


Is problematic exercise really problematic? A dimensional approach

Samuel R. Chamberlain,^{1*}  and Jon E. Grant²

¹ Department of Psychiatry, University of Cambridge, and Cambridge and Peterborough NHS Foundation Trust, Cambridge, United Kingdom

² Department of Psychiatry and Behavioral Neuroscience, University of Chicago, Chicago, IL, USA

Objective. Though moderate exercise has numerous health benefits, some individuals may become excessively preoccupied with exercise, endorsing features akin to “addiction.” The aim of this study was to evaluate the relationships between problematic exercise (viewed dimensionally), quality of life, and psychological measures.

Methods. Young adults were recruited from an established population-based cohort in the United Kingdom and completed an online survey. The factor structure of the Exercise Addiction Inventory (EAI) was characterized. Relationships between dimensional EAI factor scores and other variables (impulsivity, compulsivity, emotional dysregulation) were elicited.

Results. Six hundred and forty-two individuals took part in the study (mean age 23.4 years, 64.7% female). The EAI yielded two factors – a “general factor” and a “relationship conflict factor.” Both EAI factor scores were associated with disordered eating, impulsivity (UPPS), and compulsivity (CHI-T). Only the relationship conflict factor score was significantly associated with impaired quality of life (all domains) and with maladaptive personality traits (emotional dysregulation and obsessive-compulsive personality disorder traits). Few participants met conventional threshold for full exercise addiction (1.1%).

Conclusion. Higher problematic exercise scores, in a sample largely free from exercise addiction, were associated with impulsive and compulsive personality features, emotional dysregulation, and disordered eating. Further research is needed to examine whether these results generalize to other populations (such as gym attendees) and are evident using more rigorous in-person clinical assessment rather than online assessment. Longitudinal research is needed to examine both positive and negative impacts of exercise, since moderate exercise may, in fact, be useful for those with impulsive/compulsive tendencies, by dampening negative emotional states or substituting for other more damaging types of repetitive habit.

Received 11 September 2018; Accepted 10 January 2019

Key words: Compulsive, impulsive, addiction, exercising, exercise.

Introduction

While exercise has numerous health benefits, excessive exercise for some individuals may have untoward mental and/or physical health consequences.¹ For example, continuing to engage in exercise despite an injury could lead to worsening or permanence of that injury, and excessive time spent on exercise could lead to neglect of other areas of life, for example, interpersonal relationship.² Excessive

exercise could also have a negative impact in relation to other mental health disorders, such as people with eating disorders exercising in order to maintain unhealthily low body mass indices,³ or people with muscle dysmorphia who strive to increase muscle mass with exercise and steroids.⁴ Other consequences of excessive exercise reported in the literature include immune dysfunction and chronic fatigue arising from excessive exercise.⁵ The concept of “negative exercise” or “exercise addiction” was first developed in the 1980s, drawing contrast with the earlier concept of “positive exercise” indicating positive health benefits.^{6–8} Here, we use the term “problematic exercise” to describe these phenomena, since this term focuses on the behavior rather than assuming it to be contained within a particular theoretical framework of, for example,

*Address correspondence to: Samuel R. Chamberlain, Department of Psychiatry, University of Cambridge, Addenbrooke’s Hospital, Cambridge CB2 0QQ, United Kingdom.

(Email: src33@cam.ac.uk)

The study was supported by the Neuroscience in Psychiatry Network, a strategic award from the Wellcome Trust to the University of Cambridge and University College London (095844/Z/11/Z).

addiction or compulsivity. Nonetheless, current measures of problematic exercise tend to utilize questions relating to addiction.

Two concepts that have proven to be useful in understanding other types of repetitive behavior, and which may be relevant for excessive exercise, are impulsivity and compulsivity.⁹⁻¹³ Impulsivity refers to hasty premature actions, without due forethought, which have untoward longer-term consequences. Compulsivity refers to repetitive habitual behaviors that have lost their relationship with the original intent or goal. While studies have examined impulsivity¹⁴ and compulsivity¹⁵ in problematic exercise, the interplay between these two constructs has seldom been examined in the same setting or using statistical techniques that are resilient to expected issues such as collinearity (correlations) across variables of interest. Another concept important in understanding excessive exercise is emotional dysregulation, which has been found to predict subsequent excessive/compulsive exercise.¹⁵ Furthermore, acute exercise has been found to dampen emotion regulation deficits.¹⁶ Understanding the roles of impulsivity, compulsivity, and emotional dysregulation in problematic exercise may help to identify predisposing factors and implicated mechanisms, as well as help account for overlap with other disorders such as eating disorders.¹⁷

Therefore, the aims of this study were (i) to explore the factor structure of problematic exercise (measured using the Exercise Addiction Inventory, EAI) in young adults; (ii) to assess the impact of identified EAI factor scores on quality of life; and (iii) to evaluate the potential contribution of impulsive and compulsive psychological mechanisms to problematic exercise. We hypothesized that all EAI factor scores would be associated with elevated occurrence of impulsivity, compulsivity, and emotional dysregulation.

Methods

Participants

Participants were recruited from the Neuroscience in Psychiatry Network, which is an established cohort of young adults being followed over time to explore brain development and mental health.¹⁸ The sample was originally recruited on a stratified basis, in order to maximize representativeness of the normal population in the catchment areas covered (Cambridge and London). We contacted all individuals who were still enrolled in this cohort at the time of data collection (2017-2018) via email and invited them to take part in an online study being conducted using SurveyMonkey. Prior to participation, individuals read an information sheet, indicated consent, and had the opportunity to contact the study team to address any queries/concerns they might have. The study was approved by research ethics committee,

and the people taking part received £15 compensation in the form of a gift voucher.

Measures

The following demographic information was collected: age, gender, ethnicity, and education level. Problematic exercise was assessed using the EAI.¹⁹ This is a six-item screening tool that was previously shown to have good psychometric properties and sound concurrent validity against other established scales for problematic exercise. The scale enquires about: conflicts occurring with one's partner/family due to exercise, using exercise to change one's mood (e.g., obtain a "buzz"), escalating participation in exercise over time, irritability if missing exercise, and failed attempts to cut back. For each question, the individual responses on a scale of 1-5, ranging from "strongly disagree" to "strongly agree." Thus, the scale gives a total score out of 60.¹⁹ In addition to the EAI, the following scales were completed, focusing on quality of life, impulsivity, compulsivity, and emotional regulation.

*Brunnsvikien Brief Quality of Life Scale (BBQ).*²⁰ BBQ is a previously validated self-report quality-of-life scale, which covers six life areas (leisure time, view of life, creativity, learning, friends/friendship, and view of self) that are important determinants of the overall quality of life. This scale has been validated in various normative and clinical population settings.²⁰ The measure of interest was the total quality of life score.

*SUPPS.*²¹ SUPPS is a short version of the UPPS, which is a questionnaire capturing different aspects of impulsivity, namely sensation seeking, lack of premeditation, lack of perseverance, negative urgency, and positive urgency.²² There are 20 items, each responded to on a scale of 0-3. Measures of interest were summed for each domain, yielding five measures of impulsivity, each out of a maximum of 12 points.

*SCOFF Eating Disorder Questionnaire.*²³ This is a previously validated screening tool for detection of disordered eating. The scale is sensitive to the presence of different aspects of disordered eating, such as deliberately making one's self sick, distorted body image, and loss of control over eating. We included the SCOFF as we were interested in a possible relationship between exercise and eating disorder-related symptoms.^{3,24} The measure of interest was total items endorsed on the SCOFF.

*Cambridge-Chicago Compulsivity Trait Scale (CHI-T).*⁹ This is a recently developed scale designed to capture the comprehensive aspects of compulsivity, viewed transdiagnostically. The scale comprises 15 items, each scored on a Likert scale of 1-4, from "strongly disagree" to "strongly agree." The total score is 60, with higher scores indicating higher compulsivity. The scale is sensitive to compulsivity across a range of pathologies, such as

disordered gambling, substance use, and obsessive-compulsive symptoms.⁹ The measure of interest was the total score.

Padua Obsessive-Compulsive Inventory (Washington State Revision).^{25,26} This is a 39-item questionnaire measuring the broad range of obsessive-compulsive symptoms, designed for use in normative and clinical populations. Each item has a Likert scale (0–4), with higher scores indicating more symptoms. The scale gives a total score out of maximum of 156, which was the measure of interest.

Difficulties with Emotion Regulation Scale (DERS).²⁷ This is a 36-item questionnaire encompassing multiple aspects of emotional dysregulation, indicating difficulties controlling one's emotional responses relating to social interactions.²⁸ Each question is responded to on a scale of 0–5, ranging from “almost never” to “almost always.” The measure of interest was the total score out of 180, with higher scores indicating more emotional dysregulation.

Data analysis

The demographic characteristics of the sample were summarized. The structure of the EAI was explored using exploratory factor analysis, with the optimal number of factors selected using scree plot combined with the inspection of eigenvalues. The potential clinical relevance of EAI factor scores was considered by undertaking Spearman's r correlations against quality-of-life scores on the BBQ, with $p < 0.05$ uncorrected being defined as statistically significant.

To evaluate the links between problematic exercise and impulsivity/compulsivity, and emotional dysregulation (plus relevant demographic characteristics), we used the statistical technique of partial least squares (PLS). PLS is a multivariate statistical technique that models the relationship between a number of X (explanatory) variables and one or more outcome (Y) variables through an iterative process.^{29–31} This statistical approach is highly suited to situations such as cross-sectional analyses, in which there are relatively large numbers of variables, and these variables are correlated, hence breaching statistical assumptions of many typical statistical approaches. Here, the Y variable of interest was factor score on the EAI, and the X variables of interest were all other measures (demographic characteristics and questionnaire scores). A separate PLS model was run for each EAI factor score type identified. The optimal model was selected using leave-one-out cross-validation and by minimizing the PRESS statistic. We used a two-stage process in order to identify measures significantly associated with problematic exercise, per previously established methodologies.³² First, X measures with variable importance parameter (VIP) < 0.8 were removed from the initial PLS model. Second, the distributions of model coefficients were characterized using bootstrap (1000 iterations). Explanatory variables with VIP > 0.8 whose 95% confidence intervals did not cross the null

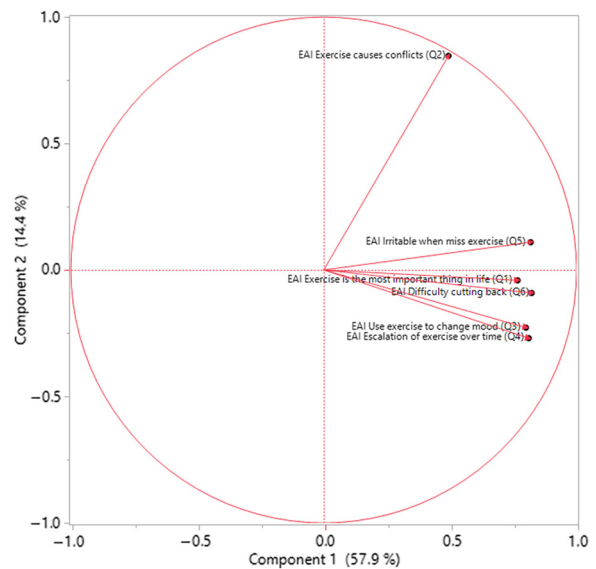


FIGURE 1. Loading of individual EAI items onto the two factors.

line in the final PLS model were deemed statistically significant. All statistical analyses were conducted using JMP Pro.

Results

In total, 642 people completed the study. The sample had mean (standard deviation) age of 23.4 (3.2) years, were mostly female (64.7%), and were mostly of self-defined White Caucasian ethnicity (78.7%). The distributions of EAI item responses and total scores are provided in the Supplementary Material. Factor analysis based on scree plot inspection and eigenvalues (see Supplementary Material) indicated two factors for the EAI, accounting for 57.9% and 14.8% of the variance, respectively (cumulatively 72.3% of the variance). The loadings of each individual scale item onto these two factors are shown in Figure 1. It can be seen that factor 1 related to the majority of scale items (hereafter termed “general factor”) and that factor 2 related more specifically to conflicts arising between the individual and their partner/family members due to exercise (hereafter termed “relationship conflict factor”). EAI general scores did not correlate with quality of life on the BBQ ($r = 0.013$, $p = 0.740$), whereas EAI relationship conflict scores did ($r = -0.120$, $p < 0.001$). The latter was also significant for all domains of functioning on the BBQ considered separately (all $p < 0.001$ per domain, except for creativity-related quality of life, which was significant but less so with $p = 0.0324$).

PLS yielded an optimal model capturing 58.6% of variance in the explanatory (X) variables and 13.2% of variance in problematic exercise *general factor*. Figure 2 shows variables retained in the final model (i.e., those with VIP > 0.8); those explanatory variables that were statistically

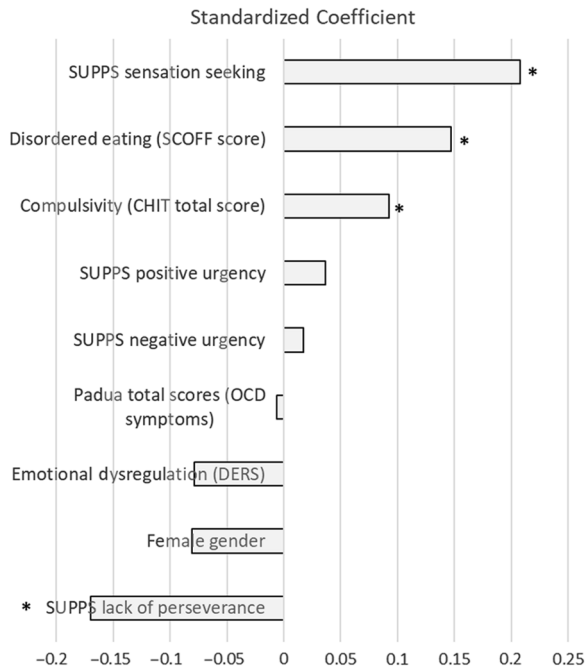


FIGURE 2. Variables in the PLS model predicting EAI general factor scores (VIP > 0.8). * indicates statistically significant predictor ($p < 0.05$ using conservative bootstrap).

significant ($p < 0.05$, bootstrap) are shown with an asterisk. PLS yielded an optimal model capturing 47.1% of variance in the explanatory (X) variables and 6.2% of variance in problematic exercise relationship *conflict factor*. Figure 3 shows variables retained in the final model (i.e., those with VIP > 0.8); those explanatory variables that were statistically significant ($p < 0.05$, bootstrap) are shown with an asterisk.

Discussion

This study used a dimensional approach to investigate problematic exercise in young adults recruited from a cohort of young adults recruited from the general population. The percentage of the sample with an EAI total score >24, suggestive of overt exercise addiction based on previous validation, was 1.1%. As expected due to the epidemiologic nature of the cohort, this is slightly lower than the prevalence rate of 3% found in a sample of habitual exercisers.¹⁹ In young people, prevalence rates based on an equivalent version of this instrument have been estimated at 4% in school athletes, 8.7% in fitness attendees, and 21% in people with eating disorders.³³ Hence it should be born in mind that the current sample mainly focused on exercise that fell short of the full definition of exercise addiction. Nonetheless, this dimensional approach that includes subsyndromal people may provide useful insights into the full range of behaviors and their associations.

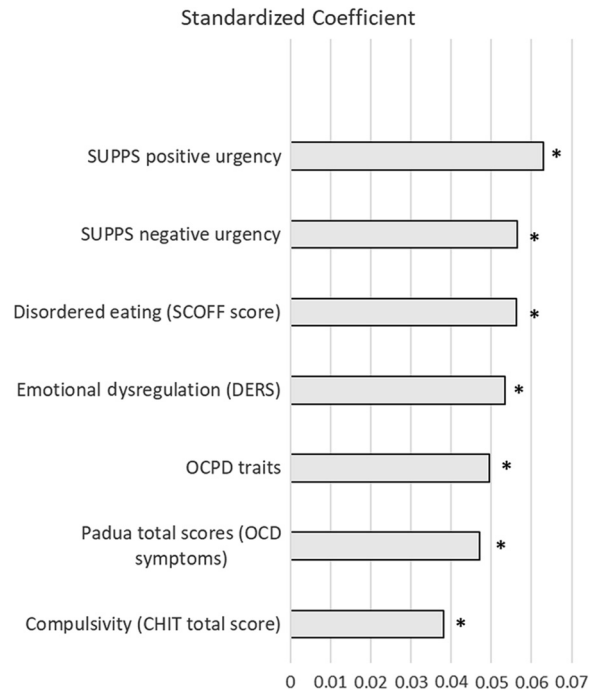


FIGURE 3. Variables in the PLS model predicting EAI relationship conflict factor scores (VIP > 0.8). * indicates statistically significant predictor ($p < 0.05$ using conservative bootstrap).

We focused on the factor structure of a standard assessment tool for problematic exercise and how scale factor scores related to quality of life and psychological mechanisms. Factor analysis of the EAI indicated the existence of a “general” factor and a “relationship conflict” factor. Both factors were associated with disordered eating (SCOFF questionnaire), impulsivity (several SUPPS subscales), and compulsivity (CHI-T scores). The relationship conflict factor score was additionally associated with worse quality of life, emotional dysregulation, and obsessive-compulsive personality traits. Problematic exercise scores were not significantly influenced by demographic characteristics of age, gender, or ethnic grouping.

The significant relationship between disordered eating as measured by the SCOFF instrument and problematic exercise is in keeping with a substantive body of literature. Studies have found elevated rates of excessive exercise in people with eating disorders or disordered eating, for example, ref. [3]. In some studies, the prevalence of eating disorders has been found to be elevated in athletes as compared to the background population,¹⁷ though this relationship may not be universal. For example, disordered eating has been found to be higher in sports such as dancing, wrestling, and body building, but not necessarily equally so across genders.³⁴⁻³⁶ In a sample of runners, those at risk of eating disorder, based

on a SCOFF cut-off, had significantly higher problematic exercise scores on the EAI.¹⁷ Here, disordered eating on the SCOFF was significantly associated with both problematic exercise factors on the EAI.

Impulsivity is not a unitary phenomenon but rather encompasses a number of separable domains. We used the SUPPS, which dissects sensation seeking, lack of premeditation, lack of perseverance, negative urgency, and positive urgency.²¹ In a prior study using the UPPS, sensation seeking, positive urgency, and negative urgency, all appeared to play a role in problematic exercise.¹⁴ Here, on the SUPPS, the EAI general factor was associated with higher sensation-seeking and with lower lack of perseverance (i.e., with higher perseverative tendencies). Thus, this propensity toward excessive exercise per se may be more common in people who enjoy the risky element of sports, and in those who have a tendency toward perseveration, that is, repetition of habits, which would be more related to the construct of compulsivity than impulsivity. The relationship conflict EAI factor had different associations with impulsivity; this was significantly related to positive and negative urgency, as well as to emotional dysregulation. Positive urgency refers to the tendency to engage in acts due to a positive mental state (e.g., excitement), whereas negative urgency refers to a tendency to engage in acts due to unpleasant emotional states (e.g., low mood or anxiety).³⁷ Emotional dysregulation reflects difficulties handling emotionally charged social situations.^{28,38} Collectively these data indicate that the relationship conflict component of problematic exercise is associated with impulsive responses to extreme emotions (positive and negative urgency), which indeed may be more commonly experienced in people with emotional dysregulation (short-term emotional lability). In a prior longitudinal study conducted in adolescents, emotional dysregulation predicted problematic exercise 12 months later.¹⁵ This raises the possibility that, in fact, those with problematic exercise are undertaking said exercise in order to deal with emotional dysregulation.

Turning to compulsivity, trans-diagnostic compulsivity on the CHIT was significantly associated with both general and relationship conflict factor scores from the EAI. This tendency toward repetitive ingrained habits could reflect a propensity (vulnerability) toward the development of problematic exercise. Longitudinal research would be valuable to test the idea that elevated compulsivity may predispose toward a range of later problem behaviors, including excessive exercise. The number of diagnostic items endorsed for obsessive-compulsive personality disorder was significantly associated with higher relationship conflict problematic exercise scores, but not general scores. This highlights that the use of trans-diagnostic markers, rather than scales specifically relating to one disorder, may be more sensitive to the detection of vulnerability issues.

Several limitations should be considered. Online surveys have limitations compared to in-person clinical assessments – instruments may be less accurate for measuring psychopathology, and there may be less quality control. Therefore, the findings should be replicated using more rigorous in-person clinical assessments. Online surveys are subject to potential sampling bias (e.g., more extensive users of the Internet may be more likely to participate in online surveys, whereas this may not impact participation in an in-person study). In contrast, online assessment has the advantage of being extremely convenient for study participants, since it does not involve travel and can be done at a convenient time. We assessed problematic exercise using the EAI. However, in future work it would be valuable to include a broader range of rating scales pertaining to the measurement of different aspects of problematic exercise. While this study identified two factors as the optimal structure to account for the current EAI data, prior work suggested a one-factor solution.¹⁹ Our current data do not contradict this previous finding because (i) a one-factor solution would have been reasonable with the current dataset if one focused solely on eigenvalues as the selection criteria; (ii) the majority of variance here was captured within the first extracted factor; and (iii) in some populations, a one-factor solution may be preferred.³³ Hence, depending on the focus of a given study and its purpose, one- or two-factor solutions would both appear reasonable. Nonetheless, we believe that the two-factor solution here revealed some interesting insights in relation to how distinct aspects of problematic exercise may have different associations with quality of life and underlying psychological processes. Our use of a normative sample can be viewed as being a positive feature, since results may be more likely to generalize to the background population as compared, for example, to studies that recruit people in particular clinical settings, or from gyms. The current cohort was largely free from full “exercise addiction” by conventional criteria. Future studies should also use case-control designs to explore the full disorder rather than a dimensional measure of exercise. Another limitation is that we did not evaluate the psychometric properties of various instruments. Further research is needed to confirm if these current findings do indeed generalize to other groups, including cohorts with higher degrees of pathology. Finally, we did not examine whether problematic exercise was secondary to body dysmorphic disorder or eating disorders.

Conclusions

We found that problematic exercise is associated with both impulsivity and compulsivity, even controlling for the interplay between these and other variables using the statistical technique of PLS. The aspect of

problematic exercise relating to relationship conflict was additionally associated with worse quality of life and with more maladaptive personality traits (obsessive-compulsive personality disorder and emotional dysregulation). An interesting possibility suggested by these data is that people with emotional dysregulation, and perhaps impulsive/compulsive tendencies, may engage in exercise as a compensatory mechanism or coping strategy, and that exercise – even when scoring on the EAI – need not necessarily be viewed as pathological. In a laboratory-based study, acute exercise (30 min stretching or running) dampened down emotional dysregulation due to later mood challenge.¹⁶ The definition of “problematic exercise” and its potential clinical utility, therefore, requires more research, and it is for this reason that we used a dimensional approach in this study. As with many repetitive behaviors, drawing guidelines as to what is healthy or moderate versus pathological remains challenging.

Disclosures

Dr. Grant has received research grants from NIDA, National Center for Responsible Gaming, TLC Foundation for BFRBs, American Foundation for Suicide Prevention, Brainsway, and Psyadon, and Takeda Pharmaceuticals. He receives yearly compensation from Springer Publishing for acting as Editor-in-Chief of the *Journal of Gambling Studies* and has received royalties from Oxford University Press, American Psychiatric Publishing, Inc., Norton Press, and McGraw Hill. Dr. Chamberlain consults for Cambridge Cognition, Shire, and Promentis. His involvement in this project was funded by a Wellcome Trust Fellowship (110049/Z/15/Z). The study was supported by the Neuroscience in Psychiatry Network, a strategic award from the Wellcome Trust to the University of Cambridge and University College London (095844/Z/11/Z).

Supplementary materials

To view supplementary material for this article, please visit <https://doi.org/10.1017/S1092852919000762>.

REFERENCES:

- Petit A, Lejoyeux M. [Exercise addiction]. *Rev Med Liege*. 2013; **68**(5–6): 331–339.
- Berczik K, Szabo A, Griffiths MD, et al. Exercise addiction: symptoms, diagnosis, epidemiology, and etiology. *Subst Use Misuse*. 2012; **47**(4): 403–417.
- Schlegl S, Dittmer N, Hoffmann S, Voderholzer U. Self-reported quantity, compulsiveness and motives of exercise in patients with eating disorders and healthy controls: differences and similarities. *J Eat Disord*. 2018; **6**: 17.
- Segura-Garcia C, Ammendolia A, Procopio L, et al. Body uneasiness, eating disorders, and muscle dysmorphia in individuals who overexercise. *J Strength Cond Res*. 2010; **24**(11): 3098–3104.
- Chen WJ. Frequent exercise: a healthy habit or a behavioral addiction? *Chronic Dis Transl Med*. 2016; **2**(4): 235–240.
- Lichtenstein MB, Hinze CJ, Emborg B, et al. Compulsive exercise: links, risks and challenges faced. *Psychol Res Behav Manag*. 2017; **10**: 85–95.
- Demetrovics Z, Kurimay T. [Exercise addiction: a literature review]. *Psychiatr Hung*. 2008; **23**(2): 129–141.
- Lejoyeux M, Guillot C, Chalvin F, et al. Exercise dependence among customers from a Parisian sport shop. *J Behav Addict*. 2012; **1**(1): 28–34.
- Chamberlain SR, Grant JE. Initial validation of a trans-diagnostic compulsivity questionnaire: the Cambridge-Chicago compulsivity trait scale. *CNS Spectr*. 2018; **23**(5): 340–346.
- MacKillop J, Weafer J, Gray JC, et al. The latent structure of impulsivity: impulsive choice, impulsive action, and impulsive personality traits. *Psychopharmacology (Berl)*. 2016; **233**(18): 3361–3370.
- Fontenelle LF, Oostermeijer S, Harrison BJ, et al. Obsessive-compulsive disorder, impulse control disorders and drug addiction: common features and potential treatments. *Drugs*. 2011; **71**(7): 827–840.
- Yucel M, Oldenhof E, Ahmed S, et al. A transdiagnostic dimensional approach towards a neuropsychological assessment for addiction: an international Delphi consensus study. *Addiction*. 2018. E-pub ahead of print.
- Brooks SJ, Lochner C, Shoptaw S, et al. Using the research domain criteria (RDoC) to conceptualize impulsivity and compulsivity in relation to addiction. *Prog Brain Res*. 2017; **235**: 177–218.
- Kotbagi G, Morvan Y, Romo L, et al. Which dimensions of impulsivity are related to problematic practice of physical exercise? *J Behav Addict*. 2017; **6**(2): 221–228.
- Goodwin H, Haycraft E, Meyer C. Emotion regulation styles as longitudinal predictors of compulsive exercise: a twelve month prospective study. *J Adolesc*. 2014; **37**(8): 1399–1404.
- Bernstein EE, McNally RJ. Acute aerobic exercise helps overcome emotion regulation deficits. *Cogn Emot*. 2017; **31**(4): 834–843.
- Di Lodovico L, Dubertret C, Ameller A. Vulnerability to exercise addiction, socio-demographic, behavioral and psychological characteristics of runners at risk for eating disorders. *Compr Psychiatry*. 2018; **81**: 48–52.
- Kiddle B, Inkster B, Prabhu G, et al. Cohort profile: the NSPN 2400 Cohort: a developmental sample supporting the Wellcome Trust Neuroscience in Psychiatry Network. *Int J Epidemiol*. 2018; **47**(1): 18–19.
- Griffiths MD, Szabo A, Terry A. The exercise addiction inventory: a quick and easy screening tool for health practitioners. *Br J Sports Med*. 2005; **39**(6): e30.
- Lindner P, Frykheden O, Forsstrom D, et al. The Brunnsvikien brief quality of life scale (BBQ): development and psychometric evaluation. *Cogn Behav Ther*. 2016; **45**(3): 182–195.
- Cyders MA, Littlefield AK, Coffey S, et al. Examination of a short English version of the UPPS-P impulsive behavior scale. *Addict Behav*. 2014; **39**(9): 1372–1376.
- Cyders MA, Smith GT. Emotion-based dispositions to rash action: positive and negative urgency. *Psychol Bull*. 2008; **134**(6): 807–828.
- Luck AJ, Morgan JF, Reid F, et al. The SCOFF questionnaire and clinical interview for eating disorders in general practice: comparative study. *BMJ*. 2002; **325**(7367): 755–756.
- Renz JA, Fisher M, Vidair HB, et al. Excessive exercise among adolescents with eating disorders: examination of psychological and demographic variables. *Int J Adolesc Med Health*. 2017. E-pub ahead of print.
- Burns GL. *Padua Inventory-Washington State University Revision*. Pullman, WA: Washington State University; 1995.
- Sanavio E. Obsessions and compulsions: the Padua Inventory. *Behav Res Ther*. 1988; **26**(2): 169–177.

27. Gratz KL, Roemer L. Multidimensional assessment of emotion regulation and dysregulation: development, factor structure, and initial validation of the difficulties in emotion regulation scale. *J Psychopathol Behav Assess*. 2004; **26**: 41-54.
28. D'Agostino A, Covanti S, Rossi Monti M, *et al*. Reconsidering emotion dysregulation. *Psychiatr Q*. 2017; **88**(4): 807-825.
29. Wold S, Sjöström M, Eriksson L. PLS-regression: a basic tool of chemometrics. *Chemometr Intell Lab Syst*. 2001; **58**(2, 28): 109-130.
30. Wold H. Soft modelling. The basic design and some extensions. In: Jöreskog KG, Wold H, eds. *Systems Under Indirect Observation*. Vol **1-2**. Amsterdam: North-Holland; 1982.
31. Wold H. *Estimation of Principal Components and Related Models by Iterative Least Squares*. New York: Academic Press; 1966.
32. Chamberlain SR, Cavanagh JT, de Boer P, *et al*. Treatment-resistant depression and peripheral C-reactive protein. *Br J Psychiatry*. 2019; **214**(1): 11-19.
33. Lichtenstein MB, Griffiths MD, Hemmingsen SD, *et al*. Exercise addiction in adolescents and emerging adults - validation of a youth version of the exercise addiction inventory. *J Behav Addict*. 2018; **7**(1): 117-125.
34. Chapman J, Woodman T. Disordered eating in male athletes: a meta-analysis. *J Sports Sci*. 2016; **34**(2): 101-109.
35. Smolak L, Murnen SK, Ruble AE. Female athletes and eating problems: a meta-analysis. *Int J Eat Disord*. 2000; **27**(4): 371-380.
36. Devrim A, Bilgic P, Hongu N. Is there any relationship between body image perception, eating disorders, and muscle dysmorphic disorders in male bodybuilders? *Am J Mens Health*. 2018; **12**(5): 1746-1758.
37. Billieux J, Gay P, Rochat L, *et al*. The role of urgency and its underlying psychological mechanisms in problematic behaviours. *Behav Res Ther*. 2010; **48**(11): 1085-1096.
38. Lavender JM, Wonderlich SA, Engel SG, *et al*. Dimensions of emotion dysregulation in anorexia nervosa and bulimia nervosa: a conceptual review of the empirical literature. *Clin Psychol Rev*. 2015; **40**: 111-122.