5 (APA, 2013) on diagnostic criteria for eating disorders represent an important and current innovation. A number of measurement tools have been created to assess eating disorders, some of which are used in clinical studies and others in epidemiological
research. The latter comprise a significant segment of the research on eating disorders. By introducing the prevalence of the disorder, epidemiological studies call attention to the significance of prevention and treatment as well. From this perspective, research on representative samples is highly relevant. International research has drawn attention to the fact that eating disorders are no longer illnesses exclusive to women in developed Western societies, as was once thought; they also increasingly occur outside of Western countries and among men as well. Epidemiological studies of eating disorders in Hungary were carried out by Szumska et al. (2001, 2005) on a representative sample of women aged 15–24 and on an adult sample within the Hungarostudy 2013 research project by Túry et al. (2013).

Another advantage of complex theories is that they offer a broader framework for interpretation of what we call selective theories – which emphasise the role of one specific factor in the aetiology of eating disorders. The most well-known of the selective theories are the biological theories (Cummings & Overduin, 2007; Dhillo, 2007; Kaye & mtsai, 1991; Smeets & Kosslyn, 2001; Uher et al., 2006), the cognitive-behavioural theory (Fairburn, 1981; Slade, 1982; Fairburn et al., 2003; Waller et al., 2004; Cooper, 2005), psychoanalytic theories (Lane, 2002; Dare & Crowther, 1995; Skarderud, 1999) and the system theory (Bruch, 1966; Marcus & Wiener, 1989; Vandereycken, 1995) as well as theories of aetiology for eating disorders, which view them as constituting part of the spectrum of some known psychiatric disease, for example, depression (Pollice et al., 1997; Herzog, 1984; Corcos et al., 2000; Bushnell et al., 1994). Another stimulating area of inquiry is the link between self-esteem and eating disorders (Button et al., 1996; Gual et al., 2002; Halvorsen & Heyerdahl, 2006). This area is particularly relevant, as I have already pointed out, because the correlation between exercise dependence and self-esteem is currently being studied.

Another fascinating research area focuses on the comorbidity, similarities and differences in eating disorders and exercise dependence. Data from previous studies indicates that problems with eating behaviour are often accompanied by an excessive amount of exercise, with the converse also holding true: people suffering from exercise dependence are often excessively focused on their body image, weight and control over their diet (Blaydon & Lindner, 2002; Klein et al., 2004; Lyons & Cromey, 1989; Sundgot-Borgen, 1994). However, De Coverley Veale (1987) has distinguished between primary and secondary exercise dependence. In the case of primary exercise dependence, there is no comorbid eating disorder, while in the case of secondary exercise dependence, exercise dependence develops secondarily to eating disorder. The presence of primary exercise dependence as an independent disorder has raised questions among a few authors. According to some researchers (Bamber et al., 2000), primary exercise dependence cannot essentially be regarded as an independent pathology; they maintain that exercise that meets the criteria for dependence can always be tied to eating disorder. Others (Blaydon & Lindner, 2002), however, consider the phenomenon of primary exercise dependence as distinct from that of secondary exercise dependence.

**AIMS**

I focus on two major areas in my dissertation, exercise dependence and eating disorders, and on an investigation of the relationship between them. My research topic essentially derives from a study of the literature that analyses exercise dependence, specifically primary exercise dependence...
dependence and secondary exercise dependence, which is accompanied by eating disorder (De Coverley Veale, 1987). As a first step, having examined the phenomenon in a special sample of exercisers in Hungary, I was interested in the question of whether my analysis would support the existence of primary exercise dependence as a psychological construct.

Based on the literature, secondary exercise dependence shows close ties to eating disorders (De Coverley Veale, 1987; Blaydon & Lindner, 2002; Bamber & mtsai., 2000); it was therefore justified to include an examination of eating disorders in the research.

The prevalence study is one of the cornerstones of scholarly research on various disorders. The prevalence of exercise dependence in previous research has been analysed through a number of measurement tools and on a range of populations. However, no analysis has been carried out to date on a national representative sample. Therefore, it was entirely justified to carry out a survey on such a sample. With regard to the prevalence of eating disorders, there has been research on representative samples both domestically and internationally. However, in Hungary, no studies have been carried out on a representative sample of adolescents. That is why it was particularly important to measure the prevalence of eating disorders within this population along with its psychological correlates, since this age group is particularly at risk with regard to these disorders, given that anorexia nervosa typically begins between the ages of 12 and 18 and bulimia nervosa does so between the ages of 15 and 25 (Türy, 2015).

One of the key goals was to adapt internationally acknowledged measurement tools for examining exercise dependence to Hungary, since there had so far been no proper questionnaire with the appropriate psychometric indicators to measure exercise dependence in Hungarian, although a number of them had been used abroad. Within the research framework of the National Survey on Addiction Problems in Hungary (OLAAP) (Paksi, Arnold, Kun & Demetrovics, 2011; Paksi, Rózsa, Kun, Arnold & Demetrovics, 2009), validation of two internationally recognised measurement tools that assessed exercise dependence, the Exercise Dependence Scale (EDS) (Hausenblas & Symons Downs, 2002; Demetrovics & Kurimay, 2008) and the Exercise Addiction Inventory (EAI) (Griffiths, Szabo & Terry, 2005; Terry, Szabo & Griffiths, 2004; Demetrovics & Kurimay, 2008) has been completed. Moreover, since, to our knowledge, the incidence of exercise dependence in Hungary had not yet been measured through a national representative sample, the goal was to determine the prevalence of exercise dependence with the measurement tools that had already been validated.

The second part of my empirical studies consists of research conducted within the 2011 ESPAD (European School Survey Project on Alcohol and other Drugs) (Elekes, 2012; Elekes & Domokos, 2011, Gyepesi et al., 2013) study. My goal within this study was also to use the data collected through the current research to examine the factor structure of the SCOFF questionnaire (Morgan, Reid & Lacey, 1999), which is often used both in domestic and international research on eating disorders. Moreover, I wished to measure the incidence of eating disorders on a representative sample of adolescents in Hungary, since, to my knowledge, no such analysis had been conducted so far. Another aim of my study was to examine the psychological correlations of eating disorder and to analyse the variables that distinguish people with eating disorders from those without them. Finally, in order to gain a better understanding of the possible background factors of eating disorders, I used a path analysis to test a theoretical model related to variables that increase the chance for the development of eating disorders.
In the third part of the study, I analysed the phenomenon of exercise dependence from various perspectives on a special sample of thousands of exercisers, people who engage in regular exercise but are not professional athletes. Like most behavioural addictions, exercise dependence is a low-prevalence phenomenon. Thus, it was justified to conduct a study of a special sample to reach a relatively large population with this problem. In my research, I wished to measure the prevalence of exercise dependence and eating disorders within a special sample of exercisers, and I was also attempting to determine the link between the two types of exercise dependence – primary and secondary – and between each of them and eating disorders and to ascertain the psychological variables that distinguish these disorders. I hope that my research has also contributed to the clarification of the problem of whether primary exercise dependence can be considered an independent disorder or not.

EMPIRICAL STUDIES

1. Research: Adaptation of the Exercise Dependence Scale (EDS) and the Exercise Addiction Inventory (EAI). Survey of the prevalence of exercise dependence in a representative sample in Hungary

1.1. Study - Adaptation of the Exercise Dependence Scale (EDS) and the Exercise Addiction Inventory (EAI)

1.1.1. Aims

One of the most important aims of the research was to adapt measurement tools acknowledged internationally to assess exercise dependence in Hungary since there had been no measurement tool in this regard available in Hungarian with the proper psychometric indicators. Since the Exercise Dependence Scale (EDS) (Hausenblas & Symons Downs, 2002, Demetrovics & Kurimay, 2008) and the Exercise Addiction Inventory (EAI) (Griffiths, Szabo & Terry, 2005; Terry, Szabo & Griffiths, 2004, Demetrovics & Kurimay, 2008) have proved to be valid and reliable measurement tools in international practice, the aim was to adapt these to Hungary.

1.1.2. Method

1.1.2.1. Participants and procedure

We gained access to a sample that had been examined through the National Survey on Addiction Problems in Hungary (OLAAP)\(^1\) (Paksi, Arnold, Kun & Demetrovics, 2011; Paksi, Rózsa, Kun, Arnold & Demetrovics, 2009) conducted in 2007. This was a representative sample of the Hungarian population aged 18–64 (6,703,854 persons). The sample which represented adequately the target population consisted of 3,183 persons. The clean sample

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\(^1\) The research was carried out under a contract with and with funding from the National Drug Prevention Institute and the National Drug Focus Point under the leadership of the Centre for Behavioural Research at the Institute of Behavioural Science and Communication Theory at the Corvínus University in Budapest (Borbála Paksi) in cooperation with the Institutional Group on Addiction Research at the Institute of Psychology at Eötvös Loránd University (Zsolt Demetrovics) in Budapest. Researchers participating in the project also included Petra Arnold, Bernadette Kun and Sándor Rózsa.
size consisted of 2,710 participants (response rate: 85.1%). Out of the total OLAAP sample, the analysis for my dissertation involved those who indicated that they engaged in some kind of exercise with at least weekly regularity. Altogether there were 474 such individuals (17.5% of the total population examined as part of the OLAAP project). The sample consisted of 270 men (57%) and 204 women. The average age was 33.2 years (SD=12.1).

1.1.2.2. Measures

The complete OLAAP research featured a test battery with over 800 questions, which addressed a number of areas. The questions regarded substance use behaviours, behavioural addictions, sociodemographic data and specific personality dimensions.

Two tools were used to measure exercise dependence: the Exercise Addiction Inventory and the Exercise Dependence Scale.

*Exercise Addiction Inventory*

The Exercise Addiction Inventory (EAI) (Terry, Szabo & Griffiths, 2004; Demetrovics & Kurimay, 2008) is a short measurement tool comprising six statements that were designed to be indicative of core addictive behaviour components. Each item is rated on a five-point Likert-scale.

*Exercise Dependence Scale*

The Exercise Dependence Scale, EDS) (Hausenblas & Symons Downs, 2002; Symons Downs, Hausenblas & Nigg, 2004; Demetrovics & Kurimay, 2008) is a multidimensional theoretical-based measure of exercise-dependence. The items refer to current exercise beliefs and behaviours. The response options were on a 6-point Likert-type scale.

1.1.2.3. Statistical analysis

The present study sought to examine the factorial and the concurrent validity of the two different exercise addiction inventories, namely the AEI and the EDS. Confirmatory factor analyses (CFA) were performed separately with both measures with MPLUS 6.0. Maximum likelihood estimation with robust standard errors (MLR) was used because of non-normal data in both cases (Muthén & Muthén, 1998-2007). Reliability was assessed by Cronbach’s alpha.

1.1.3. Results

1.1.3.1. Confirmatory factor analysis of the Exercise Addiction Inventory (EAI)

A confirmatory factor analysis was performed with the six items of the EAI in the regular exercisers (N = 465), and tested the onefactor solution. The fit indices indicated good fit($\chi^2=20.2$ df=9 $p=0.016$; $CFI=0.971$; $TLI=0.952$; $RMSEA=0.052$ $[0.021–0.082]$; $CFit=0.418$; $SRMR=0.029$). No modification indices were found above the minimum value. Factor loadings overall were moderate in the 0.38 to 0.72 range. This one-factor solution clearly confirms the theoretically proposed structure of this scale. Internal consistency was adequate in this sample (Cronbach alpha=0.72).
1.1.3.2. Confirmatory factor analysis of the Exercise Dependence Scale (EDS)

To examine the factor structure of the EDS, a confirmatory factor analysis was performed to test the original 7-factor solution (N=458) (Hausenblas & Symons Downs, 2002). Fit indices indicated adequate fit to the data ($\chi^2=351.9$, df=168, p<0.0001; $\text{CFI}=0.938$; $\text{TLI}=0.922$; $\text{RMSEA}=0.049$ [0.042–0.056]; Cfit=0.590; SRMR=0.052). Factor loadings ranged between 0.45 and 0.88. The range of internal consistencies (Cronbach a) of the subscales is between 0.62 and 0.88 in this sample.

1.1.3.3. Concurrent validity of the Exercise Addiction Inventory (EAI)

Confirmatory factor analysis was performed to assess the concurrent validity of EAI using the EDS in the model description. The solution presented an adequate fit to the data ($\chi^2=651.724$, df=291, p<0.0001; $\text{CFI}=0.908$; $\text{TLI}=0.897$; $\text{RMSEA}=0.052$ [0.046–0.057]; Cfit=0.306; SRMR=0.055). The correlation between the two measures was high ($r = 0.79$) supporting the convergent validity of both scales.

1.1.4. Discussion

In the present study, validation of two exercise addiction measures was carried out. Original factor structures of both inventories were confirmed and the two measures, in line with the expectations, showed high correlation.

1.2. Study - A survey of the prevalence of exercise dependence in a representative sample in Hungary

1.2.1. Aims

Since the prevalence of exercise addiction had not yet been measured in a national representative sample, either in Hungary or internationally, the aim of the current study was to do so using a representative sample in Hungary with measurement tools that had already been validated.

1.2.2. Method

1.2.2.1. Participants and procedure

The sample is identical to that described in Section 1.1.2.1.

1.2.2.2. Measures

The analysis relied on the Exercise Dependence Scale and Exercise Addiction Inventory described in the analysis in Section 1.1.

1.2.2.3. Statistical analysis

The sensitivity analysis was based on EDS as criteria. sensitivity and specificity values were calculated for several EAI cut-off points. In order to explore the probability that the EAI will give the correct “diagnosis”, the positive predictive values (PPV), the negative predictive values, (NPV) and the accuracy values were calculated for several EAI cut-off points.
receiver operating characteristic curve analysis (ROC analysis) was obtained to establish the threshold or cut-off.

1.2.3. Results

1.2.3.1. Surveying the prevalence of exercise dependence based on the original EDS and EAI classification system

Based on the original classification systems of EDS and EAI, the prevalence data were assessed and their confidence intervals for both measures in exercising population and in the general population as well. According to the EDS, 38.1% - [33.7–42.6] of exercisers (6.2% - [5.4–7.2] of the total sample) could be characterized as nondependent-symptomatic exercisers. According to the EAI, 61.0% - [56.5–65.4] (10.1% - [9.0–11.3] of the total sample) could be characterized as nondependent-symptomatic exercisers. The proportion of exercisers at-risk of dependence is 1.9% [1.0–3.7] among exercisers and 0.3% [0.1–0.6] in the general population as measured by the on EDS. Estimation based on the EAI resulted in slightly higher rates for being at-risk for dependence, that is 3.2% [2.0–5.3] in the case of regular exercisers and 0.5% [0.3–0.9] in the case of the total sample. EDS and EAI thus provided different estimations about the proportion of nondependent-symptomatic exercisers and exercisers at-risk of dependence that can be explained by the lack of empirically based cut-off scores for EAI.

1.2.3.2. Calculating the threshold of the Exercise Addiction Inventory (EAI)

Based on EDS as criteria, the sensitivity, specificity, the positive and negative predictive values, and the accuracy for EAI were calculated at several cut-off points in order to establish the most optimal thresholds. cut-off at 13, as suggested by Terry et al. (2004), results in acceptable sensitivity (89% in this sample) with rather low specificity (53%), accuracy is only 63% at this point. At the next cut-off point at 14, accuracy is better (69%) with a still acceptable sensitivity (82%) and better specificity (59%). Accuracy reaches its best value at 16, but sensitivity decreases to 61% at this point. Lower cut-off points were also examined. The cut-off point 12 shows also a better accuracy than the original 13 do, with an excellent sensitivity (94%), but with an unacceptable specificity (44%).

To find the best cut-off point, ROC analyses were performed for all possible EAI cut-off points, with what could be sufficient to describe the full range of screening performance of the test.

The empirical ROC curve that provides the evidence forthe ability of the EAI to discriminate between participants who are classified asymptomatic (non-cases) and individuals who are classified nondependent symptomatic or at-risk by the EDS. The best performance of EAI in this discrimination was at an EAI observed test value of 14. The overall performance of the EAI was measured by the Area Under the Curve value (AUC). The AUC was 0.794 [0.754-0.835] with its 95% CI. Both its confidence interval and a statistical test under the nonparametric assumption confirmed that this area is significantly different from 0.50 (p < 0.0001).

To identify the threshold for the EAI to discriminate well between asymptomatic/non-dependent symptomatic and at-risk classified individuals another ROC analysis was performed. The best performance of EAI was at the test value of 24. The AUC was 0.957
[0.909-1.00] with its 95% CI. Statistical test (under the nonparametric assumption) confirmed that this area is significantly different from 0.50 (p < 0.0001).

1.2.3.3. Surveying the prevalence of exercise dependence based on modified limit values

Calculating the proportion of asymptomatic, non-dependent symptomatic, and at-risk classified individuals with new thresholds (0-13= asymptomatic; 14-23= symptom non-dependent; 24-30= at risk from exercise dependence) resulted that 44.8% [40.4-49.4] of exercisers (7.4% [6.5-8.5%] of general population) could be characterized as asymptomatic, 52% [47.5-56.6] (8.6% [7.6-9.7%] of total sample) could be described as nondependentsymptomatic exercisers, and 3.2% [2.0-5.3%] (0.5% [0.3-0.9%] of total sample) could be classified as at risk from exercise dependence according to the new cut-off points of EAI.

1.2.4. Discussion

In the present study cut-off points of EAI were defined using the EDS, a scale based on the DSM-IV psychoactive substance use dependence criteria. Based on the results of ROC analyses, raising cut-off points of EAI by one point appears to be reasonable in case of differentiating between nondependent symptomatic and asymptomatic persons.

Furthermore, the study was the first ever national prevalence survey examining exercise addiction.

The results presented here (using a nationally representative sample) now confirm the hypothesis suggested in earlier studies, that exercise addiction does not belong to the group of frequent disorders among general population (Sussman et al., 2011). On the basis of results obtained with the two questionnaires, 0.3-0.5% of population is involved seriously, which equates to 1.9%-3.2% of weekly regular exercisers. Given that earlier studies have been carried out on very different samples and prevalence rates were highly variable (see Berczik et al., 2012). However, samples in previous studies that most resemble the present study’s sample gave similar results. (Griffiths, Szabo & Terry, 2005; Hausenblas & Symons Downs, 2002).

2. research: A study of the incidence and psychological correlates of eating disorders in a representative sample of adolescents in Hungary

2.1. study: A confirmatory factor analysis of the SCOFF questionnaire

2.1.1. Aims

Since one of the main goals of the current research was to measure the prevalence of eating disorders, as a first step my goal was to check the factor structure of the SCOFF questionnaire used for the measurement (Morgan, Reid & Lacey, 1999).

2.1.2. Method
2.1.2.1. Participants and procedure

Students who participated in the 2011 ESPAD survey\(^2\) (European School Survey Project on Alcohol and other Drugs) constituted the study sample. The target group for the survey comprised students born in 1995, who had turned 16 in the data collection year.

The research included students who participated in conventional full-time institutional schooling. 95.5% of the 16-year-old population at schools and 95.3% of the total 16-year-old population were accessible at the time of the data collection (Elekes, 2012; Elekes & Domokos, 2011; Gyepesi et al., 2013). The sample was representative with regard to type of school, grade and geographic region as well. It was necessary for the data to be weighted in order to balance out deviations which resulted from participants dropping out of the groups sampled.

7,437 student respondents were reached during the research period. 83 of them were deleted from the database due to unreliable completion of the questionnaire. The SCOFF questionnaire, which is key from the perspective of my analysis, was not administered among students in Year 8 or among those at vocational schools because it had proved to make the full inventory too long for them and they were thus unable to keep to the 45-minute timeframe. This affected 2,313 students.

The sample included in the current analysis is a representative sample of high school students in Years 9 and 10 (from grammar schools and vocational schools), altogether 5,041 participants. 73 students either did not complete the SCOFF questionnaire, so important for the analysis, or only partially filled it in (Morgan, Reid & Lacey, 1999). Also, the body mass index for two other individuals was unrealistic (BMI was also a very important part of the analysis), so I deleted their data. Deleting 75 people thus represented a 1.48% loss for the database of 5,041 participants.

After deleting these participants, 4,966 people remained; I completed the statistical analysis using their data. The sample included 4,966 participants, of whom 2,534 were male (51.03%) and 2,432 were female (48.97%). Their average age was 16.41 years (min=15, max=23; SD=0.866). 2,457 participants (49.47%) attended grammar schools and 2,509 (50.53%) were enrolled in vocational schools.

2.1.2.2. Measures

The ESPAD inventory used in Hungary contains all the questions from the original, core, English-language questionnaire and is supplemented by 57 questions which mainly focus on behavioural addictions. The final version of the inventory consisted of 294 items.

In the current analysis of the various questionnaires, I used the SCOFF questionnaire (Morgan, Reid & Lacey, 1999), which is designed to measure eating disorders.

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\(^2\) The research was carried out under the leadership of Zsuzsanna Elekes from the Corvinus University in Budapest in collaboration with the the ECHO Survey Sociological Research Institute (Tamás Domokos) and the Departments of Clinical Psychology and Addictology, Institute of Psychology, Eötvös Loránd University, Budapest. The research was funded by the Hungarian OTKA grant (K81353) and the National Drug Focus Point.
The SCOFF questionnaire is a short, easily administered measurement tool created to assess eating disorders. It consists of five questions, each of which can be answered with a “yes” or “no”, with each “yes” being worth one point. Two or more points indicate a suspicion of an eating disorder. SCOFF is not a diagnostic test, but a screening tool. Besides cases of anorexia and bulimia, the questionnaire also indicates so-called EDNOS cases as well (Luck & Mtsai., 2002; Garcia-Campayo & Mtsai., 2005).

2.1.2.3. Statistical analysis

I carried out a one-factor confirmatory factor analysis (CFA) of the five items on the SCOFF questionnaire (Morgan, Reid & Lacey, 1999) using the MPLUS 6.0 statistical software (Muthén & Muthén, 1998-2011). Since the indicator variables were categorical, I used the weighted least squares means and variance adjusted estimation method (WLSMV) for estimation during the confirmatory factor analysis.

2.1.3. Results

The comparative fit indices indicated an acceptable fit ($\chi^2=77.8$ df=5 $P<.0001$; CFI=0.959; TLI=0.918; RMSEA=0.054 [0.044-0.065] Cfit>0.90 pclose=0.241). The factor loadings were moderate, falling in the 0.38–0.74 range. Reliability was relatively low (Cronbach’s $\alpha=0.51$).

2.1.4. Discussion

The factor structure of the questionnaire was confirmed during the analysis. The relatively low reliability value may be explained by the weakness of the second item on the instrument.

2.2. study: Calculating the prevalence of eating disorders, particularly anorexia nervosa and bulimia nervosa

2.2.1. Aims

In this study, I wished to measure the incidence of eating disorders, particularly anorexia nervosa and bulimia nervosa, on a representative sample of adolescents in Hungary, since to my knowledge no such examination had yet been carried out.

2.2.2. Methods

2.2.2.1. Participants and procedure

The sample is identical to that described in Section 2.1.2.1.

2.2.2.2. Measures

During the study, I used the SCOFF questionnaire described in Section 2.1., and I also considered questions regarding weight and height to calculate the participants’ body mass index (BMI). These questions were as follows:

- “What is your body weight? (If you don’t know exactly, please give an estimate.)”
- “How tall are you? (If you don’t know exactly, please give an estimate.)”
2.2.2.3. Statistical analysis

I administered the SCOFF questionnaire (Morgan, Reid, Lacey, 1999) to measure the incidence of eating disorders. I used the SPSS 20.0 statistical package (IBM Corp. Released, 2011) for the analysis.

Moreover, I also found it important to measure the proportion of the incidence of anorexia nervosa and bulimia nervosa among the eating disorders indicated by the SCOFF questionnaire within the population I studied. In calculating the incidence of the two disorders, I considered the system of criteria developed by Túry et al. (2013). In addition, when judging the severity of anorexia nervosa, I took into account the recommendation in the DSM-5 (APA, 2013), according to which the level of severity of anorexia nervosa among children and adolescents is based on the BMI percentage defined by the WHO.

2.2.3. Results

The incidence of eating disorder

Based on the SCOFF questionnaire, 4,025 participants, that is, 81.06% of the total sample, have no symptoms of eating disorder (referred to as “non-eating disorder”). 941 individuals, 18.94% of the entire sample, may be classified as likely to suffer from an eating disorder (referred to as “eating disorder”). 1,759 females, 35.42% of the entire sample, and 2,266 males, that is, 45.63% of the entire sample, show no signs of eating disorder. 672 females, 27.63% of the female sample (13.53% of the entire sample), and 269 males, 10.62% of the male sample (5.41% of the entire sample), fall into the category of being likely of suffering from an eating disorder.

The incidence of anorexia nervosa

The rate of the likelihood of anorexia nervosa was 0.38% in the female sample (9 participants) (0.18% of the entire sample). Anorexia nervosa was likely among 0.12% of the males (3 participants) (0.06% of the total sample).

The incidence of bulimia nervosa

The prevalence of bulimia nervosa within the female sample is 2.92% (71 participants) (1.43% of the total sample), and that figure is 1.18% (30 participants) (0.60% of the total sample).

2.2.4. Discussion

Proportions of eating disorders indicated only by the SCOFF questionnaire (Morgan, Reid & Lacey, 1999) during the survey can be considered very high in relation to Hungarian and international data on prevalence with regard to the incidence of anorexia nervosa and bulimia nervosa. The second analysis, in which I only measured the incidence of AN and BN, produced a prevalence value that was in agreement with the Hungarian and international data regarding the two disorders. These numbers indicate that, in this case, the SCOFF questionnaire also indicates cases of eating disorders that differ from anorexia nervosa and bulimia nervosa, similarly to other research (Luck & mtsai., 2002; Garcia-Campayo & mtsai., 2005), in which the inventory also indicated so-called EDNOS cases in addition to cases of anorexia nervosa and bulimia nervosa. In all probability, participants diagnosed in DSM-4 (APA, 1994) as “Eating Disorder Not Otherwise Specified” and in DSM-5 (APA, 2013) as “Unspecified Feeding or Eating Disorder”, “Other Specified Feeding or Eating Disorder” or
“Binge Eating Disorder” are also flagged by the questionnaire. In order to determine the likelihood of other types of eating disorders that may have come to light in our case, a two-step study would have been called for: personal interviews following the questionnaire may have aided in clarifying any problems.

2.3. study: A comparison of the eating disorder group with the non-eating disorder group with regard to gender, symptoms of depression, self-esteem and satisfaction with relationship with parents

2.3.1. Aims

The goal of my study was to ascertain the psychological correlates in eating disorders and to determine which psychological variables distinguish people with eating disorders from those without them.

2.3.2. Methods

2.3.2.1. Participants and procedure

The sample was identical to that described in Section 2.1.2.1.

2.3.2.2. Measures

During the study, I identified eating disorders using the SCOFF questionnaire (see Section 2.1.) and analysed depression, self-esteem and satisfaction with relationship with parents using the following measurement tools and questions:

- Center for Epidemiological Studies Short Depression Scale (CES-D) (Radloff, 1977), which measures symptoms of depression.
- Rosenberg Self-Esteem Scale (RSES) (Rosenberg, 1965) to assess self-esteem.
- Questions regarding satisfaction with the relationship with one’s mother and father. The ESPAD inventory contained questions regarding the extent to which the participant is generally satisfied with his/her relationship with his/her mother and father.

2.3.2.3. Statistical analysis

During the procedure, I compared the two groups based on the variables. For the analysis, I used the SPSS 20.0 statistical package (IBM Corp. Released, 2011). In the case of continuous variables, I performed a two-sample t-test and calculated the Cohen’s d. In the case of the nominal variable (gender), I calculated a chi-square test and an Odds ratio. Because of the difference in the number of members in the two groups and the non-normal distribution of the variables I also conducted the analysis with a nonparametric test (Mann–Whitney U-test).

2.3.3. Results

The differences between the two groups were significant to the same extent in the case of each variable examined (p<0.0001) on both parametric and nonparametric tests. The role of gender is decisive: females have three times the odds of showing signs of eating disorder over males (Odds ratio=3.22). In the case of people with eating disorders, a larger degree of depression and a lower degree of self-esteem are present than in the non-eating disorder group.
and they account for a greater level of dissatisfaction both in connection with their mothers and their fathers.

2.3.4. Discussion

The results are in complete agreement with findings in the literature. Eating disorders have traditionally been considered to be a female condition (Túry, 2015). My analysis also supports this conclusion: the chance for the incidence of eating disorders is three times more likely for females than for males.

Low self-esteem has been considered a correlate to eating disorders by a number of studies (Mayhew & Edelmann, 1989; Fisher & mtsai., 1991; Williams & mtsai., 1993; Joiner & Kashubeck, 1996; Vohs & mtsai., 1999) or a predictor (Button & mtsai., 1996; Cervera & mtsai., 2003; Gual & mtsai., 2002). Based on a comparison of the groups conducted on the ESPAD sample, the difference is clearly noticeable in this regard: in the case of the group with eating disorders, self-esteem is significantly lower.

Based on research on the coincidence of depression and eating disorders, it can generally be stated that the average points for patients with eating disorders tend to be higher on the scale for depression (Walsh & mtsai., 1985; Bushnell & mtsai., 1994; Pollice & mtsai., 1997). In agreement with the data in the literature, the value for depression within the group with eating disorders is significantly higher in the ESPAD sample examined.

Studies support the perspective of the systemic model (Bruch, 1966; Marcus & Wiener, 1989; Vandereycken, 1995), which emphasises the significance of in-family relations in the case of eating disorders: participants with eating disorders indicated a higher level of dissatisfaction with both parents than those with no eating disorders. My results are in agreement with research findings, according to which people with eating disorder describe their relationship with their parents in negative terms (Humphrey, 1986; Calam & mtsai., 1990; Canetti & mtsai., 2008).

2.4. study: A path analysis of variables that increase the chances of the development of eating disorders

2.4.1. Aims

In order to gain a better understanding of the possible background factors behind eating disorders, I used a path analysis to test a theoretical model tied to variables that increase the chances of the development of eating disorders.

2.4.2. Methods

2.4.2.1. Sample

The sample is identical to that described in Section 2.1.2.1.

2.4.2.2. Measures

During the study, I worked with data acquired through the SCOFF questionnaire, the CES-D inventory, which measures depression (Radloff, 1977), the Rosenberg Self-Esteem Scale used
to measure self-esteem (Rosenberg, 1965), and *questions regarding satisfaction with the relationship with parents.*

### 2.4.2.3. Statistical analysis

During the path analysis, I used the MPLUS 6.0 statistical software (Muthén & Muthén, 1998-2011) and the WLSMV estimation method to test the theoretical model tied to variables that increase the chances of the development of eating disorders. I calculated the Odds ratio with the MLR estimation method. The output variable of the fully saturated model was the eating disorder. The two explanatory variables were the gender and the dissatisfaction with the relationship with the mother. The two mediating variables were depression and self-esteem. I introduced every variables as observed variables in the analysis.

### 2.4.3. Results

The likelihood of eating disorders is influenced exclusively in indirect ways by dissatisfaction with the relationship with the mother. The direct relationship between the two variables is not significant. Indirect relation, however, is bidirectional. On the one hand, the greater the dissatisfaction with the relationship with the mother, the greater the chance is that depression occurs, thus increasing the possibility of the incidence of eating disorders (the rate of the indirect way is 0.065, p<0.001). On the other hand, the relationship with the mother may also have an influence via self-esteem. The greater the dissatisfaction with the relationship with the mother, the lower the detectable self-esteem. Self-esteem in turn has an inverse relationship with the likelihood of eating disorder: the lower the self-esteem, the more likely it is that an eating disorder can be detected. The rate of the indirect way via self-esteem is 0.052, p>0.001.

Between gender and eating disorder, however, both direct and indirect paths exist. The influence of the direct path is more powerful. Gender influences eating disorders indirectly both through depression and self-esteem. In the case of the direct influence, the chances for the development of eating disorders is greater among females than among males. The indirect path calls attention to the fact that depression, which is more likely to present among females, increases the chance of the incidence of eating disorders. The rate of the indirect way via depression is 0.053, p<0.001. Furthermore, in the case of females, low self-esteem, which has a greater chance of detection, increases the likelihood of the presence of eating disorders. The rate of the indirect way via self-esteem is 0.052, p<0.001.

The study has demonstrated an oppositional relationship between depression and self-esteem: the greater the self-esteem is, the lower the chance of depression and vice-versa. The results of the path analysis are illustrated in Fig. 1.

Based on the Odds ratios, we can see that gender – whether the person is a female – has the greatest impact on increasing the chance of detecting eating disorders in the case of the individual (Odds ratio=2.20). The role of gender is followed in order by the presence of symptoms of depression (Odds ratio=1.16), then by dissatisfaction with the relationship with the mother (Odds ratio=0.93), and finally by self-esteem (Odds ratio=1.00).
Fig. 1. The results of the path analysis for variables that increase the chances of eating disorders

2.4.4. Discussion

With regard to gender, the path analysis points out that gender has not only direct impacts on the chances of the development of eating disorders, but also indirect impacts. Moreover, in the latter case, the impact is even stronger. The direct path indicates that depression is more likely to occur among females, and the chance of lower self-esteem is also greater. Both factors increase the chances of developing eating disorder. Females are therefore more vulnerable and at risk in various respects with regard to eating disorders.

In connection with depression, based on the path analysis, it may be concluded that the development of depression may lead to eating disorders.

The path analysis shows dissatisfaction with the relationship with the mother to be a decisive factor. This variable influences the likelihood of the development of eating disorder indirectly. Dissatisfaction with the maternal relationship increases the chances of the development of depression and of low self-esteem (and these two are also linked), which make the incidence of eating disorder likely.
3. research: A study of primary and secondary exercise dependence and eating disorder in a special exerciser sample: incidence and links

3.1. study: A survey of the prevalence of eating disorder and primary and secondary exercise dependence and a distribution of these disorders in a special exerciser sample

3.1.1. Aims

In this study, my aim was to measure the prevalence of exercise dependence and eating disorder as well as their relative distribution on a few thousand-strong special sample of exercisers. Like other behavioural addictions, exercise dependence is a low-prevalence phenomenon. Therefore, in order to reach a relatively large problem population, it was justified to conduct research on a special exerciser sample.

3.1.2. Method

3.1.2.1. Participants and procedure

The sample consisted of individuals who were guests of frequented gyms in Budapest and triathletes. The complete exerciser sample consisted of 2,823 participants. Of these, I was able to include information from 2,655, since they were the ones who filled out the SCOFF and EDS inventories, which were of key significance to the study.

The sample consisted of 1,146 males (43.16%) and 1,509 females (56.84%). Their average age was 31.50 years (SD=8.47; min=18, max= 61).

3.1.2.2. Measures

During the study, I used the Exercise Dependence Scale (EDS) for exercise dependence (Hausenblas & Symons Downs, 2002; Symons Downs & mtsai, 2004; Demetrovics & Kurimay, 2008) and the SCOFF questionnaire for eating disorder (Morgan, Reid, Lacey, 1999).

3.1.2.3. Statistical analysis

As a first step, I created four groups out of the sample, and I classified the participants into those four groups based on their responses to the two questionnaires described above.

1. Control: no exercise dependence and no eating disorder.
2. Eating disorder: eating disorder but no exercise dependence.
3. Primary exercise dependence: exercise dependence but no eating disorder.

3.1.3. Results

81.17% (2,155 participants) of the sample under examination are not characterized by eating disorders or exercise dependence – they can be regarded as the control group for the two disorders. 14.46% (384 participants) of the sample show signs of eating disorder only. 2.67% (71 individuals) from the sample have exercise dependence only – they have primary exercise dependence. The smallest group in the sample consists of people who can be described as
having both exercise dependence and eating disorder, that is, secondary exercise dependence: 1.69% (45 people). Within the complete sample, the proportion of females with eating disorder is almost three times as high (10.89%, N=289) as that of males (3.58%, N=95). There is no major difference between the genders in terms of primary exercise dependence. 1.39% (37 people) of the males and 1.28% of the females (34 individuals) show signs of primary exercise dependence. The proportion of secondary exercise dependence is similar to that of eating disorder: 0.38% (10 individuals) of males and 1.32% (35 individuals) of females have secondary exercise dependence.

Within the female sample, the proportion of females with likely eating disorder was 19.15 per cent. The proportion of primary exercise dependence (2.25%) and secondary exercise dependence (2.32%) was roughly identical. Within the male sample, the percentage of participants with likely eating disorder is significantly lower, only 8.29% compared to 19.15% of females. The difference, however, between primary (3.23%) and secondary (0.87%) exercise dependence is greater, a fact which can be understood from the perspective that the incidence of eating disorder among males is lower.

3.1.4. Discussion

4.36% of the sample under examination within the exerciser population is somehow linked to exercise dependence: 2.67% of the participants show signs of primary exercise dependence, and 1.69% have secondary exercise dependence. This proportion is practically identical to results found through two inventories with appropriate psychometric indicators (Exercise Addiction Inventory, Griffiths, Szabo & Terry, 2005; Exercise Dependence Scale, Hausenblas & Symons Downs, 2002; Demetrovics & Kurimay, 2008). The results from the current research are similar to the findings from the first study carried out on the Hungarian representative sample, the study conducted among exercisers, according to which the risk of dependence was 3.2 per cent.

Females are overrepresented in the groups with eating disorder and with secondary exercise dependence associated with eating disorder. These results are in agreement with the general findings (Túry, 2015) as well as the findings introduced in the second study within the current dissertation, suggesting that eating disorder is a condition that is more characteristic of women. The high percentage of eating disorder in the current sample allows us to consider similar reasons as in the case of the ESPAD sample: the SCOFF questionnaire probably indicates the eating disorders that fall outside of anorexia nervosa and bulimia nervosa in the current sample as well. No significant difference can be found between the proportion of females and that of males with regard to primary exercise dependence.

When the male and female samples are examined separately, it is noticeable and in line with the previous results that eating disorder and secondary exercise dependence tied to eating disorder occur in a larger proportion in the female sample than in that of the males. In the male sample, however, primary exercise dependence not tied to eating disorder appears in a higher proportion than among females. The results from Blaydon and Lindner (2002) are in line with my research findings: in their study, eating disorder and secondary exercise dependence among women appeared in larger proportion, while the percentage of primary exercise dependence was higher among males.
3.2. study: A study of the link between primary and secondary exercise dependence and eating disorder

3.2.1. Aims
In my study, I examined the relationship between the two types of exercise dependence – primary and secondary – and between them and eating disorder as well as the psychological variables that differ in the case of the various disorders. I hope that my research will contribute to clarifying the problem as to whether primary exercise dependence can be considered an independent disorder.

3.2.2. Method

3.2.2.1. Participants and procedure
The sample is identical to that described in Section 3.1.2.1.

3.2.2.2. Measures
The four groups formed during the analysis discussed in Section 3.1 were measured with the following scales:

- *Brief Symptom Inventory* (BSI) (Derogatis, 1975; Derogatis & Spencer, 1982). I used this scale to measure psychiatric symptoms. During the statistical analysis, I worked with the scales for interpersonal sensitivity, depression and anxiety as well as calculating the Global Severity Index.
- Hungarian version of the Barratt Impulsiveness Scale (Varga & mtsai., 2015) to measure impulsivity.
- *Human Figure Drawings Test* (Fallon-Rozin, 1985), which is a procedure for the measurement of variables tied to body image. Within this, I measured the degree of dissatisfaction with the body image.

3.2.2.3. Statistical analysis
Having formed the four groups, I conducted an one-way analysis of variance (ANOVA), in which I compared the four groups on the basis of the psychological variables defined on the basis of the tools described in Section 3.2.2.2.

3.2.3. Results
The analysis of variance (ANOVA) demonstrated significant results (p<0.001) for each psychological variable studied. The results of the analyses can be seen in Table 1.
Table 1. An analysis of variance (ANOVA) of the control group and groups with eating disorder, primary exercise dependence and secondary exercise dependence on the basis of particular psychological variables

<table>
<thead>
<tr>
<th>Indicator variables</th>
<th>Control group (N=2073–2115)</th>
<th>Eating disorder (N=375–380)</th>
<th>Primary exercise dependence (N=67–69)</th>
<th>Secondary exercise dependence (N=44)</th>
<th>Comparison of the four groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>General well-being</td>
<td>0.54 (0.98)a</td>
<td>-0.26 (1.00)b</td>
<td>-0.13 (1.05)ab</td>
<td>-0.19 (1.26)ab</td>
<td>F-test</td>
</tr>
<tr>
<td>Interpersonal sensitivity</td>
<td>-0.11 (0.90)a</td>
<td>0.42 (1.19)b</td>
<td>0.18 (1.10)ab</td>
<td>0.89 (1.63)b</td>
<td>11.36</td>
</tr>
<tr>
<td>Depression</td>
<td>-0.12 (0.91)a</td>
<td>0.44 (1.13)bc</td>
<td>0.34 (1.11)b</td>
<td>1.10 (1.60)c</td>
<td>57.81</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-0.11 (0.91)a</td>
<td>0.39 (1.10)bc</td>
<td>0.27 (1.16)b</td>
<td>1.10 (1.76)c</td>
<td>49.02</td>
</tr>
<tr>
<td>Compulsivity</td>
<td>-0.09 (0.93)a</td>
<td>0.38 (1.13)bc</td>
<td>0.08 (1.09)ab</td>
<td>0.98 (1.48)c</td>
<td>40.88</td>
</tr>
<tr>
<td>Global Severity Index for psychiatric symptoms</td>
<td>-0.12 (0.89)a</td>
<td>0.46 (1.11)bc</td>
<td>0.33 (1.20)b</td>
<td>1.20 (1.81)c</td>
<td>65.36</td>
</tr>
<tr>
<td>Impulsivity</td>
<td>-0.05 (0.96)a</td>
<td>0.13 (1.04)b</td>
<td>0.43 (1.64)ab</td>
<td>0.52 (1.00)b</td>
<td>11.78</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>0.11 (0.96)a</td>
<td>-0.51 (1.00)b</td>
<td>0.06 (1.00)a</td>
<td>-0.86 (1.24)b</td>
<td>54.43</td>
</tr>
<tr>
<td>Dissatisfaction with body image (min= 0, max=8, avg=1.16, SD=0.97)</td>
<td>1.00 (0.87)a</td>
<td>1.97 (1.08)b</td>
<td>0.84 (0.79)a</td>
<td>1.84 (1.00)b</td>
<td>135.13</td>
</tr>
</tbody>
</table>

Note: Different subscript letters (a, b, c) in the same row reflect significant (p < 0.05) difference between the means while same subscript letters in one row reflect non-significant difference between the means.

Participants with eating disorder differ significantly from the control group: each of the nine psychological variables studied shows a significant difference (p<0.001) between the two groups. Participants with eating disorder are characterized by lower indicators for general well-being and self-esteem, but by a higher figure on the scales for interpersonal sensitivity, depression, anxiety, compulsivity, global psychiatric symptoms and dissatisfaction with body image.

Four scales indicate a significant difference between the primary exercise dependence and the control group. Those with exercise dependence have a higher level of depression, anxiety and global psychiatric symptoms and a lower level of general well-being than the control group.

The difference between the control group and secondary exercise dependence is almost as significant as that between the control group and the eating disorder group. Only one variable shows no difference between them: general well-being. All the other variables indicate the same deviation as they do between the control group and the eating disorder group.

The eating disorder group only differs significantly from the primary exercise dependence group in the case of two variables: the self-esteem of the eating disorder group is lower than that of the primary exercise group, and their dissatisfaction with their body image is higher.

The eating disorder group and the secondary exercise dependence group are not significantly different from one another in terms of any of the variables.

The primary and secondary exercise dependence groups differ significantly from each other in the case of six variables: among secondary exercise dependence sufferers, depression,
anxiety, compulsivity and global psychiatric symptoms are on a higher level, their self-esteem is lower, and they indicate a larger degree of dissatisfaction with their body image.

3.2.4. Discussion

One of the truly outstanding results of the analysis of variance (ANOVA) is that there is no difference in any of the variables under examination between the eating disorder group and the secondary exercise dependence group. Similarly to findings by Bamber et al. (2000), however, both the eating disorder group (in all the variables examined) and the secondary exercise dependence group (for all the variables except for one, general well-being) differ strongly from the control group. The degree of the differences is in line with what was expected: the eating disorder group scored lower than the control group in terms of general well-being and self-esteem and higher in the areas of interpersonal sensitivity, depression, anxiety, compulsivity, global psychiatric symptoms, impulsivity and dissatisfaction with body image. Differences between the secondary exercise dependence group and the control group follow the same trend, except for the general well-being indicator, which shows no difference between the two groups. Based on these results, it can be concluded that eating disorder and secondary exercise dependence tied to eating disorder essentially exhibit the same psychological profile in the variables examined and are clearly distinct from the control group (with no signs of eating disorder or exercise dependence). Therefore, psychiatric symptoms present in the case of eating disorder, impulsivity is heightened, and self-esteem and body image are affected negatively.

The results of the primary exercise dependence group differ from those of the control group although not so significantly: a difference can only be seen in the case of four variables. At this point, the findings from my study differ from those of the analysis by Bamber et al. (2000) referred to in the previous paragraph. It is important to see which variables indicate a difference between the exercise dependence group and the control group: they are more characterized by depression, anxiety and global psychiatric symptoms, and their general well-being is lower. In contrast to the secondary exercise dependence group and the eating disorder group, they show no difference in relation to the control group in terms of impulsivity, self-esteem and body image.

The primary and secondary exercise dependence groups are very clearly distinct as well. The secondary exercise dependence group shows a higher value on a number of scales that measure psychiatric symptoms and are distinct in their self-esteem and body image from the primary exercise dependence group as well: their self-esteem is lower, and they are more dissatisfied with their body image. The primary exercise dependence group and the eating disorder group differ in two areas: participants with eating disorder have lower self-esteem and a higher level of dissatisfaction with their body image than participants with primary exercise dependence.

Based on the results, it seems that with the incidence of eating disorder (in the case of the eating disorder and secondary exercise dependence groups), self-esteem and body image are lower in addition to the presence of general psychiatric symptoms. In the case of primary exercise dependence, however, in line with Szabo’s (2010) interpretation, it seems that it is rather anxiety, mood problems and a lower level of general well-being that may be found in the background rather than problems tied to self-esteem, body image or impulsivity. However, the primary exercise dependence group is clearly distinct in these areas from the control group, whose members show no signs of exercise dependence or eating disorder.
Thus, I believe that primary exercise dependence is an existing and valid psychological category which shows characteristic psychological differences with respect to the normal population with no signs of this condition and with respect to the secondary exercise dependence group, which – in this current study – shows a psychological profile which is identical to the eating disorder group.

**DISCUSSION**

For my dissertation, I carried out examinations on the topics of exercise dependence and eating disorder within the framework of three large empirical studies. Some of the studies focused on measuring the prevalence of the two disorders, both on national representative samples and on a special exerciser sample. The prevalence studies were conducted following a psychometric analysis of the measurement tools to be used and, in the case of the first study, an adaptation of these tools. In the second major area, I aimed to study the psychological correlates of eating disorders. Finally, I compared people with primary and secondary exercise dependence and those with eating disorder based on a number of variables. One of the main questions in the third study was whether primary exercise dependence can be considered an independent disorder.

In the first study, validation of two exercise measures acknowledged internationally – the Exercise Dependence Scale (EDS) (Hausenblas & Symons Downs, 2002, Demetrovics & Kurimay, 2008) and the Exercise Addiction Inventory (EAI) (Griffiths, Szabo & Terry, 2005; Terry, Szabo & Griffiths, 2004, Demetrovics & Kurimay, 2008) – was carried out on a Hungarian representative sample in the framework of the National Survey on Addiction Problems in Hungary (OLAAP) study. A number of state-of-the-art measurement tools are used in international research; however, these two tools enjoy the widest currency. They also have appropriate validity and reliability indicators. Instead of developing a new tool, we thus deemed it appropriate to adapt these two scales. Original factor structures of both inventories were confirmed and the two measures, in line with the expectations, showed high correlation. Based on the results of ROC analysis, raising cut-off points of EAI by one point (from 13 to 14) appears to be reasonable in case of differentiating between nondependent symptomatic and asymptomatic populations. Based on the findings, it can be concluded that the suitability of both of these theoretically-based scales (the EAI, based on Griffiths component model, and the EDS, based on the DSM-4 psychoactive substance dependence diagnosis) also stems from the fact that their theoretical foundations are indeed adequate.

Adapting the two measurement tools made it possible to develop a picture of the prevalence of the disorders. Since the incidence of exercise dependence had not yet been studied on a national representative sample either in Hungary or internationally, it was timely and justified to study this disorder on this type of population. Within the National Survey on Addiction Problems in Hungary (OLAAP) project, there was an opportunity to be the first to measure the prevalence of exercise dependence on a representative adult sample with two questionnaires, which had been validated by then.

According to the EDS, 38,1%-a of exercisers (6,2%-a of the total sample) could be characterized as nondependent-symptomatic exercisers. According to the EAI, 61,0%-a (10,1%-a of the total sample) could be characterized as nondependent-symptomatic exercisers. The proportion of exercisers at-risk of dependence is 1,9% among exercisers and
0.3% in the general population as measured by the on EDS. Estimation based on the EAI resulted in slightly higher rates for being at-risk for dependence, that is 3.2% in the case of regular exercisers and 0.5% in the case of the total sample. EDS and EAI thus provided different estimations about the proportion of nondependent-symptomatic exercisers and exercisers at-risk of dependence that can be explained by the lack of empirically based cut-off scores for EAI. Calculating the prevalence with new thresholds resulted that 44.8% of exercisers (7.4% of general population) could be characterized as asymptomatic, 52% (8.6% of total sample) could be described as nondependentsymptomatic exercisers, and 3.2% (0.5% of total sample) could be classified as at risk from exercise dependence according to the new cut-off points of EAI.

The results from the national representative sample discussed here support the claim that has been asserted in previous studies that exercise dependence is not among the common disorders found in the average population (Sussman, Lisha & Griffiths, 2011). Since previous studies have been conducted on very different samples and data on prevalence varies widely (Berczik & mtsai, 2012), a comparison of these with the current results is problematic. However, research conducted on samples that are closest to the current one has also reached similar conclusions (Griffiths, Szabo & Terry, 2005; Hausenblas & Symons Downs, 2002). Data on prevalence gathered in the current study can be considered unique both in Hungary and internationally.

Within the second major study, I had the opportunity to measure the incidence of eating disorders on a national representative sample as well. As the first step, I checked the factor structure of the SCOFF questionnaire used during the study (Morgan, Reid & Lacey, 1999). The original factor structure of the questionnaire was confirmed. Afterwards, I measured the prevalence of eating disorders on the European School Survey Project on Alcohol and Other Drugs (ESPAD) sample. The target group for the analysis consisted of students who had turned 16 in the data collection year. The sample is representative in terms of type of school, year and geographical region. I considered it significant to measure the prevalence of eating disorders on a representative sample of adolescents, since we have no relevant Hungarian data available and because this age group is particularly at risk for eating disorders since anorexia nervosa typically begins between the ages of 12 and 18 and bulimia nervosa starts between the ages of 15 and 25 (Túry, 2015).

Based on the SCOFF questionnaire and the variables defined by Túry et al. (2013), I calculated the prevalence of all the eating disorders, including that of anorexia nervosa and bulimia nervosa. 81.06% of the population (4,025 participants) showed no symptoms of eating disorder. In the case of 18.94% (941 people), eating disorder is likely. In terms of the gender division, 13.53% of the total female sample (672 females) falls into the likely eating disorder category, while this figure is 5.41% for males (269). Within the total sample, the prevalence of anorexia nervosa is 0.18% for females (9 participants) and 0.06% for males (3 individuals), while the prevalence of bulimia nervosa is 1.43% among females (71 people) and 0.06% among males (30 individuals). The prevalence of anorexia nervosa within the female sample is 0.38%, and within the male sample it is 0.12%. The incidence of bulimia nervosa is 2.92% in the female sample and 1.18% among the males.

The data is essentially in line with results from Hungarian and international research on the incidence of the disorder. I consider it important to add that although researchers on this topic increasingly emphasise that eating disorders are no longer exclusively characteristic of females (in this case, girls), the results still show that, while eating disorders do present
among men/boys, the incidence among women is many times that among men even today. Further analysis will provide possible explanations for this phenomenon.

The literature on eating disorder has identified a number of factors that are present in the case of individuals with eating disorders in one way or another – either as causes or correlates. The significance of gender, as seen above in the prevalence data, is clear. In addition to this, I focused on three variables in my study that demonstrate a link to eating disorder based on the research. These are depression, self-esteem and satisfaction with the relationship with the parents. I compared the groups with and without eating disorders based on gender and the other three variables. The differences between the two groups were significant for each variable (p<0.001). Females have three times higher chances than males of having eating disorder. In the case of individuals with eating disorder, there is a larger chance of depression and a lower level of self-esteem than in the case of the non-eating disorder group, and members of the former group gave accounts of a larger degree of dissatisfaction with their relationship with both their mother and father.

The results are in agreement with those from studies that indicate that eating disorders are very frequently accompanied by depression and problems with self-esteem. Furthermore, they also draw attention to the fact that individuals with eating disorders and non-eating disorders also differ with regard to family relations and their subjective satisfaction with them.

I carried out a path analysis in connection with the variables examined in which I tested a theoretical model on variables that increase the chances of eating disorder developing. Gender influences the likelihood of eating disorder both indirectly and directly. The direct path suggests that there is a significantly greater chance of detecting eating disorder among females. Gender influences eating disorder indirectly through depression (which is higher among females) and self-esteem (which is lower among females). Moreover, dissatisfaction with the relationship with the mother indirectly influences the likelihood of the development of eating disorder through self-esteem and depression.

In my opinion, the path analysis calls attention to a number of important points. First, it is a warning about the vulnerability of females to eating disorders in that it indicates a direct relationship between female gender and eating disorder. Second, it points to the fact that the lower self-esteem and greater degree of depression that can be observed in the case of females may operate as a mediating variable on the path to eating disorder. Third, it also indicates that dissatisfaction with the relationship with the mother may lead to the development of depression, which thus may become a mediating variable on the path to eating disorder. The relevance of depression with regard to eating disorder has therefore been reinforced from a number of perspectives throughout the research. The research results support the notion that the aetiology of eating disorders can be understood best through multidimensional complex theories (Garner & Garfinkel, 1980; Garner, 1993).

Although the incidence of exercise dependence was measured on a national representative sample as part of the OLAAP study, I found it justified to carry out further research on a special exerciser population since my goal was to reach a larger problematic population and since exercise dependence is a low-prevalence phenomenon. As the first step with the SCOFF questionnaire (Morgan, Reid & Lacey, 1999) and the Exercise Dependence Scale (EDS) (Hausenblas & Downs, 2002) used in the earlier research, I measured the relevant percentages in groups with eating disorder and with primary and secondary exercise dependence and in a control group not affected by either of the disorders within the total sample. The distribution of the four groups was as follows: eating disorder 14.46%; primary exercise dependence:
2.67%; and secondary exercise dependence: 1.69 per cent. 81.17% of the sample did not show signs of either of the disorders. The proportion of females is over three times higher than that of males in the eating disorder and secondary exercise dependence groups. Within the male sample, the proportion of primary exercise dependence was higher than that within the female sample: 2.67% of the individuals had primary exercise dependence and 1.69% had the secondary form. These proportions are essentially in agreement with the results from two questionnaires with appropriate psychometric indicators: the Exercise Addiction Inventory (Griffiths, Szabo & Terry, 2005) and the Exercise Dependence Scale (Hausenblas & Symons Downs, 2002; Demetrovics & Kurimay, 2008). Results from the current research were close to those of the survey conducted among exercisers within a representative sample in Hungary demonstrated in the first research, in which the risk of dependence was 3.2 per cent.

Like research conducted on a sample of adolescents, the proportion of women is overrepresented in the eating disorder group and the secondary exercise dependence group, members of which are affected by eating disorder. No significant difference can be detected in the proportion of women and men with regard to primary exercise dependence. These findings are in agreement with research results by Blaydon and Lindner (2002): they also found that eating disorder and secondary exercise dependence presented in the case of women in higher proportions but that the proportion of primary exercise dependence was higher among men.

The last area of inquiry in my research focused on the nature of the relationship between the two types of exercise dependence (primary and secondary), eating disorders and the types of psychological variables that distinguish the particular disorders. My purpose was also to clarify whether primary exercise dependence can be considered an independent disorder. In order to answer these questions, I compared the four groups introduced previously based on nine psychological variables using an analysis of variance. The variables were as follows: general well-being, interpersonal sensitivity, depression, anxiety, compulsivity, the global severity index for psychiatric symptoms, impulsivity, self-esteem and dissatisfaction with body image.

One outstanding result is that, in line with the findings in Bamber et al. (2000), the eating disorder and secondary exercise dependence groups are not distinguished in terms of any of the variables. Both groups differ markedly from the control group with regard to the trends anticipated: the eating disorder group is lower than the control group on the scales for general well-being and self-esteem, while they show higher scores on the scales for interpersonal sensitivity, depression, anxiety, compulsivity, global psychiatric symptoms, impulsivity and dissatisfaction with body image. Similar differences were indicated in the results between the secondary exercise dependence group and the control group, except for the indicator for general well-being, which signifies no difference between the two groups. Based on these results, it can be stated that eating disorder and secondary exercise dependence influenced by eating disorder essentially show the same psychological profile based on the variables examined and differ markedly from the control group, members of which are not affected by eating disorder (or exercise dependence). Therefore, psychiatric symptoms are involved when eating disorder is present, impulsivity is higher, and self-esteem and body image are also affected negatively.

The results from the primary exercise dependence group also differed from those of the control group, although to a lesser extent, based on four variables altogether. The results from my study differ on this point from the research by Bamber et al. (2000) noted in the previous
paragraph. Those with exercise dependence are more likely to be characterized by depression, anxiety and global psychiatric symptoms, and their general well-being is lower. Unlike the secondary exercise dependence and eating disorder groups, however, they do not diverge from the control group in terms of impulsivity, self-esteem or body image.

The primary and secondary exercise dependence groups differ from one another very distinctly. Those with secondary exercise dependence score higher on a number of scales for psychiatric symptoms and are distinct from those with primary exercise dependence with regard to self-esteem and body image as well: they have lower self-esteem and are also less satisfied with body image. The primary exercise dependence group differs from the eating disorder group in two areas: the eating disorder group has lower self-esteem and higher dissatisfaction with body image than the primary exercise dependence group.

Based on the results, it can be concluded that when eating disorder is present (in the case of people with both eating disorder and secondary exercise dependence) self-esteem and body image are affected in a negative way in addition to the presence of general psychiatric symptoms. In the case of primary exercise dependence, in agreement with Szabo’s (2010) understanding, however, it seems that anxiety, mood problems and a lower level of well-being lie in the background rather than problems with self-esteem, body image or impulsivity. However, in connection with the former problems, primary exercise dependence is distinct from the control group, in which participants are not affected by exercise dependence or eating disorder.

Depression has proved to be significant during the study conducted on the exerciser sample too: this latter study warns us that, as with people affected by eating disorders, a heightened level of depression is characteristic of those with exercise dependence (whether primary or secondary) compared to those that show no signs of dependence.

Theories that deal with both eating disorder and exercise dependence stress the role of lower self-esteem lying behind the problems. The results show that with eating disorder as well as secondary exercise dependence that may accompany it the connection is clear; however, this is not the case with primary exercise dependence, since those with primary exercise dependence do not differ from the control group with regard to self-esteem. It seems that a major difference between the primary and secondary exercise dependence groups is that body image and self-esteem are lower in the second group than in the first. It is anxiety, mood problems and a lower level of well-being rather than self-esteem or problems with body image that lie behind primary exercise dependence. These results indicate the significance of recognising and treating comorbid disorders that accompany eating disorders and exercise dependence (Berczik et al, 2014b).

One of the main questions I wished to answer in my dissertation was whether primary exercise dependence is an independent disorder or not. Based on my results, the answer is affirmative. Primary exercise dependence can be defined as an existing valid psychological category which demonstrates typical psychological differences compared to the unaffected, normal population and to the secondary exercise dependence group, which has a psychological profile which is identical to the eating disorder group.
CONCLUSIONS AND FUTURE TASKS

One general task for the future would be to conduct a prevalence study on these two disorders again on both the adult and adolescent populations using proper measurement tools, both domestically and internationally. This would provide an opportunity to identify prevalence trends and further cultural comparisons.

With regard to this, a prevalence study conducted on the representative sample of adolescents in Hungary poses the question of what eating disorders there are in addition to anorexia nervosa and bulimia nervosa, as indicated by the SCOFF questionnaire (Morgan, Reid & Lacey, 1999). This questionnaire was created by the authors based on DSM-4 (APA, 1994), which diagnosed three eating disorders altogether: anorexia nervosa, bulimia nervosa and “Eating Disorder Not Otherwise Specified”. In order to answer this question as well as to be able to establish a more elaborate differentiation, I believe – besides a two-step studies – it would be worthwhile and timely to revise the questionnaire based on the criteria in DSM-5 (APA, 2013) for future research.

In the case of exercise dependence, it would be important to ascertain when and beyond what point it is possible to speak in terms of a particular disorder requiring treatment from a specialist. In order to clarify this, it is necessary to use tools and interview methods on clinical samples to measure the disorder. A further task in this area would be the development of therapeutic principles and methods for exercise dependence.

REFERENCES CITED IN THE THESIS


