

THE FACTORIAL VALIDITY AND PSYCHOMETRIC PROPERTIES OF THE POLISH VERSION OF EXERCISE DEPENDENCE SCALE-REVISED (EDS-R)

STRUKTURA CZYNNIKOWA I WŁASNOŚCI PSYCHOMETRYCZNE POLSKIEJ WERSJI EXERCISE DEPENDENCE SCALE-REVISED (EDS-R)

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Abstract

Introduction: Physical exercise is a hallmark of physical and mental well-being. The benefits of regular exercise of moderate intensity were proven in case of various conditions, disorders and diseases. However, in some cases, excessive exercise may lead to loss of control over the behaviour and to suffering due to various negative consequences. This condition is referred to as exercise dependence. The purpose of this study was to verify the factorial structure, internal validity, reliability and criterion validity of the 21-item Exercise Dependence Scale-Revised (EDS-R) in a sample of Polish recreational exercisers selected according to the convenience method.

Material and methods: In studies 1 and 2 there were 625 participants (52% female) who exercised recreationally from 3 to 5 times a week. In both studies, the participants filled in a Polish version

Streszczenie

Wprowadzenie: Ćwiczenia fizyczne są bardzo ważnym elementem zdrowia fizycznego i psychicznego. Korzyści płynące z regularnego uprawiania ćwiczeń z umiarkowaną intensywnością zostały udowodnione w przypadku różnych zaburzeń i chorób. W niektórych przypadkach nadmierne ćwiczenia mogą jednak prowadzić do utraty kontroli nad tym zachowaniem i cierpienia z powodu negatywnych konsekwencji. Taki stan określa się mianem uzależnienia od ćwiczeń. Celem pracy była weryfikacja struktury czynnikowej, trafności wewnętrznej, rzetelności i trafności kryterialnej 21-punktowej Skali Uzależnienie od Ćwiczeń (*Exercise Dependence Scale-Revised* – EDS-R) na próbie rekreacyjnie ćwiczących Polaków wybranej metodą uznaniową.

Materiał i metody: W badaniu 1. i 2. wzięło udział 625 uczestników (52% kobiet) uprawiających ćwiczenia rekreacyjnie z częstotliwością od trzech do

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of the EDS-R and answered demographic questions and questions about the frequency and duration of their exercise activity.

Results: In study 1, an Exploratory Factor Analysis was conducted, a five-factor solution was found. The internal consistency for the subscales and the total scale were high. In study 2, a Confirmatory Factor Analysis was performed though neither the five or seven-factor solution yielded an acceptable fit.

Discussion: Study 1 showed promising results suggesting that the five-factor EDS-R has a very good fit to the Polish data. The results of the study 2 are inconclusive as neither of the tested models fit the data. It is important to note that some international studies showed a lack of scale invariance both between different nationalities and different ages persons.

Conclusions: Further studies are necessary to investigate the factorial structure of EDS-R-PL and, until this is confirmed, the scale and the results should be analysed with caution.

Keywords: Behavioural addictions, Exercise dependence, EDS-R, exercise frequency.

pięciu razy w tygodniu. W obu badaniach uczestnicy wypełniali polską wersję EDS-R i odpowiadali na pytania dotyczące demografii oraz częstotliwości i czasu trwania ćwiczeń.

Wyniki: W badaniu 1. przeprowadzono eksploracyjną analizę czynnikową metodą głównych składowych i uzyskano pięcioczynnikową strukturę narzędzia. Spójność wewnętrzna podskal i skali ogólnej była wysoka. W badaniu 2. przeprowadzono confirmacyjną analizę czynnikową, ale ani pięcio- ani siedmioczynnikowe rozwiązanie nie dało możliwości do zaakceptowania dopasowania.

Omówienie: Wyniki badania 1. sugerują, że model pięcioczynnikowy EDS-R jest bardzo dobrze dopasowany do polskich danych. Wyniki badania 2. są niejednoznaczne – żaden z testowanych modeli nie był dobrze dopasowany do danych. Niektóre badania międzynarodowe wykazały brak równoważności skali zarówno pomiędzy narodowościami, jak i osobami w różnym wieku.

Wnioski: Konieczne są dalsze badania w celu zwerifikowania struktury czynnikowej polskiej adaptacji EDS-R, a do czasu jej potwierdzenia należy ostrożnie analizować skalę i wyniki.

Słowa kluczowe: uzależnienia behawioralne, uzależnienie od ćwiczeń, EDS-R, częstość uprawiania ćwiczeń.

■ INTRODUCTION

Physical exercise is an important hallmark of physical and psychological well-being [1]. The benefits of regular moderate-intensity of exercising were proven in case of various conditions, disorders and diseases; they significantly lower the risk of breast and colon cancers, diabetes, ischemic heart disease and strokes [2], as well as slow down cognitive and physical decline [3], decrease depressive symptoms [4] and improve well-being in general [5]. However, in some cases, excessive exercise may lead to loss of control over said behaviour and to suffering due to various negative consequences (including mental, psychological or social) [6]. Even though there is no consensus on how to call such a phenomenon, exercise dependence is among the most frequently used ones (next to exercise addiction) [7]. Either exercise dependence or exercise addiction has not been classi-

fied in DSM or ICD classifications. However, they are referred to as behavioural addictions [7, 8].

Exercise dependence was first conceptualised by Hausenblas and Downs as a “multidimensional maladaptive pattern of exercise, leading to clinical impairment or distress” [9: 4]. They further employed the DSM-IV criteria of substance addiction to develop the Exercise Dependence Scale [9]. The tool originally consisted of 30 items, was later reduced to 28, and was finally limited to 21 as the Exercise Dependence Scale-Revised (EDS-R) [10]. The latter version became one of the most extensively used and adapted questionnaires measuring exercise dependence worldwide [7]. The EDS-R consists of 7 subscales (3 items per scale) rated on a 6-point answers scale (from 1 – “never” to 6 – “always”). The subscales correspond with the criteria for substance-related addiction [11] in the DSM-4 (Table 1) [9, 12]. The higher the total scores, the greater the risk for exercise dependence. More-

Table 1. EDS-R criteria and their definitions [12]

	Criterion	Definition
1	Tolerance	“Either a need for increased amounts of exercise to achieve the desired effect or a diminished effect occurs with continued use of the same amount of exercise”
2	Withdrawal	“Manifested by either the characteristic withdrawal symptoms for exercise (e.g., anxiety, fatigue) or the same (or closely related) amount of exercise is taken to relieve or avoid withdrawal symptoms”
3	Intention effects	“Exercise is often taken in larger amounts or over a longer period than was intended”
4	Lack of control	“A persistent desire or unsuccessful effort to cut down or control exercise”
5	Time	“A great deal of time is spent in activities necessary to obtain exercise (e.g., physical activity vacations)”
6	Reduction in other activities	“Social, occupational, or recreational activities are given up or reduced because of exercise”
7	Continuance	“Exercise is continued despite knowledge of having a persistent or recurrent physical or psychological problem likely to have been caused or exacerbated by the exercise (e.g., continued running despite injury)”

over, the authors suggested cut-off points for differentiation between individuals at risk of exercise dependence, nondependent-symptomatic and non-dependent-asymptomatic patients. Furthermore, the authors suggest how to differentiate physiological dependence (i.e., evidence of tolerance or withdrawal) and lack of physiological dependence (i.e., no evidence of tolerance or withdrawal) [9].

There were numerous studies investigating the factorial structure of the EDS-R and in some of them, the seven-factor structure was confirmed [e.g. 13]. However, in some cases, the items' factor loading was smaller than 0.70, which is problematic [14]. In other studies, researchers either did not find support for the suggested 7-factor model or found support for different models; e.g., Allegre and Therme found that in French adaptation of the EDS-R items of “lack of control” and “time” dimensions form a single factor [15] and Pujals *et al.* [13] found that the Spanish adaptation consists of 5 factors (where items from “time” and “reduction of other activities” were distributed between the original factors of “tolerance” and “lack of control”).

There were two studies published with Polish adaptation of the EDS-R; however, in one of them, only reliability coefficients (Cronbach's α) for original scales were provided [16], whereas in the other study, an Exploratory Factor Analysis (EFA) was conducted. Nevertheless, no factorial structure was tested [17]. However, the reported reliability indicators were between acceptable and very high (e.g., the lowest Cronbach's α was reported from ‘withdrawal’ 0.71 and for ‘tolerance’ 0.74 and the highest for ‘time’ and ‘intention’ –

0.90 and 0.91 respectively). In the latter study, the authors obtained a five-factor structure of the Polish EDS-R: three factors remained the same as in the original scale, namely ‘withdrawal’ (items: 1, 8, and 15), ‘lack of control’ (items: 4, 11, and 18) and ‘continuance’ (items: 2, 9 and 16) and two new factors were created: ‘tolerance’ which consisted of its original items (3, 10 and 17) and by item 6 (originally from ‘time’) and item 21 (originally from ‘intention’) and a new factor which was called ‘reduction of other activities’, which was composed of its original items 5, 12, 19 and by the additional items 13 and 20 (originally from ‘time’). Two items were not included in the factorial structure (items 7 and 14) but were included in the final score (score over the 21 items).

Even though the seven-factor structure of the EDS-R was confirmed in many studies, there are some in which other structures came to light e.g., in Spanish or French studies [13, 15]. There was also no verification of the factorial structure of the Polish adaptation. Hence, this study aimed to verify the factorial structure, internal validity, reliability and criterion validity of the 21-item Exercise Dependence Scale-Revised (EDS-R) in Poland. Since not all previous studies had a confirmed seven-factor model of EDS-R, two separate studies were designed to accomplish this purpose.

Adaptation

EDS-R was translated from English into Polish by two independent researchers fluent in English and Polish. After comparing the two versions,

a single version was prepared by the Principal Investigator (fluent in English). The Polish version was then translated into English and compared with the original (the final wording of the items is presented in Table IV). A pilot study (with 45 individuals) was conducted to assess the comprehensiveness of the questions. Each participant answered the questions and additionally assessed how understandable each question was (on a scale from 1 – not very well understandable to 5 – very well understandable). All of the scores (with an exception of two items for one respondent) were 5.

Finally, the Polish EDS-R was consulted by two sports specialists, and no changes needed to be introduced.

■ MATERIAL AND METHODS

The procedure and measures were the same in studies 1 and 2 though the participants and data analysis approach differed.

Procedure

The same procedure was employed in both studies 1 and 2. The studies were conducted online via the LimeSurvey Platform. The participants were presented with the study's aim and description per the APA Code of Ethics and asked for their consent to participate. After that, there was a round of demographic questions, followed by questions about sports activity characteristics before the EDS-R (in Polish) was finally administered. Participation in the study was not paid in any way. The study received acceptance from the institutional Ethics Committee of the Maria Grzegorzewska University, Warsaw, no 5/2022.

Measures

In both studies 1 and 2, a self-administered general questionnaire was used to collect socio-demographic data like gender and age. The questionnaire also included questions intended to estimate the duration of daily and weekly exercise ("How much time do you exercise on average daily?" with an indication of the number of minutes) and frequency of exercising of each participant ("How frequently do you exercise?" with 8 answers: from one to seven days a week and one additional answer "less frequently").

An adapted version of the Polish Exercise Dependence Scale-Revised consisting of 21 statements and

rated on a 6-point answers scale (from 1 – "never" to 6 – "always") was administered.

Study 1

Participants

In study 1, two hundred and twenty participants ($n = 116$; 53% female) were recruited from sport-related internet fora. All the participants exercised recreationally with the frequency between three and five times a week (on average $M = 4.27$; $SD = 0.675$), between 30 and 90 minutes a day ($M = 68.48$; $SD = 18.48$) and between 90 minutes and 7.5 hours a week ($M = 295.27$ minutes; $SD = 91.81$). The participants were between 19 and 46 years of age ($M = 27.43$; $SD = 5.36$).

Data analysis

The data was recorded and analysed using SPSS 29 and AMOS 29 software packets.

Preliminary analysis was conducted to check the statistical assumption of normality and to analyse descriptive statistics per item.

The correlation matrix of items was observed to ensure that correlations between the items within the same construct are significant and superior to those within different constructs.

Exploratory Factor Analysis (a principal component analysis) with varimax rotation was conducted to establish the number of factors. Criteria accuracy was tested by correlating the EDS-R total score with exercising frequency and duration, as well as comparing the non-dependent asymptomatic and non-dependent symptomatic groups with respect to the frequency of exercising.

Study 2

Participants

Four hundred and five participants ($n = 211$; 52% female) were recruited from sport-related online forums. All the participants exercised recreationally with the frequency between three and five times a week (on average $M = 4.28$; $SD = 0.67$), between 30 and 100 minutes a day ($M = 68.47$; $SD = 18.55$) and between 90 minutes and 7.5 hours a week ($M = 295.86$ minutes; $SD = 91.69$). The participants were between 18 and 45 years of age ($M = 28.35$; $SD = 5.51$).

Data analysis

The data was recorded and analysed using SPSS 29 and AMOS 29 software packets.

Table II. Study 1 – correlation coefficients (r -Pearsons) between items of EDS-R and the EDS-R total score

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
2	0.349***	-																					
3	0.243***	0.493***	-																				
4	0.188**	0.331***	0.349***	-																			
5	0.237***	0.398***	0.408***	0.373***	-																		
6	0.219**	0.441***	0.550***	0.402***	0.587***	-																	
7	0.418***	0.358***	0.412***	0.423***	0.436***	0.465***	-																
8	0.638***	0.287***	0.140*	0.219**	0.279**	0.258***	0.456***	-															
9	0.141*	0.529***	0.301***	0.299***	0.335***	0.353***	0.250**	0.208**	-														
10	0.353***	0.388***	0.635***	0.410***	0.449***	0.452***	0.574***	0.305***	0.432***	-													
11	0.270***	0.214*	0.297***	0.687***	0.443***	0.471***	0.481***	0.246***	0.274***	0.443***	-												
12	0.382***	0.336***	0.448***	0.283***	0.579***	0.552***	0.397***	0.429***	0.322***	0.398***	0.392***	-											
13	0.252***	0.370***	0.504***	0.455***	0.606***	0.662***	0.491***	0.240***	0.340***	0.499***	0.550***	0.698***	-										
14	0.355***	0.292***	0.439***	0.360***	0.457***	0.453***	0.739***	0.478***	0.240***	0.524***	0.391***	0.511***	0.583***	-									
15	0.612***	0.312**	0.219*	0.200*	0.271**	0.343***	0.395***	0.732***	0.174**	0.278**	0.187**	0.441***	0.314**	0.504***	-								
16	0.224*	0.688***	0.328***	0.221*	0.362***	0.388***	0.371**	0.323**	0.723***	0.409***	0.238**	0.382**	0.391***	0.413**	0.324**	-							
17	0.429***	0.321**	0.545***	0.463***	0.438***	0.489***	0.511***	0.397***	0.360***	0.717**	0.419**	0.522**	0.516**	0.579**	0.358**	0.382**	-						
18	0.232*	0.201*	0.269**	0.657***	0.429**	0.457**	0.387**	0.289**	0.431**	0.441**	0.782**	0.434**	0.545**	0.448**	0.201*	0.410**	0.585**	-					
19	0.278***	0.301**	0.288***	0.344**	0.705***	0.502**	0.400**	0.375**	0.414**	0.384**	0.315**	0.509**	0.554**	0.477**	0.409**	0.446**	0.563**	0.446**	-				
20	0.274***	0.347***	0.469***	0.431**	0.574***	0.755***	0.488***	0.296**	0.410**	0.496**	0.498**	0.691**	0.815**	0.550**	0.342**	0.408**	0.622**	0.605**	0.610**	-			
21	0.391***	0.354**	0.400**	0.475***	0.469**	0.462**	0.775***	0.534**	0.325**	0.572**	0.477**	0.462**	0.519**	0.843**	0.424**	0.456**	0.646**	0.528**	0.505**	0.584**	-		
EDS	0.538***	0.593***	0.615***	0.611**	0.693***	0.722**	0.721**	0.584**	0.549**	0.714**	0.643**	0.718**	0.766**	0.751**	0.578**	0.626**	0.765**	0.689**	0.690**	0.790**	0.791**	-	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$
 EDS – the total score of EDS-R

Preliminary analysis was conducted to check the statistical assumption of normality and to analyse descriptive statistics per item.

The correlation matrix of items was observed to ensure that correlations between the items within the same construct are significant and superior to those that do not belong to the same factor.

Confirmatory factor analysis (CFA) was used to test the theoretical model with the five-factor model (obtained in study 1), the original seven-factor model and the five-factor model obtained in a previous adaptation study [17]. The maximum likelihood method was used, and the chi-square goodness-of-fit statistic, the root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis index (TLI) fit indices were analysed. RMSEA of 0.06 or less and CFI and TLI superior to 0.90 indicate a good model fit [18, 19].

■ RESULTS

Study 1

Descriptive statistics for each EDS-R item were calculated (Annex 1). Participants answered each of the items using all six points on the Likert scale; the mean values per item ranged between 1.80 (for item 19) and 3.66 (for item 3). The values of skewness and kurtosis did not exceed the absolute value of 2 (Annex 1).

Correlation analysis showed that all of the items correlate with one another. In most cases, the correlation coefficients between items belonging to the same original factor are of greater magnitude than with items now belonging to the same factor, except items 3, 5 and 12. These items might prove to be problematic by either loading two factors or creating one new factor (Table II). Furthermore, each item was correlated with the total score of the EDS-R and the correlation coefficients were significant and high (0.528 for item 1) to very high (0.791 for item 21) (Table II).

Construct and convergent validity

To examine construct validity, a principal axis factor analysis (with Oblimin rotation) was performed. The Oblimin rotation was chosen to allow for factors correlations. The Exploratory Factor Analysis (EFA) yielded a five-factor solution that together explained 66.61% of the variance, which support the appropriate construct validity of

the scale (Table III). As it is presented in Table III the item-factor loadings ranged between 0.398 and 0.894. The original factors “withdrawal”, “lack of control” and “continuance” were confirmed. On the other hand, “reductions of other activities” and “time” were merged into one factor as were “tolerance” and “intention”. Furthermore, as presented in Table III, internal consistence measure by Cronbach’s α was high in case of the factors (ranging between 0.954 and 0.909) as well as the total score (0.938).

Criteria validity

To evaluate the criteria validity of Polish adaptation of the EDS-R scale was measured by correlating the EDS-R with the frequency of exercising (times per week, duration per day and duration per week). There was a small, positive correlation between EDS-R and the time spent exercising per week ($r = 0.199$; $p = 0.003$). There was also a moderate positive correlation between EDS-R and exercise frequency ($r = 0.335$; $p < 0.001$).

Study participants were divided between non-dependent asymptomatic ($n = 160$) and non-dependent symptomatic ($n = 56$) based on the total score of the EDS-R. The group membership was calculated according to the procedure described by Downs [12] as well as in the manual [11]. According to the authors, an individual can be assigned to a non-dependent asymptomatic group when they score low (1-2 on the Likert scale) on at least three criteria and a non-dependent symptomatic group when they score in a middle range (3-4 on the Likert scale). The two groups differed regarding the frequency of exercise per week ($Z = -4.09$; $p < 0.001$). Non-parametric testing was used due to the frequency of exercising deviating from normal distribution in the latter group.

Study 2

Descriptive statistics for each EDS-R PL item were calculated (Annex 2). Participants answered each of the items using the whole scale (from 1 to 6), and the mean values per item ranged between 1.85 (for item 19) and 3.69 (for item 3). The values of skewness and kurtosis did not exceed the absolute value of 2.

Correlation analysis showed that all of the items correlate with one another. In most cases, the correlation coefficients between items belonging to the same original factor are greater than with items

Table III. Study 1 – exploratory factor analysis results

	Factors				
	Reduction of other activities combined with time	Withdrawal	Continuance	Lack of control	Tolerance combined with Intention
Item 20. A great deal of my time is spent exercising Znaczna część mojego czasu poświęcam na wykonywanie ćwiczeń	0.838				
Item 13. I spend most of my free time exercising Większość wolnego czasu spędzam na ćwiczeniach	0.818				
Item 12. I think about exercise when I should be concentrating on school/work Myślę o ćwiczeniach, kiedy powinienem/nam być skoncentrowany/na na szkole/pracy	0.769				
Item 6. I spend a lot of time exercising/Spędzam dużo czasu na wykonywaniu ćwiczeń	0.701				
Item 5. I would rather exercise than spend time with family/friends Wolę przeznaczyć swój czas na ćwiczenia, niż spędzać go z rodziną/przyjaciółmi	0.662				
Item 19. I choose to exercise so that I can get out of spending time with family/friends Wybieram ćwiczenia, aby wymigać się od spędzania czasu z rodziną/znajomymi	0.582				
Item 8. I exercise to avoid feeling anxious/Wykonyuję ćwiczenia, aby uniknąć uczucia niepokoju		0.890			
Item 15. I exercise to avoid feeling tense/Ćwiczę, aby uniknąć uczucia napięcia		0.765			
Item 1. I exercise to avoid feeling irritable/Ćwiczę, aby uniknąć poczucia irytacji		0.625			
Item 16. I exercise despite persistent physical problems Ćwiczę, nawet jeśli mam poważne dolegliwości fizyczne			0.876		
Item 9. I exercise when injured/Wykonyuję ćwiczenia, nawet kiedy jestem kontuzjowany			0.791		
Item 2. I exercise despite recurring physical problems Ćwiczę pomimo nawracających dolegliwości fizycznych			0.672		
Item 18. I am unable to reduce how intense I exercise Nie jestem w stanie zmniejszyć intensywności wykonywanych ćwiczeń				0.881	
Item 11. I am unable to reduce how often I exercise Nie jestem w stanie zmniejszyć częstotliwości wykonywania ćwiczeń				0.791	
Item 4. I am unable to reduce how long I exercise Nie jestem w stanie zredukować czasu trwania wykonywanych ćwiczeń				0.644	
Item 7. I exercise longer than I intend to/Wykonyuję ćwiczenia dłużej, niż zamierzałem/łam					0.600
Item 10. I continually increase my exercise frequency to achieve the desired effects/benefits Ciagle zwiększam częstotliwość ćwiczeń, aby osiągnąć pożądany efekt/korzyści					0.592
Item 21. I exercise longer than I plan to/Ćwiczę dłużej, niż planuję					0.534
Item 3. I continually increase my exercise intensity to achieve the desired effects/benefits Ciagle zwiększam intensywność ćwiczeń, aby osiągnąć zamierzone efekty					0.527
Item 14. I exercise longer than I expected to/Ćwiczę dłużej, niż się tego spodziewałem					0.519
Item 17. I continually increase my exercise duration to achieve the desired effects/benefits Ciagle zwiększam czas trwania moich ćwiczeń, aby osiągnąć pożądany efekt/korzyści					0.391
Explained variance	44.60%	7.71%	6.05%	4.48%	3.78%
Cronbach's α	0.909	0.897	0.854	0.875	0.838
			0.938		

Table IV. Study 2 – correlation coefficients (*r*-Pearsons) between the EDS-R items

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
2	0.339***	-																			
3	0.255***	0.489***	-																		
4	0.188***	0.321***	0.363***	-																	
5	0.233***	0.396***	0.402	0.374***	-																
6	0.222***	0.438***	0.559***	0.405***	0.588***	-															
7	0.417***	0.356***	0.428***	0.437***	0.451***	0.469***	-														
8	0.640***	0.284***	0.151***	0.204***	0.277***	0.252***	0.460***	-													
9	0.142***	0.547***	0.312***	0.308***	0.341***	0.364***	0.239***	0.207***	-												
10	0.368***	0.387***	0.648***	0.437***	0.459***	0.469***	0.585***	0.317***	0.434***	-											
11	0.276***	0.218***	0.312***	0.697***	0.450***	0.483***	0.484***	0.244***	0.264***	0.454***	-										
12	0.384***	0.322***	0.458***	0.272***	0.580***	0.560***	0.403***	0.425***	0.320***	0.413***	0.392***	-									
13	0.257***	0.366***	0.515***	0.458***	0.609***	0.674***	0.494***	0.236***	0.344***	0.503***	0.551***	0.701***	-								
14	0.369***	0.303***	0.460***	0.368***	0.473***	0.468***	0.742***	0.489***	0.236***	0.542***	0.387***	0.517***	0.584***	-							
15	0.615***	0.302***	0.234***	0.179***	0.269***	0.338***	0.389***	0.727***	0.172***	0.284***	0.178***	0.436***	0.307***	0.503***	-						
16	0.224***	0.701***	0.331***	0.228***	0.367***	0.391***	0.362***	0.327***	0.722***	0.400***	0.229***	0.375***	0.386***	0.413***	0.326***	-					
17	0.428***	0.317***	0.556***	0.483***	0.452***	0.505***	0.520***	0.405***	0.362***	0.732***	0.428***	0.524***	0.527***	0.602***	0.379***	-					
18	0.238***	0.206***	0.278***	0.676***	0.433***	0.470***	0.385***	0.294***	0.425***	0.450***	0.780***	0.431***	0.544***	0.442***	0.197***	0.593***	-				
19	0.279***	0.305***	0.288***	0.349***	0.709***	0.503***	0.402***	0.374***	0.413***	0.386***	0.309***	0.508***	0.550***	0.484***	0.407***	0.445***	0.443***	-			
20	0.272***	0.348***	0.485***	0.443***	0.574***	0.764***	0.485***	0.288***	0.414***	0.503***	0.503***	0.694***	0.816***	0.548***	0.332***	0.404***	0.632***	0.610***	0.605***	-	
21	0.406***	0.369***	0.433***	0.490***	0.480***	0.468***	0.781***	0.542***	0.319***	0.594***	0.476***	0.465***	0.518***	0.849***	0.452***	0.670***	0.529***	0.508***	0.580***	0.580***	-
EDS	0.540***	0.590***	0.627***	0.616***	0.696***	0.729***	0.723***	0.582***	0.550***	0.726***	0.645***	0.716***	0.766***	0.758***	0.623***	0.776***	0.692***	0.689***	0.790***	0.798***	0.798***

*** $p < 0.001$

EDS – the total score of EDS-R

now belonging to the same factor, except for items 3, 5 and 12 (Table IV). The same items as in study 1 turned out to be problematic. This also shows that the results are stable over different samples.

As presented in Table V, model fit indices did not provide a satisfactory fit for the original seven-factor model. Moreover, a very high correlation between two factors was observed ($r = 0.95$) between “time” and “reduction of other activities”, suggesting that they should be merged. As a matter of fact, these two factors were merged in the model from study 1. There was one more change compared to the original model as “tolerance” and “intention”, two more original factors, were merged. Further analysis showed that neither of the five-factor models fit the data even after adjusting for modification indices.

Furthermore, composite reliability (CR), and average variance extracted (AVE) was calculated for the model structure obtained in study 1 (five-factor model) and the values were satisfactory showing good reliability (Table VI). However, when divergent validity was investigated using the comparison between the inter-factor correlations and squared value of AVE, it turned out that there is too much common variance between “reduction + time” and each other factor as well as between “intention + tolerance” and each other factor (Table VI). Further investigation into modification indices revealed that some of the errors corre-

sponding with items from different factors were correlated. The items corresponding to said errors were removed (items 3, 5, 10 and 12) and the model parameters were checked. We were not able to reach satisfactory model parameters and the problem with divergent validity was not resolved.

■ DISCUSSION

This paper investigated factorial validity and psychometric properties of the Exercise Dependence Scale-Revised-Polish. Study 1 showed promising results suggesting that the EDS-R has five instead of seven factors. The reduction from seven to five factors meant that some original factors were merged namely ‘reduction of other activities’ with ‘time’ and ‘tolerance’ with ‘intention’. Similar issues were noted by other researchers who found a high correlation between ‘reduction in other activities’ and ‘time’; ‘lack of control’ and ‘intention’ [20-22]. Even Downs pointed out that the wording of items from the ‘reduction in other activities’ factor should be carefully analysed in other languages. In study 1, the items from ‘reduction in other activities’ and ‘time’ were highly correlated and merged.

Nevertheless, the five-factor model proposed in study 1 differed from the models developed in studies conducted by Pujals [13] or by Danych [17]. The model obtained from study 1 has an important advantage. Apart from being generally characterised

Table V. Fit indices for the original and the two investigated EDS-R models

	χ^2	χ^2/df	RMSEA [LO 90; HI 90]	CFI	TLI	AIC
Original seven-factor model	1129	7.19***	0.121 [0.122; 0.135]	0.862	0.823	1370.78
Five-factor model obtained in study 1	1371	7.59***	0.130 [0.127; 0.136]	0.829	0.796	1476.43
Five factor model (Danych et al., 2019)	1189	6.87***	0.136 [0.131; 0.141]	0.820	0.781	1531.32

*** $p < 0.001$

RMSEA – Root Mean Square Error of Approximation; CFI – Comparative Fit Index; TLI – Tucker-Lewis Index; AIC – Akaike Information Criterion

Table VI. Reliability and divergent validity for the 5-factor model (obtained in study 1)

	CR	AVE	Withdrawal	Continuance	Lack of control	Intention + tolerance	Reduction + time
Withdrawal	0.856	0.666	0.444				
Continuance	0.860	0.674	0.389	0.454			
Lack of control	0.886	0.722	0.322	0.394	0.521		
Intention + tolerance	0.900	0.604	0.614	0.520	0.654	0.365	
Reduction + time	0.907	0.623	0.429	0.517	0.673	0.762	0.388

CR – composite reliability, AVE – average variance extracted

On the diagonal – AVE squared, the remaining values – Pearson's correlation coefficients between factors

by high reliability and reliabilities of its factors, it includes all twenty-one items. The results can be compared between various studies (at least with respect to three original factors and the total score).

However, the results obtained in study 1 were not confirmed by study 2; not only did an attempt to confirm the five-factor model fail, but also the original seven-factor model was not confirmed. Another five-factor model obtained from an Exploratory Factor Analysis in another study was tested [17] but failed to provide a satisfactory fit.

As a result, the data does not support either of the theoretical models, which is puzzling. On the other hand, there are some studies in which researchers could not fit the tested structure of the EDS-R [13, 15, 21]. It could be concluded that the problem we faced in study 2 is not a novel one. At this point, two recommendations can be made. First, it is possible to analyse the data by calculating the total score for the Polish adaptation of the EDS-R, which is congruent with other results [16, 17, 23]. Second, further investigation into the factorial structure of the Polish adaptation of the EDS-R is necessary (in particular, a Confirmatory Factor Analysis).

In Polish studies, rather small convenient samples were investigated e.g., in their studies, Krzyżak-Szymańska and Szymański studied 290 young adults (at the age between 19 and 23 years of age) [16]; in another study, 137 individual were studied (aged between 19 and 56) [17]. Even though the recommended minimum of participants was obtained in all the previous adaptation

studies as well as in the presented studies [24, 25], it is worth mentioning that all of the samples were convenient and not random and it can be expected that the bigger the sample is, the more reliable the results of EFA and CFA can be.

Further, some studies showed a lack of invariance between different nationalities [22]. In other studies, a partial lack of invariance was shown depending on the participants' age [20]. This might be worth consideration in future studies on Polish samples.

It is also important to note that EDS-R was developed based on DSM-4 criteria and, due to changes introduced in DSM-V, a review of the definition of exercise dependence should be conducted (and as a result also, the factors should be reviewed) [26].

Finally, it is important to note that in the current study no variables were included for external validity check; e.g., no investigation into the relationship between Exercise Dependence and wellbeing was conducted. It is, therefore, highly recommended to include external validity in further studies [see 10].

■ CONCLUSIONS

The results presented suggest but do not determine the five-factor structure of the Polish adaptation of the EDS-R. After the reduction in factors, the number of items remained unchanged, allowing for comparison with other studies' results and calculating the total score of the EDS-R. However, further studies are essential to confirm the factorial structure of the Polish EDS-R.

Conflict of interest/Konflikt interesów

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None declared./Nie zadeklarowano.

Ethics/Etyka

The work described in this article has been carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) on medical research involving human subjects, Uniform Requirements for manuscripts submitted to biomedical journals and the ethical principles defined in the Farmington Consensus of 1997.

Treści przedstawione w pracy są zgodne z zasadami Deklaracji Helsińskiej odnoszącymi się do badań z udziałem ludzi, ujednoliconymi wymaganiami dla czasopism biomedycznych oraz z zasadami etycznymi określonymi w Porozumieniu z Farmington w 1997 roku.

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Annex 1. Study 1: Descriptive statistics for each EDS-R item

	Minimum	Maximum	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
Item 1	1	6	3.10	1.49	0.14	-1.17
Item 2	1	6	2.85	1.65	0.49	-1.08
Item 3	1	6	3.66	1.35	0.05	-0.83
Item 4	1	6	2.69	1.64	0.65	-0.85
Item 5	1	6	2.53	1.48	0.77	-0.39
Item 6	1	6	3.15	1.43	0.31	-0.78
Item 7	1	6	2.68	1.28	0.59	-0.29
Item 8	1	6	2.96	1.58	0.26	-1.22
Item 9	1	6	1.94	1.25	1.43	1.34
Item 10	1	6	2.94	1.40	0.48	-0.62
Item 11	1	6	2.37	1.54	0.98	-0.21
Item 12	1	6	2.33	1.46	0.94	-0.21
Item 13	1	6	2.28	1.33	0.99	0.26
Item 14	1	6	2.57	1.49	0.59	-0.79
Item 15	1	6	3.26	1.59	0.05	-1.22
Item 16	1	6	2.03	1.44	1.39	0.86
Item 17	1	6	2.57	1.47	0.74	-0.42
Item 18	1	6	2.1	1.37	1.36	1.08
Item 19	1	6	1.8	1.30	1.61	1.54
Item 20	1	6	2.17	1.34	1.05	0.20
Item 21	1	6	2.25	1.37	1.19	0.78

M – mean, *SD* – standard deviation

Annex 2. Study 2: Descriptive statistics for each EDS-R item

	Minimum	Maximum	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
Item 1	1	6	3.13	1.50	0.11	-1.18
Item 2	1	6	2.87	1.65	0.46	-1.12
Item 3	1	6	3.69	1.35	0.02	-0.82
Item 4	1	6	2.72	1.65	0.61	-0.92
Item 5	1	6	2.58	1.50	0.73	-0.49
Item 6	1	6	3.19	1.45	0.29	-0.84
Item 7	1	6	2.71	1.30	0.56	-0.38
Item 8	1	6	2.99	1.59	0.24	-1.25
Item 9	1	6	1.98	1.27	1.35	1.07
Item 10	1	6	2.98	1.41	0.42	-0.70
Item 11	1	6	2.43	1.57	0.91	-0.39
Item 12	1	6	2.38	1.48	0.89	-0.33
Item 13	1	6	2.33	1.35	0.94	0.11
Item 14	1	6	2.63	1.50	0.55	-0.84
Item 15	1	6	3.31	1.60	0.01	-1.23
Item 16	1	6	2.08	1.47	1.32	0.59
Item 17	1	6	2.62	1.49	0.69	-0.53
Item 18	1	6	2.16	1.40	1.28	0.79
Item 19	1	6	1.85	1.33	1.51	1.17
Item 20	1	6	2.22	1.37	0.99	0.01
Item 21	1	6	2.30	1.39	1.14	0.59