Originales

The mediating role of impulsiveness in the relationship between exercise addiction, muscle dysmorphia and other addictions

El papel mediador de la impulsividad en la relación entre la adicción al ejercicio, la dismorfia muscular y otras adicciones

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Abstract

Exercise Addiction (EA) and Muscle Dysmorphia (MD) have difficulties in common, such as impulse control, an important antecedent of addictions. Understanding how these variables are related to impulsivity and other addictions is essential for prevention and intervention. The objectives were: to explore the relationship between EA, MD, and impulsiveness and other addictions, to study the predictive role of impulsiveness in EA and MD, and to analyze the possible mediating role of impulsiveness in the relationship between addictions, and EA and MD. The sample is made up of 315 participants, 183 of them women (58.1%), aged between 18 and 30 years (M = 21.83, SD = 3.28). Among the novel results, it is worth noting the significant differences between men and women in most addictions but not in impulsivity, the significant relationships between EA and impulsivity, alcohol abuse/dependence, substance addiction, pathological gambling, compulsive spending, and eating disorders, as well as the relationships between MD and impulsivity and all the addictions, except for video game and sex addiction. Additionally, the predictive role of impulsivity on MD but not on EA is highlighted, as well as the mediating role of impulsivity between some of the addictions and EA and MD. Understanding these relationships and adopting a gender perspective is crucial for the prevention of addictions and muscle dysmorphia.

Keywords

Exercise addiction, muscle dysmorphia, addictions, behavioral addictions, impulsiveness.

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Resumen

La adicción al ejercicio (AE) y la dismorfia muscular (DM) comparten dificultades como el control de los impulsos, un antecedente importante en el desarrollo de las adicciones. Comprender cómo se relacionan estas variables con la impulsividad y otras adicciones resulta esencial para su prevención e intervención. Los objetivos del estudio fueron: explorar la relación entre AE, DM, la impulsividad y otras adicciones; analizar el papel predictivo de la impulsividad en la AE y la DM; y examinar el posible papel mediador de la impulsividad en la relación entre las adicciones y la AE y la DM. La muestra estuvo compuesta por 315 participantes, 183 de ellos mujeres (58,1 %), con edades comprendidas entre los 18 y los 30 años (M = 21.83, DT = 3.28). Entre los resultados más relevantes, cabe destacar las diferencias significativas entre hombres y mujeres en la mayoría de las adicciones, pero no en la impulsividad; las relaciones significativas entre AE e impulsividad, abuso/dependencia de alcohol, adicción a sustancias, juego patológico, compras compulsivas y trastornos de la conducta alimentaria; así como las relaciones entre la DM y la impulsividad y todas las adicciones, excepto la adicción a los videojuegos y al sexo. Asimismo, se observa un papel predictivo de la impulsividad sobre la DM, pero no sobre la AE, y un papel mediador de la impulsividad entre algunas de las adicciones y la AE y la DM. Comprender estas relaciones y adoptar una perspectiva de género resulta fundamental para la prevención de las adicciones y la dismorfia muscular.

Palabras clave

Adicción al ejercicio, dismorfia muscular, adicciones, adicciones comportamentales, impulsividad.

INTRODUCTION

One of the most important elements present in addictive pathologies is impulsiveness. This is because people with difficulties in impulse control act without making a prior assessment or judgment of the possible consequences (Evenden, 1999). They also present sensation-seeking, need for stimulation, risk-seeking (Myrseth et al., 2012; Zuckerman et al., 1972), intolerance of reinforcer delay (Moeller et al., 2001), and high sensitivity to positive reinforcements, seeking a quick and immediate reward (Stewart et al., 2004). The model of Koob and Volkow (2010) explains the process of addiction from the viewpoint of impulsiveness and compulsion, such that addictive behavior is initially guided by an impulse to seek a pleasant sensation but subsequently, it will be accompanied by a compulsion in the attempt to relieve the discomfort experienced.

The prefrontal neural circuits involved in executive processing, decision-making, and associated neurotransmission systems are at the neurobiological basis of impulsiveness (de Sola Gutiérrez et al., 2013). Likewise, there is a neurobiological correlation between substance addictions and behavioral addictions, as they activate the same brain reward circuit, which gives rise to a parallel between them (Blum et al., 2017; Grant et al., 2006; Holden, 2001). In different studies, significant relationships have been found between impulsiveness and various addictions, for example, alcohol abuse/dependence and addictions to substance, food, Internet, video games, shopping, gende or cybersex, mobile phone, social networks, compulsive spending, gambling disorder and emotional dependence (Chávez-Vera et al., 2018; Estévez et al., 2018; González López & Lemos, 2020; Levi et al., 2020; Li et al., 2020; Marco & Choliz, 2012; Maxwell et al., 2020; Tristán

et al., 2018; Wang & Dai, 2020). Given the difficulty in impulse control present in addictions, high comorbidity between them is frequent; approximately 25% of people with one addiction suffer from at least another (Granero et al., 2016; Kotyuk et al., 2020; Sussman et al., 2011).

One of the behavioral addictions receiving increasingly more attention is the addiction to physical exercise (EA) (Fernández et al., 2020). It is defined through elements that have traditionally been linked to substance addictions, such as abstinence, tolerance, relevance, desired effects, euphoria, interpersonal conflicts, time spent on behavior, reduction of other important activities, permanence of the behavior despite its negative consequences, loss of control, and relapses (Berczik et al., 2014 Griffiths, 1997; Hausenblas & Downs, 2002a; Lichtenstein & Hinze, 2020; Terry et al., 2004).

Likewise, muscle dysmorphia (MD) is presented in various investigations using an addictive model in which a maladaptive pattern of intense physical exercise persists accompanied by rigid eating habits to achieve an ideal body image (Foster et al., 2015; Griffiths et al., 2015; Mayville et al., 2002). In this sense, both EA and MD present as their main behavior the compulsive practice of physical exercise and they share the presence of low self-esteem as well as maladaptive early schemas of grandiosity, unattainable standards, and abandonment, an insecure attachment style in their bond with others, and emotional dependence in which the search for attention and need for the partner's affective expression stands out (Olave et al., 2021; Olave et al., 2019). EA and MD are also related to each other, such that people with MD may experience greater muscle dissatisfaction, checking body image, more dependence on exercise (Cafri et al., 2008, Pope et al., 1997, Pope et al., 2000), higher levels of EA, and increasingly frequent exercise (Babusa et al., 2015). It even seems that increasing the severity of MD increases the risk of EA, in turn favoring muscle dissatisfaction and increased MD (Olave et al., 2019).

We note that in the previous literature on addictions with and without substances, there are important sex differences, especially in favor of men. MD and EA are more prevalent in men (Dumitru et al., 2018; Nagata et al., 2022) as are substance and alcohol use, gambling disorder, and sex addiction (Chiclana, 2013; López Fernández et al., 2020; Pérez, 2014; Pérez & Echeburúa, 2019). However, recent studies point to differences (small to moderate) in favor of women in symptoms involving withdrawal, lack of exercise enjoyment, the employment of exercise as a means to ends such as health improvement, mood management and body weight control (Alcántara-Ibáñez et al., 2022). In addition, it seems that when clinical case studies are taken into account, women are more affected than men by addiction to physical exercise, or at least are more open to communicating their problem (Juwono & Szabo, 2021).

Considering the relationship and comorbidity between impulsiveness and addictions, and specifically with EA and MD, the present research proposes as the main objective to examine both EA and MD in more depth. We shall explore their comorbidity with the rest of the most documented addictions and the possible role of impulsiveness as a mediator. In this context, we propose three main objectives: 1) to explore the relation-

ship between EA, MD, and impulsiveness and other addictions, 2) to study the predictive role of impulsiveness in EA and MD; and 3) to analyze the possible mediating role of impulsiveness in the relationship between addictions and EA and MD. However, given the well-known role of sex in the prevalence of different addictions, as a previous step, its possible influence on the variables under study (MD, EA, impulsiveness, and other addictions) will be analyzed (through bivariate analysis) to control for its possible role (as a covariate) in the established objectives.

METHOD

This study uses a non-experimental, correlational, cross-sectional design. For sample selection, we performed a non-probabilistic sampling of university students. Participation was voluntary. There was no reward for participating. Everyone who wanted to participate was included. A larger sample of 720 was obtained, but only those people who practice physical exercise at least one day a week were selected to be part of this study. Data analyses were carried out with the IBM SPSS version 22 statistical program. This study was carried out following the criteria of the Declaration of Helsinki (World Medical Association, 2013) and has the favorable report of the Deontological Commission of the Faculty of Psychology of the Complutense University of Madrid (with reference Ref. 2020/21-035).

Participants

The final sample is composed of 315 participants who practice physical exercise regularly in their daily routine, 183 of them women (58.1%) and 132 men (41.9%) aged between 18 and 30 years (M = 21.83, SD = 3.28). They practice exercise recreationally, and there are no professional or federated athletes in the sample. Since there are no quantitative diagnostic criteria to determine exercise addiction, the scoring on the Exercise Addiction Inventory (EAI) instrument (Terry et al., 2004) has been used to assess the risk of exercise addiction.

Regarding their employment situation, 235 (74.6%) study, 76 (24.1%) work, and 4 (1.3%) are unemployed. In reference to marital status, 300 (95.2%) are single, 4 (1.3%) are married, and 11 (3.5%) replied "other."

Instruments

Exercise Addiction Inventory – EAI (Terry et al., 2004). We used the Spanish adaptation of Sicilia et al. (2013). It is a 6-item one-dimensional self-reported questionnaire rated on a 5-point Likert response format (1 = *completely disagree*; 5 = *strongly agree*). It evaluates the risk of addiction to physical exercise through three cut-off points (24 points indicate risk of addiction, between 13 and 23 points suggest symptoms of addiction, and less than 13 points indicate absence of symptoms). The EAI has shown adequate psychometric indicators with a level of internal consistency measured through Cronbach's alpha of .70 (Sicilia et al., 2013). In our study, we found a Cronbach alpha of .82.

The Muscle Appearance Satisfaction Scale (MASS; Mayville et al., 2002). In this work, we used the adaptation by González-Martí et al. (2012). It is a self-reported instrument that addresses the cognitive, emotional, and behavioral aspects of MD. It consists of 19 items and 5 scales: (a) Bodybuilding Dependence

refers to how addicted the respondents perceive themselves to exercising with weights and how upset they feel if they cannot exercise; (b) Muscle Checking indicates that the person cannot resist checking their muscles in the mirror and seeks reaffirmation in other people that their muscles are large enough; (c) Substance Use measures the frequency with which money is spent on supplements for weight training and the approval anabolic androgenic steroids (AAS) to gain muscle mass; (d) Injuries measures accepting the idea that to grow more, you have to endure a lot of pain and the fact that pain is ignored to attain more muscle; (e) Muscle Satisfaction evaluates the satisfaction that a person feels with their size, tone, and muscle definition when looking in the mirror. The scale is rated on a 5-point Likert scale (1 =*completely disagree*; 5 = *strongly agree*). In this study, the total score was used, as well as the scores in the five dimensions that make up the instrument. The scale has good psychometric properties with a Cronbach alpha ranging from .86 to .95 (González-Martí et al., 2012). Our study found a Cronbach alpha of .80 for the subscale Substance Use, .83 for Muscle Checking, .78 for Bodybuilding Dependence, .81 for Muscle Satisfaction, and .77 for Injuries.

BARRATT Impulsiveness Scale - BIS 11 (Patton et al., 1995). In this work, we used the adapted version in Spanish of Salvo and Castro (2013). It is a 30-item self-reported instrument that evaluates impulsivity with 3 subscales: (a) Cognitive Impulsivity, related to the restlessness of rapid thinking and decision-making; (b) Motor Impulsivity refers to hasty action without prior reflection; and (c) Unplanned Impulsivity refers to the performance of actions without planning towards the future. It is rated on a 4-point Likert scale (0 = *rarely or never*; 4 = *always or almost always*). For the objectives of this work, we used the total impulsivity score. The questionnaire obtained acceptable internal consistency values: the Cronbach alpha value for the total scale was .77 (Salvo & Castro, 2013). Our study found a Cronbach alpha of .79.

MULTICAGE CAD 4 (Pedrero Pérez et al., 2007). It is a 32-item self-reported questionnaire consisting with 8 factors: (a) Alcohol Abuse/Dependence, (b) Pathological Gambling, (c) Substance Addiction, (d) Eating Disorders, (e) Internet Addiction, (f) Video Game Addiction, (g) Compulsive Spending, and (h) Sex Addiction. It is responded to on a dichotomous Yes/No scale. It is not a diagnostic tool but a screening instrument that examines these factors through four questions that reproduce the schema of the CAGE (Ewing, 1984). Each factor is made up of four items that refer to the self-perception of the problem, the perception by cohabitants, the associated feelings of guilt, and the signs of abstinence or inability to control the behavior. The internal consistency values were satisfactory, the Cronbach alpha value of the total scale was .86, and the subscales showed values greater than .70 (Pedrero Pérez et al., 2007). In our study, the Cronbach alpha was .79.

The different behavioral addictions have received various names and should receive well-defined diagnostic criteria and be recognized and classified in international manuals. For example, sex addiction or hypersexuality can also be called compulsive sexual behavior (Iruarrizaga et al., 2019; World Health Organization [WHO], 2018), and pathological gambling (American Psychiatric Association [APA], 2000) has been renamed gambling disorder (APA, 2013). In

this work, in the results section, the nomenclatures of the scales of the MULTICAGE CAD 4 are used, where gambling disorder is referred to as pathological gambling and food addiction as eating disorders (Pedrero Pérez et al., 2007).

Procedure

For the recruitment of the University sample, we used the classrooms of the Faculty of Social Work of the Complutense University of Madrid, requesting the participation of volunteers who were interested in collaborating in the research. The participants who agreed completed the questionnaire in the classroom during class hours. All participants received an informed consent informing them about the voluntariness, abandonment of the research, confidentiality, anonymity, and the experimental purposes of data collection. Participants did not receive any compensation. The completion of the questionnaires took between 15 and 20 minutes.

Statistical analysis

First, we analyzed the mean differences in the study variables according to sex using Student's *t*. We also determined the magnitude of the effect size with Cohen's (1992) *d*, which stipulates that values below .20 are considered small, around .50 medium, and above .80 large. Second, we analyzed the bivariate relationships between EA, MD, addictions, and impulsivity through Pearson's *r*. Thirdly, we verified the mediating role of impulsivity in the relationship between addictions and EA. Fourthly, we confirmed the mediating role of impulsivity in the relationship between addictions and MD. For this purpose, we tested the linear regression model with the macro PROCESS v4.0 programme of SPSS by Hayes and Preacher (2013). Specifically, we applied Model 4 to test the proposed mediation models. Addictions were modeled as the independent variable, impulsivity as a mediator, and EA and MD as the dependent variables. Sex was introduced as a covariate to control for its effects. We used the SPSS version 22 (2013) program to perform all statistical analyses.

RESULTS

Preliminary Analyses: Analysis of sex as a possible covariate

To determine the possible influence of sex as a covariate in subsequent analyses, we analyzed the differences in EA, MD, addictions, and impulsivity as a function of sex (see Table 1).

Men scored higher than women on EA, MD and their subscales, and on alcohol abuse/dependence, substance addiction, pathological gambling, video game addiction, internet addiction, compulsive spending, and sex addiction. In contrast, women scored higher on eating disorders compared to men. The effect sizes were medium for pathological gambling, video game addiction, MD, bodybuilding dependence, muscle checking, and injuries, and small for the rest of the variables.

Aim 1. Relationships between EA, MD, and impulsivity and addictions

Concerning the first objective, we analyzed the relationships between EA, MD, addictions, and impulsivity (Table 2).

Table 1. Sex differences in addictions, impulsiveness, exercise addiction, and muscle dysmorphia

Variables	Woman (n=183)		Man (n=132)		t	Effect size (d)
	M	*SD*	*M*	*SD*		
Addictions						
Alcohol Abuse or Dependence	.92	1.11	1.43	1.39	3.52**	.22
Substance Addiction	.50	.95	.78	1.12	2.30**	.14
Pathological Gambling	.05	.32	.36	.80	4.16**	.31
Video Game Addiction	.11	.42	.61	1.21	4.53**	.34
Internet Addiction	1.09	1.29	1.32	1.46	1.46*	.09
Compulsive Spending	.45	.78	.52	1.08	.63*	.04
Eating Disorders	1.06	1.33	.60	1.02	-3.49**	.19
Sex Addiction	.28	.65	.51	.90	2.42**	.16
Impulsiveness						
Impulsiveness	67.38	10.11	67.37	9.27	-.005	
Addiction to physical exercise						
Addiction to physical exercise	12.43	5.00	14.40	6.15	3.03**	.19
Muscle dysmorphia						
Muscle Dysmorphia	31.55	7.53	36.92	13.10	4.23**	.29
Substance Use	4.64	1.48	5.61	2.88	3.54**	.25
Bodybuilding Dependence	7.18	2.52	8.95	4.11	4.38**	.30
Muscle Satisfaction	8.22	2.92	8.98	2.64	2.39	
Muscle Checking	5.83	2.30	7.53	3.98	4.42**	.30
Injuries	4.13	1.89	5.81	3.04	5.63**	.37

Note: *$p < .05$. **$p < .001$.

Table 2. Correlations between physical exercise addiction, muscle dysmorphia, addictions, and impulsiveness

	Exercise Addiction	Muscle Dysmorphia	Substance Use	Bodybuilding Dependence	Muscle Satisfaction	Muscle Checking	Injuries
Impulsiveness							
Impulsiveness	.14*	.25**	.20**	.18**	-.20**	.16**	.17**
Addictions							
Alcohol Abuse or Dependence	.15**	.22**	.15**	.18**	-.07	.20**	.20**
Substance Addiction	.14*	.14*	.08	.14*	-00	.13*	.15**
Pathological Gambling	.17**	.21**	.15**	.23**	.01	.21**	.20**
Internet Addiction	.08	.16**	.04	.12*	-.17**	.13*	.09
Video Game Addiction	.07	.10	.07	.08	-.01	.09	.13*
Compulsive Spending	.13*	.20**	.11*	.14*	-.23**	.13*	.15**
Eating Disorders	.12*	.21**	-.01	.12*	-.44**	.14*	.05
Sex Addiction	.10	.10	.04	.07	-.01	.13*	.13*

Note: *$p < .05$ **$p < .001$.

EA was positively and statistically significantly related to impulsivity, alcohol abuse/dependence, substance addiction, pathological gambling, compulsive spending, and eating disorders.

MD were positively and significantly associated with impulsivity and all the addictions, except for video game and sex addiction. As for the subscales of the ESM (Mayville et al., 2002), Substance Use had positive relationships with impulsivity, alcohol abuse/dependence, pathological gambling, and compulsive spending. Muscle Satisfaction was negatively linked to impulsivity, internet addiction, compulsive spending, and eating disorders. On the other hand, Muscle Checking was positively related to impulsivity and the addictions evaluated, except for video game addiction. Similarly, Injuries was also positively related to impulsivity and the addictions, except for internet addiction and eating disorders.

Aim 2: Predictive role of impulsivity in EA and MD

Table 3 shows the results of the regression analyses in the explanation of EA and MD, taking impulsivity as predictor, and sex as a covariate.

Impulsiveness predicted MD, Muscle Checking, Substance use, Bodybulding Dependence, Muscle Satisfaction and Injuries. It is important to note that impulsivity was not a predictor of EA.

Aim 3: Mediating role of impulsiveness between addictions and EA

Next, the possible mediating role of impulsiveness between addictions and EA was analyzed. Sex was introduced as a covariate in the model to control for its effects.

The results obtained show that greater alcohol abuse/dependence was related to

Table 3. The predictive role of addictions and impulsiveness on physical exercise addiction and muscle dysmorphia

Predictor variable	*B*	β	*t*	Sig.	Criterion variable
Impulsiveness	.20	.18	3.35	.00**	Muscle dysmorphia (R = .48, R^2 = .23, R^2 adj = .20)
	.04	.18	3.07	.00**	Substance consumption (R = .32, R^2 = .10, R^2 adj = .07)
	.05	.13	2.34	.02*	Bodybuilding Dependence (R = .42, R^2 = .17, R^2 adj = .14)
	-.04	-.15	-2.72	.01*	Muscle satisfaction (R = .50, R^2 = .25, R^2 adj = .23)
	.04	.11	2.03	.04*	Muscle checking (R = .41, R^2 = .17, R^2 adj = .14)
	.03	.11	2.02	.04*	Injuries (R = .42, R^2 = .17, R^2 adj = .15)

Note: *p < .05. **p < .001.

greater impulsiveness (β = 1.43; *SE* = .44; 95% CI [0.57, 2.30]), and greater impulsiveness was significantly related to greater EA (β = .07; *SE* = .03; 95% CI [0.01, 0.13]). Although alcohol abuse/dependence did not have a significant direct effect on EA (β = .42; *SE* = .25; 95% CI [-0.07, 0.92], the indirect effect of alcohol abuse/dependence on EA was significant (Indirect effect = .10; Bootstrap *SE* = .06; IC 95% [0.01, 0.23]). Thus, 3.28% of the relationship between alcohol abuse/dependence and EA was mediated by impulsiveness.

On the other hand, greater Substance Addiction was related to greater impulsiveness (β = 2.15; *SE* = .52; 95% CI [1.11, 3.18]), and greater impulsiveness was significantly related to greater EA (β = .07; *SE* = .03; 95% CI [0.00, 0.13]). Although Substance Addiction did not have a significant direct effect on EA (β = .48; *SE* = .31; 95% CI [-.13, 1.08]), the indirect effect of substance addiction on EA was significant (Indirect effect = .15; Bootstrap *SE* = .08; 95% CI [0.02, 0.33]). Thus, it was observed that 5.09% of the relationship between Substance Addiction and EA was mediated by impulsiveness.

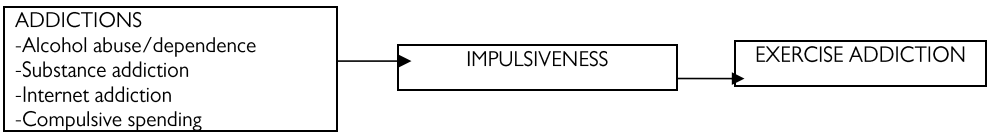
Likewise, higher internet addiction was linked to greater impulsiveness (β = 1.32; *SE* = .40; 95% CI [0.54, 1.10]), and greater impulsiveness was significantly linked to higher EA (β = .08; *SE* = .03; 95% CI [0.01, 0.14]). Although internet addiction did not have a significant direct effect on EA (β = .15; *SE* = .23; 95% CI [-0.30, 0.61]), the indirect effect of internet addiction on EA was significant (Indirect effect = .10; Bootstrap *SE* = .05; 95% CI [0.01, 0.22]). Thus, 3.41% of the relationship between internet addiction and EA was mediated by impulsiveness.

Finally, higher compulsive spending was linked to greater impulsiveness (β = 3.02; *SE* = .58; 95% CI [1.88, 4.15]), and greater impulsiveness was significantly linked to higher EA (β = .07; *SE* = .03; 95% CI [0.00, 0.13]). Although compulsive spending did not have a significant direct effect on EA (β = .53; *SE* = .35; 95% CI [-0.15, 1.22]), the indirect effect of compulsive spending on EA was significant (Indirect effect = .20; Bootstrap *SE* = .10; 95% CI [0.02, 0.43]). Thus, 8.05% of the relationship between compulsive spending and EA was mediated by impulsiveness.

Therefore, alcohol abuse/dependence, substance addiction, internet addiction, and compulsive spending were indirectly related to higher EA, explained by the positive relationship with increased impulsiveness.

Figure 1. Hypothetical model of mediation analysis

Addictions (IV), impulsiveness (M), and addiction to physical exercise (DV).



Aim 4: Mediating role of impulsiveness between addictions and MD

Finally, we analyzed the possible mediating role of impulsiveness between addictions and MD. Sex was entered as a covariate in the model.

The results showed that higher alcohol abuse/dependence was related to greater impulsiveness (β = 1.43; SE = .44; 95% CI [0.57, 2.30]), and greater impulsiveness was significantly related to higher MD (β = .24; *SE* = .06; 95% CI [0.13, 0.35]). Alcohol abuse/dependence had a significant direct effect on MD (β = 1.14; SE = .46; 95% CI [0.23, 2.04]), and the indirect effect of alcohol abuse/dependence on MD was significant (Indirect effect = 1.14; Bootstrap SE = .46; 95% CI [0.23, 2.04]). Thus, 3.28% of the relationship between alcohol abuse/dependence and MD was mediated by impulsiveness.

Also, higher Substance Addiction was linked to greater impulsiveness (β = 2.15; *SE* = .52; 95% CI [1.11, 3.18]), and greater impulsiveness was significantly related to higher MD (β = .25; *SE* = .06; 95% CI [0.14, 0.37]). Although Substance Addiction did not have a significant direct effect on MD (β = .52; *SE* = .56; 95% CI [-0.58, 1.62]), the indirect effect of substance addiction on MD was significant (Indirect effect = .54; Bootstrap *SE* = .20; 95% CI [0.21, 1.01]). Thus, 5.09% of the relationship between Substance Addiction and MD was mediated by impulsiveness.

Likewise, higher internet addiction was linked to greater impulsiveness (β = 1.32; *SE* = .40; 95% CI [0.54, 1.10]), and greater impulsiveness was significantly related to higher MD (β = .25; *SE* = .06; 95% CI [0.13, 0.36]). Although internet addiction did not have a significant direct effect on MD (β = .72; *SE* = .42; 95% CI [-0.10, 1.54]), the indirect effect of internet addiction on MD was significant (Indirect effect = .33; Bootstrap *SE* = .12; 95% CI [0.12, 0.59]). Thus, 3.41% of the relationship between internet addiction and MD was mediated by impulsiveness.

Finally, higher compulsive spending was linked to greater impulsiveness (β = 3.02; *SE* = .58; 95% CI [1.88, 4.15]), and greater impulsiveness was significantly related to higher MD (β = .22; *SE* = .06; 95% CI [0.11, 0.34]). In this case, compulsive spending had a significant direct effect on MD (β = 1.57; *SE* = .63; 95% CI [0.33, 2.81]), and the indirect effect of compulsive spending on MD was also significant (Indirect effect = .68; Bootstrap *SE* = .22; 95% CI [0.31, 1.16]). Thus, 8.05% of the relationship between compulsive spending and MD was mediated by impulsiveness.

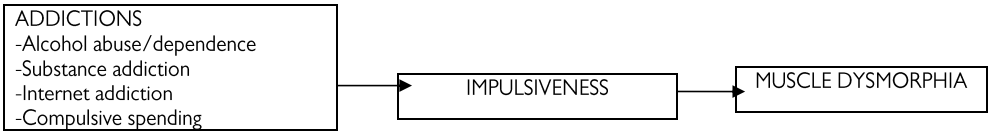
Therefore, alcohol abuse/dependence and compulsive spending were directly related to higher MD, explained by the positive relationship with increased impulsiveness. Likewise, substance addiction and internet addiction were indirectly related to higher MD, explained by the positive relationship with increased impulsiveness.

DISCUSSION

Previously, the analysis of possible differences according to sex in our variables of interest points in the same direction as prior literature. Men scored significantly higher than women in EA and MD, coinciding with

Figure 2. Hypothetical model of mediation analysis

Addictions (IV), impulsiveness (M), and muscle dysmorphia (DV).



the prevalences indicated by other works (Compte & Sepúlveda, 2014; Dumitru et al., 2018; Hausenblas & Downs, 2002b), as well as in alcohol abuse/dependence, substance addiction, pathological gambling, and addiction to video games and sex. Again this reveals that men have more problems with these behaviors (Chiclana, 2013; López-Fernández et al., 2020; Pérez, 2014; Pérez & Echeburúa, 2019) and that the combined emergence of gambling disorder and polyconsumption is frequent (Roberts et al., 2017). On the other hand, women only scored higher on food addiction, which is consistent with known data on the prevalence of eating disorders (APA, 2013). These sex differences can be explained from biological, psychological, and social points of view. The different hormonal roles (Fattore et al., 2014) and the roles that have been socially associated with women and men are also relevant: in women, a role focused on family care and emotions, and in men, a role focused on independence, competence, and confidence (Hegelson, 2002; Matud et al., 2004; Moreno & Marrero, 2015). On the other hand, the absence of statistically significant differences in impulsivity, contrasted with the presence of such differences in addictive behaviors, suggests that the disparities lie within the manifestation of symptoms (in the form of addictions) rather than in the predictive factors such as impulsivity.

The first objective, to analyze the relationship between EA, MD, impulsiveness, and other addictions is of special interest in the present work. The results show that as EA increases, so does impulsiveness, alcohol abuse/dependence, pathological gambling, compulsive spending, and addiction to sex, substances, and food. In this sense, people with EA seem to have worse emotion regulation and ability to control impulses (Huang et al., 2019; Kotbagi et al., 2017) and a higher risk of developing another addiction. Although, this relationship with the diversity of addictions contemplated in this study has not been explored to our knowledge, our results are consistent with those obtained by Chamberlain and Grant (2020), who found that high scores in EA are related to impulsiveness and compulsive personality characteristics, lack of emotion regulation, and eating disorders. Total MD is also related to impulsiveness and to all the addictions, suggesting that higher MD is linked to greater impulsiveness and more addictions. The ESM subscales (Mayville et al., 2002) all relate to impulsiveness and at least two of the other addictions. In this same vein, García-Argibay (2019) observed that people with MD who consume AAS show greater impulsiveness

and difficulty in postponing gratification, whereas Klimek and Hildebrandt (2018) found significant correlations between MD and impulsiveness in a group of people who consumed AAS. In this sense, it is suggested that people who use AAS are more likely to use other types of drugs (Havnes et al., 2020). Significant relationships were found between the consumption of these substances or fitness supplements and greater anxiety about the body and the development of EA (Corazza et al., 2019), and also a higher prevalence of MD, the presence of cognitive distortions, and body dissatisfaction (Davies et al., 2011).

The second objective of this research is the analysis of the predictive role impulsiveness in EA and MD. Impulsiveness is shown to be a predictor of MD. This result regarding impulsiveness is consistent no matter whether MD is understood within obsessive-compulsive disorders—where impulse control together with compulsion plays an important role (APA, 2013)—or whether MD is framed within behavioral addictions—where impulsiveness is proposed to be a antecedent (de Sola et al., 2013).

It is paradoxical that a behavior like physical exercise, which is healthy and recommended by the WHO (2010) is significantly related to the consumption of alcohol and other drugs when it becomes addictive and compulsive. In this sense, the comorbidity between substance addiction and EA and MD is consistent with other research that highlights the relationship between substance addiction and behavioral addiction. Di Nicola et al. (2015) found that people with an alcohol use disorder had higher impulsiveness and that this, in turn, was related to compulsive shopping, internet addiction, and EA, concluding that the presence of high impulsiveness and craving was related to other behavioral addictions. In the same vein, Lejoyeux et al. (2012) found that people with EA also presented alcohol dependence, hypochondria, bulimia, and binge eating disorder.

One of the particularly novel points of this work is the third objective: exploring the possible mediating role of impulsiveness in the relationship between addictions and EA and MD. To our knowledge, this relationship has not been previously explored, and it would allow us to understand the role of impulsiveness as a link or explanatory mechanism in the relationship between certain addictions and EA or MD. Our results show that impulsiveness is present in the relationship between substance addiction, eating disorders, and EA. On the other hand, impulsiveness is also present in the relationship between substance, internet, and food addictions, and MD. This means that a percentage of these relationships (the observed comorbidity between addictions) is explained by impulsiveness, highlighting its role in the relationship between behavioral addictions. It also provides more evidence to previous works that point out important similarities between substance addictions and behavioral addictions (Holden, 2001; Li et al., 2020).

This work also has some limitations. One of them is the cross-sectional nature of the research, which does not allow us to establish causal relationships and, as a consequence, it affects the scope of the conclusions. That is to say, despite speaking in terms of prediction, the interpretation does not lead to causal inferences precisely because it is a cross-sectional study. On the other hand,

the sample used affects the generalization of the results because it is a convenience sample and very homogeneous in certain sociodemographic characteristics (i.e., Spanish nationality and university studies). On another hand, the evaluation instruments are merely screening instruments and do not confer diagnostic categories. Future research challenges are to carry out longitudinal studies to verify whether there is a causal relationship between the variables studied and the detailed analysis of impulsiveness subscales and their relationship with EA and MD and other addictions.

Despite the above limitations, the results of this study show the relationship between different behavioral addictions, substance addictions, and the important role of impulsiveness. Specifically, it provides deeper knowledge of EA and MD from models that, considering the methodological limitations of a correlational study, propose addictions as predictors and the mediating role of impulsiveness in the comorbidity of different addictions and EA and MD. The dissemination of these findings among mental health and sports science professionals is necessary. The role of impulsiveness and emotion regulation should be addressed from the viewpoint of prevention, preferably primary prevention, because if emotion regulation skills are improved, coping styles can also be improved, and impulsive behavior can be reduced (Gómez-Romero et al., 2020). Recent results show that combined treatments, cognitive-behavioral psychological treatment along with pharmacological treatment, show the best results in the treatment of behavioral addictions (Goslar et al., 2020).

Declarations

Ethics approval

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study. The study was approved by the Deontological Commission of the Faculty of Psychology of the Complutense University of Madrid (with reference Ref. 2020/21-035).

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