

## Risk for exercise dependence, eating disorder pathology, alcohol use disorder and addictive behaviors among clients of fitness centers

ASTRID MÜLLER<sup>1\*</sup>, SABINE LOEBER<sup>2</sup>, JOHANNA SÖCHTIG<sup>1</sup>, BERT TE WILDT<sup>3</sup> and MARTINA DE ZWAAN<sup>1</sup>

<sup>1</sup>Department of Psychosomatic Medicine and Psychotherapy, Hannover Medical School, Hannover, Germany

<sup>2</sup>Department of Clinical Psychology and Psychotherapy, University of Bamberg, Bamberg, Germany

<sup>3</sup>Department of Psychosomatic Medicine and Psychotherapy, LWL University Hospital of the Ruhr University Bochum, Bochum, Germany

(Received: July 5, 2015; revised manuscript received: October 5, 2015; accepted: October 25, 2015)

---

*Background and aims:* Exercise dependence (EXD) is considered a behavioral addiction that is often associated with eating disorders. To date, only few studies examined the potential overlap between EXD and other addictive behaviors. Therefore, the present study aimed at investigating the relationship of EXD with pathological buying, pathological video gaming (offline and online), hypersexual behavior, and alcohol use disorder in a sample of clients of fitness centers. *Methods:* The following questionnaires were answered by 128 individuals (age  $M = 26.5$ ,  $SD = 6.7$  years; 71.7% men, 74.2% university students): Exercise Dependence Scale, Eating Disorder Examination-Questionnaire, Compulsive Buying Scale, Pathological Computer-Gaming Scale, Hypersexual Behavior Inventory, and Alcohol Use Disorders Identification Test (AUDIT). *Results:* 7.8% of the sample were at-risk for EXD, 10.9% reported eating disorder pathology, 2.3% pathological buying, 3.1% hypersexual behavior, and none of the participants suffered from pathological video gaming. The criteria for severe alcohol disorder pathology ( $AUDIT \geq 16$ ) were fulfilled by 10.2%. With regard to continuous symptom scores, EXD symptoms were positively correlated with both eating disorder pathology and pathological buying but not with pathological video gaming, hypersexuality or alcohol use disorder. It is noteworthy that more symptoms of pathological buying corresponded with more symptoms of hypersexual behavior. The correlation pattern did not differ by gender. *Discussion:* The co-occurrence of EXD, pathological buying and hypersexual behavior on a subclinical level or in the early stage of the disorders should be taken into account when assessing and treating patients. More research is warranted in order to investigate possible interactions between these conditions.

**Keywords:** exercise dependence, eating disorder, pathological buying, pathological video gaming, hypersexual behavior, alcohol use disorder

---

### INTRODUCTION

While regular exercise is known to have a positive impact on health, habitually engaging in high amounts of sport can become harmful to an individual. Practicing sport in an exaggerated way can meet the criteria for exercise dependence (EXD) (Coverley Veale, 1987). This type of behavioral addiction refers to excessive exercise that is associated with extreme preoccupation, neglect of exhaustion, maintenance of exercising in the presence of pain or physical impairment, and interference with work and family responsibilities (Adams, 2009; Bamber, Cockerill, Rodgers & Carroll, 2003; Berczik et al., 2012; Coverley Veale, 1987; Griffiths, 1997; Hausenblas & Downs, 2002a).

Most studies used questionnaires instead of clinical interviews to examine EXD. Given that diagnoses based on self-ratings may overestimate the presence of EXD, questionnaire-based prevalence rates should be interpreted rather as the amount of those who are at-risk for EXD (Müller et al., 2014). Representative questionnaire-based surveys found a prevalence rate between 0.5 and 3.5% for being at-risk for EXD in the general population (Hausenblas & Downs, 2002a; Mónok et al., 2012; Müller et al., 2013). The point prevalence in a representative large German population-based sample ( $N = 1,611$ ) was estimated to be 3.5% in the total sample, 4.4% in men, and 2.7% in

women, although this difference slightly failed to reach statistical significance ( $p = .056$ ) (Müller et al., 2013). The same study investigated groups that were connected to sports, namely clients of fitness centers and sport students. Not surprisingly, they presented with elevated prevalence rates, with 16.5% of the clients of fitness centers and 12.4% of the sport students being at-risk for EXD (Müller et al., 2013). Another study reported a somewhat lower frequency with 10.6% of the clients of German fitness centers ( $N = 161$ ) meeting criteria for probable EXD (Müller, 2013). Other studies investigating physically active individuals suggested much higher prevalence rates of up to 33.2% in amateur athletes (Modoio et al., 2011), 36.4% (Grandi, Clementi, Guidi, Benassi & Tossani, 2011) or 42% (Lejoyeux, Avril, Richoux, Embouazza & Nivoli, 2008) in gym users or even 52% among triathletes (Blaydon & Lindner, 2002). With regard to the relatively broad range of prevalence rates it has to be assumed that some of the results may have been biased by varying sample characteristics and measurement tools (Sussmann, Lisha & Griffiths, 2011).

---

\* Corresponding author: Astrid Müller, MD, PhD; Department of Psychosomatic Medicine and Psychotherapy, Hannover Medical School, Carl-Neuberg-Straße 1, 30625 Hannover, Germany; E-mail: [mueller.astrid@mh-hannover.de](mailto:mueller.astrid@mh-hannover.de)

It is also well known that EXD is more prevalent among patients with eating disorders who use excessive exercise to control weight (Bratland Sanda et al., 2010; Cook, Hausenblas, Crosby, Cao & Wonderlich, 2015). In that case, EXD is secondary to an anorexia or bulimia nervosa and serves as a compensatory behavior to deal with weight and shape concerns. Primary EXD, on the other hand, is characterized by the absence of an underlying eating disorder and mainly driven by goals such as athletic performance or fun from sportive activities (Cook et al., 2013; Coverley Veale, 1987; Müller et al., 2015).

Although EXD has been conceptualized as a behavioral addiction by many researchers (Adams, 2009; Hausenblas & Downs, 2002a), studies concerning the potential overlap between EXD and other addictive behaviors are still more than scarce. Lejoyeux et al. (2008) investigated EXD and its relation to other addictions among clients of a Parisian fitness center (126 women and 174 men). In addition to EXD they also assessed the presence or absence of alcohol and nicotine use disorders, time spent on the Internet, pathological buying as well as bulimia nervosa and hypochondriasis. In that study, 42% of the participants met the criteria for EXD. As expected, clients with EXD suffered more often from bulimia nervosa than those without EXD. Furthermore, pathological buying was more frequent in this group. In contrast, no differences emerged with regard to the prevalence rates of alcohol/nicotine dependence, time spent on the Internet as well as hypochondriasis, age, gender and body mass index (BMI). The study provided first insight into the relationship between EXD and other addictions but was limited by the use of a self-developed exercise addiction survey.

In terms of the increased occurrence of pathological buying in clients with EXD compared to those without EXD (63% vs. 38%), Lejoyeux et al. (2008, p. 357) assumed that both behaviors may represent “socially tolerated” or “reasonable” forms of addiction driven by appearance-related anxiety, i.e. shape concerns with respect to EXD, and narcissism – restored by purchasing consumer goods – with respect to pathological buying. The latter phenomenon is characterized by extreme preoccupation with shopping and buying resulting in repeated inappropriate purchases of frequently useless or unused consumer goods (for review see Müller, Mitchell & de Zwaan, 2015). Buying binges serve as a maladaptive coping strategy to manage negative mood states and low self-esteem, and lead in the long run to substantial adverse consequences such as clinically significant distress, debts and functional impairment.

Later on, Lejoyeux, Guillot, Chalvin, Petit and Lequen (2012) performed another study concerning the co-occurrence of EXD and other addictive behaviors. The study was conducted in a Parisian sports shop and included 500 customers. Of those, 29.6% were diagnosed with EXD. The results indicated that eating disorder pathology and alcohol use disorder were more common in participants with EXD but pathological buying was not.

Taken together, the outcomes of the aforementioned studies confirmed earlier results on the comorbidity between EXD and eating disorder pathology but produced mixed results with regard to addictive behaviors, namely alcohol use disorder and pathological buying. However, previous

studies have examined only a limited number of addictive behaviors. Thus, as Lejoyeux et al. (2008) suggested, EXD and pathological buying can be conceptualized as “socially tolerated” or “reasonable” forms of addiction driven by appearance-related anxiety, it can be assumed that EXD and, for example, pathological video gaming might have less in common. This question has not been addressed in previous studies. Pathological Internet gaming constitutes a prevalent behavioral addiction (Müller, Janikian et al., 2015) and is now included as a condition requiring further research in the appendix of the 5th edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; APA, 2013). According to the literature, individuals with pathological video gaming are physically less active or even prone to a predominantly sedentary lifestyle (Melkevik Torsheim, Iannotti & Wold, 2010; Vandewater, Shim & Caplovitz, 2004).

There is a lack of studies on the co-occurrence of EXD with other behavioral addictions and a need for research investigating prevalence rates and potential patterns of comorbidity within the same sample (Sussmann, Lisha & Griffiths, 2011). To fill this gap, we investigated the relationship between EXD and other forms of addictive behavior, namely pathological buying, pathological video gaming (offline and online) and alcohol use disorder, in a German sample of physically active adults (i.e. clients of fitness centers). We also assessed the co-occurrence with eating disorder pathology. Given the possibility of an overlap between EXD and symptoms of hypersexual disorder we further decided to include a measure for hypersexual behavior. Hypersexual disorder is a rather understudied phenomenon which refers to repetitive, intense preoccupation with sexual fantasies, urges and non-paraphilic behaviors that cause substantial adverse consequence and clinical significant impairment (Kafka, 2010). Several researchers proposed its conceptualization as a behavioral addiction (Derbyshire & Grant, 2015; Kor, Fogel, Reid & Potenza, 2013).

Furthermore, we considered potential gender effects. Past research, including studies concerning EXD, has demonstrated characteristic differences in addictive disorders between men and women (Costa, Hausenblas, Oliva, Cuzzocrea & Larcán, 2013; Fattore, Melis, Fadda & Fratta, 2014; Meulemans, Pribis, Grajales & Krivak, 2014; Szabo, Vega, Ruiz-Barquín & Rivera, 2013). For this reason, all analyses were performed with respect to gender.

Taken together, the aims of the present study were to 1) assess how many participants of a sample of fitness center clients were at-risk for EXD and if the rates differ by gender, and 2) explore the correlations between symptoms of EXD, eating disorder, alcohol use disorder, pathological buying, pathological video gaming and hypersexual behavior in men and women. In light of past research we hypothesized that the estimated prevalence of EXD in the present sample will be higher than in the general population, both in men and women. We further predicted that symptoms of EXD will be positively related to eating disorder pathology, alcohol use and symptoms of pathological buying. With regard to pathological video gaming we expected a rather low occurrence in the present sample and no association with EXD. The inclusion of hypersexual behavior in the study was for

exploratory reasons. Therefore, we did not have a specific hypothesis with respect to the link between EXD and hypersexual behavior.

## METHODS

### Participants

Assessments were conducted in a convenience sample of 128 clients of fitness centers. Inclusion criteria were age  $\geq 18$  years and a minimum of at least one hour exercising per week. Exclusion criteria were insufficient German language skills. Data were collected between April 2013 and November 2013.

### Measures

First, all participants answered questions with regard to sociodemographic characteristics (i.e. age, gender, education, occupation, presence or absence of a partnership, weight, height, hours exercising per week). Second, a questionnaire package was administered that consisted of validated self-rating instruments for eating disorder pathology, alcohol use disorder, and behavioral addictions.

EXD symptoms were measured with the German version of the Exercise Dependence Scale-21 (EDS-G) (Hausenblas & Downs, 2002b; German version: Müller et al., 2013). This widely used questionnaire assesses key features of EXD within the last three months. The total EDS-G score was used to estimate EXD, whereas EDS-G scores above 77 define individuals as being at-risk for EXD. This cutoff value was determined in an earlier representative German study (Müller et al., 2013) using a Receiver Operating Characteristic curve that was based on the diagnostic criteria for being at-risk for EXD reported by Hausenblas and Downs (2002b). Cronbach's  $\alpha$  for the total EDS-G score in the present sample was 0.91.

Eating disorder pathology was measured using the Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 1994; German version: Hilbert, de Zwaan & Braehler, 2012). A mean total EDE-Q score of 2.3 or more indicates eating disorder pathology. Cronbach's  $\alpha$  in the present sample was 0.93.

Symptoms of pathological buying were assessed using the Compulsive Buying Scale (CBS; Faber & O'Guinn, 1992; German version: Mueller et al., 2010). Lower total scores indicate higher levels of pathological buying. According to an earlier representative study, CBS-G scores of  $-1.09$  or less indicate the presence of pathological buying. Cronbach's  $\alpha$  in the present sample was 0.78.

Pathological video gaming was measured with a scale developed by Wölfling, Müller and Beutel (2011). The questionnaire includes an item asking for the preference of gaming (offline vs. online). Total scores between 3 and 6.5 indicate excessive / problematic and scores of 7 or more indicate addictive gaming behavior. Cronbach's  $\alpha$  in the present sample was 0.72.

Hypersexual behavior was assessed using the Hypersexual Behavior Inventory (HBI; Reid, Garos & Carpenter, 2011; German version: Klein, Rettenberger, Boom &

Briken, 2014). A total score of 53 or more refers to hypersexual behavior (Reid et al., 2011). Cronbach's  $\alpha$  in the present sample was 0.92.

The Alcohol Use Disorders Identification Test (AUDIT; Babor, de la Fuente, Saunders & Grant, 1989; German version: Dybek et al., 2006) was used to screen for alcohol use disorder at-risk. According to Miller (1995), a score of 16 and above is indicative for an alcohol use disorder, whereas a total AUDIT score of 8 or more is recommended as indicator of hazardous and harmful alcohol use, as well as possible alcohol dependence (Babor et al., 1989). Cronbach's  $\alpha$  in the present sample was 0.77.

### Statistical analysis

Data analysis was performed using IBM SPSS Statistics v.22. To calculate group differences (men vs. women), we performed nonparametric tests (Mann-Whitney- $U$  tests, two-tailed) given that most variables were not normally distributed. Prevalence rates were calculated based on available cutoff scores for each questionnaire. Categorical variables including prevalence rates were compared using  $\chi^2$ -tests. Fisher's exact test was used if the expected count in one of the cells was less than 5. Two-tailed Spearman's rank-order correlations were conducted to determine the relationship of EXD symptoms with eating disorder, pathological buying, pathological video gaming, hypersexual behavior and alcohol use disorder symptoms. The significance level for all tests was set at  $\alpha = 0.05$ .

### Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. After being informed about the aims of the study, all participants provided written informed consent. The research protocol was approved by the Institutional Ethics Committee of the Hannover Medical School.

## RESULTS

### Sociodemographic characteristics and prevalence estimates in the total sample

Table 1 demonstrates sociodemographic characteristics and prevalence estimates in the total sample of 128 participants. As can be seen in the table, the majority of participants were male university students. The highest prevalence estimate was found for alcohol use disorder, followed by eating disorder pathology and EXD. Relatively low rates emerged for pathological buying and hypersexual behavior. None of the participants reported a total score of 7 or more on the Pathological Computer-Gaming Scale which would have been indicative for addictive gaming according to Wölfling et al. (2011) but seven men exhibited excessive / problematic computer gaming (total score 3 to 6.5). Of those, five individuals preferred online and the remaining two offline gaming. The criteria for severe alcohol disorder pathology (AUDIT  $\geq 16$ ) were fulfilled by 10.2%. Sixty participants (46.9%) met the criteria for hazardous and harmful alcohol use, as well as possible alcohol dependence (AUDIT  $\geq 8$ ).

Table 1. Sample characteristics and risk for addictive behaviors among visitors of fitness rooms

	Present German study <i>N</i> = 128
Age [ <i>M</i> ( <i>SD</i> )]	26.5 (6.7)
Body mass index (kg/m <sup>2</sup> ) [ <i>M</i> ( <i>SD</i> )]	23.0 (3.3)
Gender, female [ <i>N</i> (%)]	49 (38.3)
Living alone [ <i>N</i> (%)]	56 (43.8)
University students [ <i>N</i> (%)]	95 (74.2)
Unemployed [ <i>N</i> (%)]	0 (0.0)
Secondary level/university [ <i>N</i> (%)]	121 (95.5)
<i>At-risk for</i> [ <i>N</i> (%)]	
Exercise dependence	10 (7.8)
Eating disorder	14 (10.9)
Pathological buying	3 (2.3)
Pathological video gaming	0 (0.0)
Hypersexual behavior	4 (3.1)
Alcohol use disorder	13 (10.2) <sup>a</sup>

Notes: <sup>a</sup> The categorization was based on an AUDIT cutoff  $\geq 16$  that is indicative for alcohol use disorder (Miller, 1995).

Comparison between men and women

Men and women did not differ with respect to education or occupation. In terms of partnership, women reported more often having a partner than men (69.4% and 48.1%,

respectively,  $\chi^2 = 5.568, p = .018$ ). As shown in Table 2, no gender differences emerged with regard to age but women had a lower BMI. They further reported a smaller amount of exercise per week, less symptoms of EXD (EDS-G) but more eating disorder pathology (EDE-Q). Furthermore, women exhibited less symptoms of pathological video gaming, alcohol use disorder, and hypersexual behavior but did not differ from men with respect to pathological buying.

To explore the clinical validity of the aforementioned gender differences of the total scale scores, we compared the prevalence estimates between groups (Table 3). Except for eating disorder pathology, women tended towards fewer diagnoses. However, only for alcohol use disorder the difference between groups reached statistical significance. By using an AUDIT cutoff of 16 (Miller, 1995), none of the female participants fulfilled the criteria, while 16.9% of male individuals scored above the cutoff.

Of those being at-risk for EXD (*N* = 10), only one man was at-risk for an eating disorder. He was also at-risk for pathological computer gaming. Four men with probable EXD scored above the cutoff on the AUDIT indicating alcohol problems. Of those, two were at-risk for pathological buying and one of the two suffered from comorbid problematic computer gaming. None of the women being at risk for EXD was also at-risk for any other diagnosis.

Table 2. Comparison between male and female visitors with regard to age, Body Mass Index (BMI), hours exercising per week, eating disorder pathology, alcohol use disorder, and addictive behaviors

	Men ( <i>N</i> = 79)		Women ( <i>N</i> = 49)		Group comparison Mann–Whitney- <i>U</i> tests, two-tailed
	Range	<i>M</i> ( <i>SD</i> )	Range	<i>M</i> ( <i>SD</i> )	
Age [years]	19.00–55.00	26.51 (6.47)	20.00–53.00	26.39 (7.03)	<i>U</i> = 1897.500, <i>p</i> = .851
Body mass index [kg/m <sup>2</sup> ] <sup>a</sup>	16.36–32.37	23.97 (2.69)	17.58–35.01	21.49 (3.57)	<i>U</i> = 768.500, <i>p</i> < .001
Hours exercising per week	1.00–32.00	7.16 (4.79)	1.00–16.00	4.87 (2.72)	<i>U</i> = 1309.500, <i>p</i> = .002
Exercise Dependence Scale	25.00–108.00	53.86 (16.65)	21.00–80.00	45.80 (14.10)	<i>U</i> = 1382.500, <i>p</i> = .007
Eating Disorder Examination- Questionnaire	0.00–3.50	0.95 (0.80)	0.00–4.74	1.36 (1.13)	<i>U</i> = 1530.000, <i>p</i> = .047
Compulsive Buying Scale	–4.84–3.61	2.37 (1.46)	–0.67–3.61	2.61 (0.96)	<i>U</i> = 1847.500, <i>p</i> = .665
Pathological Computer-Gaming Scale	0.00–6.00	0.63 (1.28)	0.00–2.00	0.15 (0.51)	<i>U</i> = 1494.000, <i>p</i> = .010
Hypersexual Behavior Inventory	19.00–62.00	30.70 (9.65)	19.00–59.00	25.33 (7.97)	<i>U</i> = 1182.500, <i>p</i> < .001
Alcohol Use Disorders Identification Test	0.00–23.00	9.76 (5.36)	1.00–14.00	5.82 (3.53)	<i>U</i> = 1052.500, <i>p</i> < .001

Note: The variables were not normally distributed. Therefore, Mann–Whitney-*U* tests were used to compare both groups. <sup>a</sup> BMI data were available from 78 men and 48 women.

Table 3. Prevalence of at-risk diagnoses for exercise dependence, eating disorder pathology, alcohol use disorder, and addictive behaviors

	Men ( <i>N</i> = 79) <i>N</i> (%)	Women ( <i>N</i> = 49) <i>N</i> (%)	Group comparison <sup>a</sup>
Exercise dependence	7 (8.9)	3 (6.1)	$\chi^2 = .315, p = .740$
Eating disorder	6 (7.6)	8 (16.3)	$\chi^2 = 2.367, p = .150$
Pathological buying	3 (3.8)	0 (0.0)	n/a
Pathological video gaming	0 (0.0)	0 (0.0)	n/a
Hypersexual behavior	3 (3.8)	1 (2.0)	$\chi^2 = .308, p = 1.000$
Alcohol use disorder <sup>b</sup>	13 (16.5)	0 (0.0)	n/a

Note: <sup>a</sup> two-tailed Fisher’s exact test was used due to the low expected cell count. No comparisons were performed when the cell had an expected count of 0. <sup>b</sup> The categorization was based on an AUDIT cutoff  $\geq 16$  that is indicative for alcohol use disorder (Miller, 1995).



Table 4. Relationship between the risk for exercise dependence, eating disorder pathology, alcohol use disorder, and other addictive behaviors by gender (Spearman Rho, two-tailed)

	EDS-G	EDE-Q	CBS	PCG	HBI
4a: Among male visitors of fitness centers ( $N = 79$ )					
EDE-Q	.284*				
CBS	.270*	-.204			
PCG	.122	.272*	.116		
HBI	.177	.147	.387**	-.067	
AUDIT	.014	.016	.246*	.157	.211
4b: Among female visitors of fitness centers ( $N = 47$ )					
EDE-Q	.395**				
CBS	.381**	-.203			
PCG	-.018	.081	.038		
HBI	.282	.126	.397**	.082	
AUDIT	.119	.029	.229	.260	.146

Notes: \* $p < .05$ , \*\* $p < .01$

EDS-G = German Exercise Dependence Scale, EDE-Q = Eating Disorder Examination-Questionnaire, CBS = Compulsive Buying Scale, scores were inversed, PCG = Pathological Computer-Gaming Scale, HBI = Hypersexual Behavior Inventory, AUDIT = Alcohol Use Disorders Identification Test

#### Correlation between symptoms of exercise dependence, eating disorder pathology and other addictive behaviors by gender

As can be seen in Table 4, only the EDE-Q and the CBS were positively correlated with the EDS-G indicating an association between higher levels of EXD with more eating disorder pathology and higher levels of pathological buying. Interestingly, we found a positive relationship between symptoms of pathological buying and symptoms of hypersexual behavior in both men and women. In men but not in women, symptoms of pathological buying were also related to alcohol use, and eating disorder pathology was positively correlated with symptoms of video gaming. Of note, correlation coefficients did not differ between groups (all  $z < 1.059$ , all  $p > .145$ )

## DISCUSSION

The main result of the present study is the positive relationship between EXD symptoms and both eating disorder pathology and symptoms of pathological buying in a sample of fitness club clients, which is in line with our hypothesis. The link between EXD symptoms and disordered eating is not surprising and in accordance with past studies (Bratland-Sanda et al., 2010; Cook et al., 2015). As already mentioned above, there is a large amount of research that highlights the role of intense, habitual exercise as a maladaptive coping strategy to dealing with weight, shape and appearance-related concerns. The results further support the findings of Lejoyeux et al. (2008), who had investigated a comparable sample of fitness center clients (see Table 1).

A closer look at our results, however, shows that of those persons who were categorized as being at-risk for EXD only one reported eating disorder symptoms of clinical importance.

Therefore, it appears that the observed positive correlation between the continuous symptom scores (i.e. EDS-G and EDE-Q) should be interpreted as a significant relationship on a subclinical level, which might be explained by underlying variables such as high impulsivity or reward deficiency.

The positive correlation of EXD with pathological buying symptoms also corresponds with the findings of Lejoyeux et al. (2008). Of interest, the prevalence of pathological buying in the present sample was rather low compared to earlier representative surveys. Past studies produced prevalence estimates of pathological buying in the general population between 5 and 7% or more (for review see Müller, Mitchell & de Zwaan, 2015). Even though the number of those who exhibited both EXD and pathological buying on a clinically relevant level was low, it seems reasonable to reflect the significant correlation between the total scores of the questionnaires in more detail. We agree with the assumption of Lejoyeux et al. (2008) that both behaviors represent socially more tolerated forms of addictive behaviors. According to our clinical experience, intense exercise and overspending are indeed more often minimized than daily alcohol use or extreme online gaming. Hence, the potential co-occurrence of EXD and pathological buying symptoms – even on a subclinical level or in the early stage of the disorders – should be taken into account when assessing and treating patients.

Another interesting finding is the correlation of symptoms of pathological buying and hypersexual behavior in the present sample. Lejoyeux et al. (2008) argued that both EXD and pathological buying share appearance-related anxiety as an underlying motive. This could also be true with respect to hypersexuality, at least in a sample of clients of a fitness center. Another commonality between patients with pathological buying and those with hypersexual disorder is the presence of painful shame and embarrassment about the inappropriate behavior. Hence, they mostly keep their problem a secret. Again, this underlines the need for careful assessment of co-occurring problematic behaviors that may have developed on a subclinical level and, thus, might contribute to the primary disorder. Of course, these conclusions are tentative and more research is warranted in order to investigate possible interactions between addictive behaviors.

With regard to those participants who were at-risk for EXD we found a prevalence rate of 7.8% in the present sample without a significant difference between men and women. This rate was about double of that observed in a large representative German sample (Müller et al., 2013) and almost equivalent with the findings from an earlier study with German fitness center clients (Müller et al., 2013), though the rate was much lower than that reported in the French study (7.8% vs. 42.0%) (Lejoyeux et al., 2008). In addition to the lower EXD prevalence, we found less eating disorder pathology (10.9% vs. 57.0%) and a lower frequency of pathological buying (2.3% vs. 49.0%) than in the French study. The samples seem quite similar with regard to age, BMI and gender distribution. We do not think that the difference in prevalence rates can be fully explained by cultural differences or other sample characteristics but assume that the differences are most likely due to varying measurement tools. Lejoyeux et al. (2008) used a

self-developed exercise addiction survey that might have overestimated current prevalence. The assessment in the present study relied on standardized, internationally widely used instruments. The cutoff scores for the translated versions have all been validated in German samples (Dybek et al., 2006; Hilbert et al., 2012; Klein et al., 2014; Mueller et al., 2010; Müller et al., 2013; Wölfing et al., 2011). Therefore, we believe that the instruments were suitable and that our data reflect appropriate prevalence estimates.

As expected, only a very small number of participants exhibited excessive / problematic, mostly online, video gaming and none was classified as an addictive video gamer. The results appear reasonable as the present sample consisted of individuals who were connected to sports and therefore less prone towards a screen-based sedentary lifestyle that displaces time for physical activities (Melkevik et al., 2010; Vandewater et al., 2004).

Although women exhibited lower levels of EXD on the EDS-G and reported less hours exercising per week, the rate of those being at-risk for EXD was equivalent between male and female participants. Also, the correlation pattern was equivalent in both gender groups (see Table 4). The lack of gender differences in EXD corresponds with earlier reports (Lejoyeux et al., 2008; Müller et al., 2013). Similarly, despite significant group differences in most of the continuous symptom scores (see Table 2), no gender effect emerged in terms of categorical distinction of prevalence rates of the other investigated addictive behaviors. The only exception pertains to alcohol use disorder with 16.5% of men but none of the female participants being at-risk (AUDIT  $\geq$  16). It should be mentioned that the total number of participants of our sample that had an AUDIT score of  $\geq$  8, which is indicative for hazardous and harmful alcohol use, as well as possible alcohol dependence (Babor et al., 1989), was considerably higher compared to other German reports that used this cutoff criteria (e.g., Dybek et al., 2006; Pabst, Kraus, Matos & Piontek, 2013). This finding may be attributable to the fact that the AUDIT was developed as a screening instrument that seems very sensitive to problematic alcohol use with the risk to overestimate alcohol use disorder (Rumpf, Hapke, Meyer & John, 2002).

The conclusions are restrained by some other shortcomings. We studied a relatively small, self-selected convenience sample of fitness center clients who were probably not representative for all individuals at-risk for EXD. Further studies should address the question of whether our results can be confirmed in larger samples with more frequent diagnoses of EXD. Another limitation of the present study is that prevalence rates were not verified using structured interviews. On the other hand, some of the participants may have even favored answering an anonymous questionnaire instead of having a face-to-face clinical interview. Furthermore, we investigated only a limited spectrum of behavioral addictions. The assessment of gambling disorder or addictive use of social network sites would have contributed additional value to the study and should be considered in future research. Last but not least, the cross-sectional design precludes any causal interpretation. Taken together, our results have to be interpreted with caution and against the background of the limitations.

## CONCLUSIONS

The findings extend the literature by examining the relationship between EXD and other addictive behaviors. They support the assumption that more symptoms of EXD are related to more eating disorder pathology and more symptoms of pathological buying. Furthermore, at least in the present sample, a positive correlation between continuous symptom scores of pathological buying and hypersexual behavior was found. Future longitudinal research is encouraged to investigate potential interactions between the addictive behaviors.

---

*Funding sources:* No financial support was received for this study.

*Authors' contribution:* AM, JS, BtW, and MdZ designed the study and planned data analysis. JS and AM monitored data collection. AM, JS, and SL performed the statistical analysis. AM, SL, BtW, and MdZ supported the interpretation of the results. AM wrote the manuscript. SL, JS, BtW, and MdZ reviewed the manuscript and gave feedback. All authors had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

*Conflict of interest:* The authors declare no conflict of interest.

---

## REFERENCES

- Adams, J. (2009). Understanding exercise dependence. *Journal of Contemporary Psychotherapy*, 39(4), 231–240.
- American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders*. 5th revision ed. Washington, DC: American Psychiatric Association.
- Babor, T. F., de la Fuente, J. R., Saunders, J. & Grant, M. (1989). *AUDIT—The alcohol use disorders identification test: Guidelines for use in primary health care*. Geneva: World Health Organization, Division of Mental Health.
- Bamber, D. J., Cockerill, I. M., Rodgers, S. & Carroll, D. (2003). Diagnostic criteria for exercise dependence in women. *British Journal of Sports Medicine*, 37(5), 393–400.
- Berczik, K., Szabó, A., Griffiths, M. D., Kurimay, T., Kun, B., Urbán, R. & Demetrovics, Z. (2012). Exercise addiction: Symptoms, diagnosis, epidemiology, and etiology. *Substance Use & Misuse*, 47(4), 403–417.
- Blaydon, M. J. & Lindner, K. J. (2002). Eating disorders and exercise dependence in triathletes. *Eating Disorders*, 10(1), 49–60.
- Bratland-Sanda, S., Sundgot Borgen, J., Rø, Ø., Rosenvinge, J. H., Hoffart, A. & Martinsen, E. W. (2010). “I’m not physically active I only go for walks”: Physical activity in patients with longstanding eating disorders. *International Journal of Eating Disorders*, 43(1), 88–92.

- Cook, B., Hausenblas, H., Crosby, R. D., Cao, L. & Wonderlich, S. A. (2015). Exercise dependence as a mediator of the exercise and eating disorders relationship: A pilot study. *Eating Behaviors*, 16, 9–12.
- Cook, B., Karr, T. M., Zunker, C., Mitchell, J. E., Thompson, R., Sherman, R., Crosby, R. D., Cao, L., Erickson, A. & Wonderlich, S. A. (2013). Primary and secondary exercise dependence in a community-based sample of road race runners. *Journal of Sport & Exercise Psychology*, 35(5), 464–469.
- Costa, S., Hausenblas, H., Oliva, P., Cuzzocrea, F. & Larcán, R. (2013). The role of age, gender, mood states and exercise frequency on exercise dependence. *Journal of Behavioral Addictions*, 2(4), 216–223.
- Coverley Veale, D. D. (1987). Exercise dependence. *British Journal of Addiction*, 82(7), 735–740.
- Derbyshire, K. L. & Grant, J. E. (2015). Compulsive sexual behavior: A review of the literature. *Journal of Behavioral Addictions*, 4(2), 37–43.
- Dybek, I., Bischof, G., Grothues, J., Reinhardt, S., Meyer, C., Hapke, U., John, U., Brocks, A., Hohagen, F. & Rumpf, H. J. (2006). The reliability and validity of the Alcohol Use Disorders Identification Test (AUDIT) in a German general practice population sample. *Journal of Studies on Alcohol*, 67(3), 473–481.
- Faber, R. J. & O'Guinn, T. C. (1992). A clinical screener for compulsive buying. *Journal of Consumer Research*, 19(3), 459–469.
- Fairburn, C. G. & Beglin, S. J. (1994). Assessment of eating disorders: Interview or self-report questionnaire? *International Journal of Eating Disorders*, 16(4), 363–370.
- Fattore, L., Melis, M., Fadda, P. & Fratta, W. (2014). Sex differences in addictive disorders. *Frontiers in Neuroendocrinology*, 35(3), 272–284.
- Grandi, S., Clementi, C., Guidi, J., Benassi, M. & Tossani, E. (2011). Personality characteristics and psychological distress associated with primary exercise dependence: An exploratory study. *Psychiatry Research*, 189(2), 270–275.
- Griffiths, M. (1997). Exercise addiction: A case study. *Addiction Research*, 5(2), 161–168.
- Hausenblas, H. A. & Downs, D. S. (2002a). Exercise dependence: A systematic review. *Psychology of Sport and Exercise*, 3(2), 89–123.
- Hausenblas, H. A. & Downs, D. S. (2002b). How much is too much? The development and validation of the exercise dependence scale. *Psychology and Health*, 17(4), 387–404.
- Hilbert, A., de Zwaan, M. & Braehler, E. (2012). How frequent are eating disturbances in the population? Norms of the Eating Disorder Examination-Questionnaire. *PLoS One*, 7(1), e29125.
- Kafka, M. P. (2010). Hypersexual disorder: A proposed diagnosis for DSM-V. *Archives of Sexual Behavior*, 39(2), 377–400.
- Klein, V., Rettenberger, M., Boom, K. D. & Briken, P. (2014). [A validation study of the German version of the Hypersexual Behavior Inventory (HBI)]. *Psychotherapie, Psychosomatik, medizinische Psychologie*, 64(3–4), 136–140.
- Kor, A., Fogel, Y. A., Reid, R. C. & Potenza, M. N. (2013). Should hypersexual disorder be classified as an addiction? *Sexual Addiction & Compulsivity*, 20(1–2), 27–47.
- Lejoyeux, M., Avril, M., Richoux, C., Embouazza, H. & Nivoli, F. (2008). Prevalence of exercise dependence and other behavioral addictions among clients of a Parisian fitness room. *Comprehensive Psychiatry*, 49(4), 353–358.
- Lejoyeux, M., Guillot, C., Chalvin, F., Petit, A. & Lequen, V. (2012). Exercise dependence among customers from a Parisian sport shop. *Journal of Behavioral Addictions*, 1(1), 28–34.
- Melkevik, O., Torsheim, T., Iannotti, R. J. & Wold, B. (2010). Is spending time in screen-based sedentary behaviors associated with less physical activity: A cross national investigation. *International Journal of Behavioral Nutrition and Physical Activity*, 7, 46.
- Meulemans, S., Pribis, P., Grajales, T. & Krivak, G. (2014). Gender differences in exercise dependence and eating disorders in young adults: A path analysis of a conceptual model. *Nutrients*, 6(11), 4895–4905.
- Miller, W. R. (1995). *Motivational enhancement therapy manual: A clinical research guide for therapists treating individuals with alcohol abuse and dependence* (vol. 2). Rockville, MD: National Institute on Alcohol Abuse and Alcoholism/DIANE Publishing.
- Modoio, V. B., Antunes, H. K. M., Gimenez, P. R. B. D., Santiago, M. L. D. M., Tufik, S. & Mello, M. T. D. (2011). Negative addiction to exercise: Are there differences between genders? *Clinics*, 66(2), 255–260.
- Mónok, K., Berczik, K., Urbán, R., Szabo, A., Griffiths, M. D., Farkas, J., Magi, A., Eisinger, A., Kurimay, T., Kökönyei, Gy., Kun, B., Paksi, B. & Demetrovics, Z. (2012). Psychometric properties and concurrent validity of two exercise addiction measures: A population wide study. *Psychology of Sport and Exercise*, 13(6), 739–746.
- Mueller, A., Mitchell, J. E., Crosby, R. D., Gefeller, O., Faber, R. J., Martin, A., Bleich, S., Glaesmer, H., Exner, C. & de Zwaan, M. (2010). Estimated prevalence of compulsive buying in Germany and its association with sociodemographic characteristics and depressive symptoms. *Psychiatry Research*, 180(2), 137–142.
- Müller, V. M. (2013). *Diskriminanzvalidität der deutschen Version der Exercise Dependence Scale-21 anhand von Gruppenvergleichen*. Dissertation. Medizinische Hochschule Hannover, Hannover.
- Müller, A., Claes, L., Smits, D., Gefeller, O., Hilbert, A., Herberg, A., Mueller, V., Hofmeister, D. & de Zwaan, M. (2013). Psychometric properties of the German version of the Exercise Dependence Scale. *European Journal of Psychological Assessment*, 29(3), 213–219.
- Müller, A., Claes, L., Wos, K., Kerling, A., Wünsch-Leiteritz, W., Cook, B. & de Zwaan, M. (2015). Temperament and the risk for exercise dependence: Results of a pilot study in female patients with eating disorders compared to elite athletes. *Psychopathology*, 48(4), 264–269.
- Müller, A., Cook, B., Zander, H., Herberg, A., Müller, V. & de Zwaan, M. (2014). *Does the German version of the Exercise Dependence Scale measure exercise dependence?* *Psychology of Sport and Exercise*, 15(3), 288–292.
- Müller, K. W., Janikian, M., Dreier, M., Wölfling, K., Beutel, M. E., Tzavara, C., Richardson, C. & Tsitsika, A. (2015). Regular gaming behavior and internet gaming disorder in European adolescents: Results from a cross-national representative survey of prevalence, predictors, and psychopathological correlates. *European Child & Adolescent Psychiatry*, 24(5), 565–574.

- Müller, A., Mitchell, J. E. & de Zwaan, M. (2015). Compulsive buying. *The American Journal on Addictions*, 24(2), 132–137.
- Pabst, A., Kraus, L., Matos, E. G. D. & Piontek, D. (2013). Substanzkonsum und substanzbezogene Störungen in Deutschland im Jahr 2012. *Sucht*, 59(6), 321–331.
- Reid, R. C., Garos, S. & Carpenter, B. N. (2011). Reliability, validity, and psychometric development of the Hypersexual Behavior Inventory in an outpatient sample of men. *Sexual Addiction & Compulsivity*, 18(1), 30–51.
- Rumpf, H. J., Hapke, U., Meyer, C. & John, U. (2002). Screening for alcohol use disorders and at-risk drinking in the general population: Psychometric performance of three questionnaires. *Alcohol and Alcoholism*, 37(3), 261–268.
- Sussman, S., Lisha, N. & Griffiths, M. (2011). Prevalence of the addictions: A problem of the majority or the minority? *Evaluation and the Health Professions*, 34(1), 3–56.
- Szabo, A., Vega, R., Ruiz-Barquín, R. & Rivera, O. (2013). Exercise addiction in Spanish athletes: Investigation of the roles of gender, social context and level of involvement. *Journal of Behavioral Addictions*, 2(4), 249–252.
- Vandewater, E. A., Shim, M. S. & Caplovitz, A. G. (2004). Linking obesity and activity level with children's television and video game use. *Journal of Adolescence*, 27(1), 71–85.
- Wölfling, K., Müller, K. W. & Beutel, M. (2011). [Reliability and validity of the Scale for the Assessment of Pathological Computer-Gaming (CSV-S)]. *Psychotherapie, Psychosomatik, medizinische Psychologie*, 61(5), 216–224.