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Psychosocial factors underlying symptoms of muscle dysmorphia in a non-clinical sample of men

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ABSTRACT

Muscle dysmorphia is primarily characterized by an excessive preoccupation that one's body is not muscular or lean enough. Muscle dysmorphia has shown clinical similarities with eating disorders. The present study aims to explore the psychosocial factors underlying muscle dysmorphia symptoms by referring to Stice's dual pathway model (1994), a theoretical model of eating disorders. Three hundred and eighty-six men were recruited to complete an online survey including questionnaires assessing social pressures to reach a muscular body and internalization of the muscular body, drive for muscularity, muscular-enhancing behaviors, negative affect, narcissistic traits, and symptoms of muscle dysmorphia. Path analyses showed that the original model has a good fit, without, however, confirming a significant relationship between the drive for muscularity and negative affect. Thus, social pressure to reach a muscular body and its internalization were associated to a drive for muscularity and then, to muscle dysmorphia symptoms. The drive for muscularity was indirectly related to symptoms of muscle dysmorphia through muscle-enhancing behaviors as well as negative affect (although, only for individuals with higher levels of narcissistic vulnerability). Results supported the adaptation of the Stice's model to explain muscle dysmorphia symptoms and underlined the possible influence of narcissistic vulnerability traits in this condition.

1. Introduction

Nowadays, men are increasingly pressured to have a muscular and lean body, which is highly promoted by media (De Jesus et al., 2015; Gattario et al., 2015; Ricciardelli et al., 2010). Thus, it is not surprising that men report higher levels of body dissatisfaction because of their inability to meet this ideal body type. Besides, many authors showed that body dissatisfaction in men, which tends to reach similar levels as those seen in women, is frequently related to body image and eating behaviors (Frederick et al., 2007; Neighbors and Sobal, 2007). Indeed, muscularity has become a significant indicator of masculinity for the modern men, which may explain the generalized preoccupation regarding physical appearance and muscularity (Fabris et al., 2018). An intense drive for muscularity can lead to muscle dysmorphia, defined by Pope et al. (1997) as an excessive preoccupation with the idea that one's body is not muscular or lean enough and characterized by a range of behaviors including excessive attention to diet and muscle-enhancing physical exercise.

In the latest edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013), muscle dysmorphia has officially been classified as a specification of the body dysmorphic disorder, within the obsessive-compulsive disorders (OCD). Thus, muscle dysmorphia represents a type of body dysmorphic disorder for which the central preoccupation is one's muscularity. Indeed, obsessions about body image and more precisely muscularity are key features of muscle dysmorphia; they lead to repetitive behaviors such as excessive weight lifting and rigid dieting. Recently, Maier and his colleagues (2017) supported this classification through neurophysiological correlates of body dysmorphic disorder in bodybuilders.

Despite this classification, many authors keep linking muscle dysmorphia to eating disorders (Grieve, 2007; Lopez et al., 2015; Murray et al., 2010; Murray et al., 2012; Murray et al., 2013). For example, Murray et al. (2010) highlighted the multiple similarities between muscle dysmorphia and eating disorders. In this review, authors criticize the actual muscle dysmorphia's classification; they also draw parallels between initial onsets of both disorders, which mainly occur during adolescence. Besides, even if gender representations are in striking opposition, both disorders are highly related to social pressures surrounding body image for men and women. Indeed, men tend to adopt muscle-enhancing behaviors (e.g., exercise, weightlifting, eating more, using steroids or other drugs; Smolak et al., 2005), which fit with the mesomorphic body ideal for men, that is “a visible, although not

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excessively large musculature couple with low body fat" (Tylka, 2011); on the other hand, women tend to adopt restrictive behaviors as a way to reach the ectomorphic body ideal that is a thin and narrow body. Moreover, muscle dysmorphia symptoms are also associated to dietary restrictions and important preoccupations regarding weight and body image (Grieve et al., 2009; Lopez et al., 2015; Murray et al., 2012). Murray et al. (2012), whom compared men with muscle dysmorphia to men with anorexia nervosa, on eating behaviors and physical activity, showed no significant differences between both groups according to dieting restriction, body and weight preoccupations and compulsive exercising.

Muscle dysmorphia and eating disorders also share many other commonalities. Murray et al. (2013) tested the transdiagnostic model of eating disorders according to muscle dysmorphia's symptomatology. They examined the predictive value of eating disorders' universal features (interpersonal problems, mood intolerance, low self-esteem, perfectionism) on muscle dysmorphia symptoms. Their results showed that, except for interpersonal problems, each variable of the model significantly predicted muscle dysmorphia symptoms.

Despite those commonalities and the fact that both disorders promote opposite physical strives, an important argument against the classification of muscle dysmorphia as an eating disorder is that disordered eating behaviors seem to be a secondary component of the symptomatology of the muscle dysmorphia whereas weightlifting seems to be the central component (Olivardia, 2001). In fact, even if rigid dieting represents an important characteristic of the muscle dysmorphia disorder, it is not considered as a central symptom, as proposed in eating disorders, but rather a consequence of muscle dysmorphia (Phillipou et al., 2016). To complicate the nosographic portray, the systematic review conducted by dos Santos Filho (2016) and his colleagues showed that current evidences on muscle dysmorphia are not sufficient to conclude to the classification of this condition in any category of the actual psychiatric classification system including the body dysmorphic disorder. Considering the supported similarities between eating disorders and muscle dysmorphia, mainly in relation to body-image concerns, the classification of muscle dysmorphia as an eating disorder has not been ruled out yet.

Accordingly, it is possible to hypothesize a shared aetiology between both conditions. There exists different structural models to explain body dissatisfaction and disordered eating behaviors. The tripartite model is one of them, extensively examining the influence of the social environment on body dissatisfaction and disordered eating behaviors (Thompson, Coovert and Stomer, 1999). Although initially the model posited that social feedback will lead to body dissatisfaction and disordered eating behaviors through social comparison, recently the model rather put emphasis on the importance of the internalisation of the social pressure as an important factor related to both dissatisfaction with muscularity and body fat (Tylka, 2011). The Stice dual pathway model is another theoretical model of eating disorders that aims (Stice, 1994,2002; see Fig. 1) to conceptualize the development of eating disorders, in which the internalization of social pressures to reach the thin body ideal was associated to body dissatisfaction and subsequently to eating disorders, via two distinct patterns. This model suggests that negative affect (affective pattern) and dietary restriction (behavioral pattern) potentially lead to eating disorders. Despite the fact that Stice's model has not been tested for muscle dysmorphia, a study partially supported some of its components.

Lamanna et al. (2010) tested a model that shares a few commonalities with Stice's dual pathway model, in a sample of university students (men and women). In this model, the authors suggested that social pressure leads to body dissatisfaction, which would directly or indirectly lead (via negative affect) to muscle dysmorphia and eating disorders symptoms. However, the behavioral pathway (e.g., muscle-enhancing behaviors) was not explored in relation with muscle dysmorphia. Results showed that sociocultural influences led to body dissatisfaction, which led to muscle dysmorphia symptoms (Lamanna et al., 2010). Negative affect did not significantly mediate the relationship between body dissatisfaction and muscle dysmorphia symptoms. Authors proposed that body dissatisfaction in men would not be associated to general negative affect, but more specifically with body-related ones.

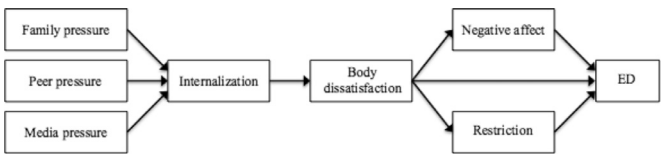

Fig. 1. Stice's dual pathway model (2002).

To account for the absence of significant association between body dissatisfaction and negative affect, personality traits might also be an interesting avenue. In fact, personality traits have already been explored as a valid moderator of the relationship between body dissatisfaction and negative affect among women (Gagnon-Girouard et al., 2009). Besides, Edelstein and his colleagues (2010) showed that men with more narcissistic traits presented a significant increase in negative affectivity than men from a control group, in reaction to an evaluative laboratory stressor akin to a context of social evaluation. In addition, some authors suggested a relationship between narcissistic traits and muscle dysmorphia symptoms based on multiple similarities between muscle dysmorphia and eating disorders, arguing that both conditions are characterised by a strong focus on the self and a low self-esteem (Kuennen and Waldron, 2007; Lewis et al., 2016). Narcissism has also been linked to compulsive exercising, drug use and risky behaviors, which are common manifestations of muscle dysmorphia (Bruno et al., 2014; Hill, 2015). However, no significant relationships between muscle dysmorphia symptoms and narcissism where observed, when considered as a one-dimensional construct. According to the existing literature on narcissism, two distinct presentations of narcissism were identified, namely a grandiose and a vulnerable presentation (Cain et al., 2008; Miller and Campbell, 2008). The vulnerable presentation of narcissism had been associated to more negative affect and more emotion regulation difficulties than the grandiose presentation (Miller et al., 2010; De Pierro et al., 2017; Hyatt et al., 2017); thus, it is possible that the vulnerable presentation of narcissism provides a better understanding of the relationships between body dissatisfaction, negative affect and muscle dysmorphia symptoms in Stice's model. Therefore, narcissistic vulnerability could represent a relevant moderator within the negative affect pathway leading to muscle dysmorphia symptoms.

The present study aims to test Stice's dual pathway model to examine the relationships between sociocultural variables and muscle dysmorphia symptoms. The model was adapted to take into account specific features of muscle dysmorphia; it suggests that sociocultural influences are associated to a drive for muscularity, which is directly and indirectly associated to muscle dysmorphia symptoms, via two distinct pathways (negative affect and muscle-enhancing behaviors). Moreover, the contribution of narcissistic personality traits will be tested in this model. More specifically, the moderating role of narcissistic vulnerability on the negative affect pathway will be tested. Stice's model is expected to fit the data and to predict adequately muscle dysmorphia symptoms.

2. Material and methods

2.1. Participants

Participants (N = 386) were male students and employees from Laval University, with a mean age of 22.24 years (SD = 4.39). Of the participants, 91.8% described themselves as Caucasians, and were of Canadian origin; 71.3% were full-time students, 20.3% were full-time workers, 6.5% were part-time students and 1.1% were unemployed or on a work stoppage. Body Mass Index (BMI) ranged between 14.92 and

34.02 kg/m^2 (M = 24.70; SD = 4.36).

2.2. Procedure

Participants were recruited at Laval University, through the campus email list including students and employees. The recruitment email included the procedure of the present study, which was to complete an online survey via Surveymethods (www.surveymethods.com) regarding psychosocial factors underlying muscle dysmorphia onset. The heading of the recruitment email sent to the university community was: "Never muscular enough?" targeting men aged between 18 and 35 years. Participants completed the survey on a voluntary basis, and no monetary compensation was associated to their participation. All measures were completed using a validated French version of the original questionnaire. Data were all collected anonymously. The Laval University Research Ethics Committee approved the study.

2.3. Measures

2.3.1. Social pressure

The Perceived Sociocultural Pressure Scale (PSPS; Stice et al., 1996) was used to assess pressure perceived by men to reach a mesomorphic body type, according to four distinct sources: parents, friends, significant others, and media. The original questionnaire consists of eight items, including two items for each source: (1) the level of pressure perceived by this source to lose weight and (2) if they have noticed a clear message to have a thin body from this source. In the modified version, validated in a sample of university students, the term "lose weight" within the first item was replaced by "become more muscular and lean", and "thin" within the second item was replaced by "muscular and lean". Items are answered on a five-point Likert scale from 1 (*none*) to 5 (*a lot*), and mean scores of both items indicate the level of perceived pressure to be more muscular and lean, from each source. For sake of parsimony, only the total score combining all sociocultural pressure sources was used considering that we were interested in examining the whole process that leads to muscle dysmorphia symptoms with a particular attention to specific constructs related to eating disorders that were adapted for muscle dysmorphia. Morever, the total score has shown an internal consistency of 0.87 (Stice et al., 1996). The total score of the PSPS had already been used in other studies (Forbes et al., 2012) and this decision was also supported by result obtained from a factorial analysis (see data analyses and results sections for more details). Moreover, in a sample of undergraduate men, this questionnaire has shown good internal consistencies (Tylka, 2011). In the present study, internal consistency was 0.78 for the total score.

2.3.2. Internalization of the muscular ideal

The Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ-3: Rousseau et al., 2010; Thompson et al., 2004), a five-point Likert scale from 1 (*definitely disagree*) to 5 (*definitely agree*), was used to assess internalization of the muscular ideal. In the present study, two of the four subscales were used, namely Internalization-General and Internalization-Athlete subscales. The Internalization-General subscale is a nine-item scale that assesses the integration of appearance standards conveyed by media (e.g., "I would like my body to look like the people who are in movies."); the Internalization-Athlete subscale is a five-item scale that assesses the integration of athletes and sports figures body standards (e.g., "I wish I looked as athletic as sports stars."). Total scores for those subscales are obtained from the mean score of all items; a higher score indicates a stronger internalization of appearance standards. A study among undergraduate men supports the use of the revised version of the questionnaire, adapted to muscularity in men, with an excellent internal consistency for both Internalization-General (α = 0.94) and Internalization-Athlete (α = 0.85) subscales (Karazsia and Crowther, 2008). The French translation of the original version of this questionnaire has also demonstrated good internal consistencies for both subscales (α = 0.81 and 0.83; Rousseau et al., 2010). In the present study, the Internalization-General subscale showed an excellent internal consistency (α = 0.95) and the Internalization-Athlete subscale showed a good internal consistency (α = 0.86).

2.3.3. Negative affect

The Negative Affect subscale of the Positive and Negative Affect Scale (PANAS; Gaudreau et al., 2006; Watson et al., 1988) was used to assess negative affect felt during the last month. It is a 10-item self-reported questionnaire that is answered on a five-point Likert scale from 1 (*very slightly or not at all*) to 5 (*extremely*). The Negative Affect Score ranges from 10 to 50; a higher score indicates a higher level of negative affect. In the original validation, the negative affect subscale demonstrated an excellent internal consistency with a 0.91 Cronbach's alpha (Watson et al., 1988). In a sample of men, the internal consistency of this subscale was 0.85 (Karazsia and Crowther, 2008), and was 0.88 for the present study.

2.3.4. Muscle-enhancing behaviors

The Muscle Building Techniques Scale (MBTS; Smolak et al., 2005) was used to assess the frequency of muscle-enhancing behaviors (1: never; 5: always). This five-item scale is answered on a five-point Likert scale from 1 (*never*) to 5 (*always*) and examines the frequency of five specific behaviors in the past year (exercise, weight lifting, eating more, taking vitamins or supplements, and using steroids or other drugs). A higher score indicates more frequent muscle-enhancing behaviors. In its validation study among adolescent boys, as well as in the present study, this scale showed an adequate internal consistency (α = 0.75),

2.3.5. Narcissism

The Narcissistic Vulnerability subscale of the Pathological Narcissism Inventory (PNI; Da Silva Luis, 2014; Pincus et al., 2009) was used to assess narcissistic personality traits (e.g. "I try to show what a good person I am through my sacrifices"). Respondents are asked to answer the 52-item self-reported questionnaire on a six-point Likert scale (0: not at all; 5: very much like me). Items are divided in two distinct dimensions (Narcissistic Grandiosity and Narcissistic Vulnerability) and seven subscales (Contingent Self-Esteem, Exploitativeness, Self-Sacrificing Self-Enhancement, Hiding the Self, Grandiose Fantasy, Devaluating, and Entitlement Rage). The mean score is used to assess the pathological narcissism total score and a higher score indicates a higher level of narcissism. In a sample of young adult men, the PNI showed an internal consistency of 0.94 (Rubinstein, 2010); in the validation study of the French version of the questionnaire, as well as for the present study, the Narcissistic vulnerability dimension showed an excellent internal consistency (α = 0.93)

2.3.6. Drive for muscularity

The Drive for Muscularity Scale (DMS; McCreary and Sasse, 2000) was used to assess attitudes and behaviors reflecting one's desire to have a more muscular body (e.g. "I think my arms are not muscular enough"). Respondents are asked to answer the 15-item measure on a six-point Likert scale from 1 (*always*) to 6 (*never*) and the total score is obtained by averaging each item. The DMS includes two subscales: Muscularity-Oriented Attitudes (seven items) and Muscularity-Oriented Behaviors (eight items). A higher score indicates a stronger drive for muscularity. In its validation study, with adolescents and young adults, the DMS showed good internal consistencies for the total score and both subscales (α = 0.81 to 0.88; McCreary and Sasse, 2000). Moreover, convergent validity and an excellent internal consistency (α ranging from 0.85 to 0.91) of the DMS have been demonstrated in studies with male participants (McCreary, 2007). In the present study, it demonstrated internal consistencies ranging from good to excellent (Total score = 0.90; Muscularity-Oriented Behaviors subscale and Muscularity-Oriented Attitudes = 0.91).

2.3.7. Muscle dysmorphia symptoms

The Muscle Dysmorphic Disorder Inventory (MDDI; Hildebrandt et al., 2004) was used to assess muscle dysmorphia symptoms. This 13-item self-reported questionnaire is answered on a five-point Likert scale from 1 (*never*) to 5 (*always*) that allows the examination of cognitions, emotions and behaviors regarding body image. It includes three subscales: Drive for Size, Appearance Intolerance, and Functional Impairment. The original validation study in men with weightlifting experience showed acceptable to good internal consistencies for subscales (α = 0.77 to 0.85) and for the total score (α = 0.81; Hildebrandt et al., 2004). In the present study, internal consistency was acceptable for the total score (α = 0.79), and acceptable to good for subscales (α = 0.76 to 0.86).

2.4. Data analyses

SPSS 24.0 and Mplus (Muthén and Muthén, 1998–2011) statistical software programs were used, with the full information maximum likelihood method to address missing data (FIML; Enders and Bandalos, 2009). Firstly, we conducted a factor analysis to ensure that the different sources of the PSPS were well represented in one sociocultural pressure factor. Afterwards, correlational analyses were conducted to examine the relationships between all variables. In order to address the primary objectives of the present study, muscle dysmorphia explanatory model was tested using path analysis (see Fig. 2). Preacher and Hayes' approach (2008) was used to test the moderation and mediation processes. Statistical significance was estimated using bootstrapping methods with 1000 resamples, and 95% confidence intervals (Edwards and Lambert, 2007). In order to measure the fit of the models to the data, the following indices were used: Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR) and the Robust Chi-Square Difference Test (χ^2). A value over 0.90 and 0.95 for the CFI and the TLI indicates an acceptable fit (Hoyle, 1995), whereas values of 0.08 and under are acceptable for the RMSEA and SRMS indices (Browne and Cudeck, 1993). Finally, the robust χ^2 must be non-significant to represent a good fit.

3. Results

Descriptive statistics were presented in Table 1 and correlational analyses were presented in Table 2. Result from the factorial analysis confirmed that the different sources of sociocultural pressure in the PSPS were well represented by a unique factor as the eigenvalue for one factor is >1 and the loading of the different pressure sources under that factor were high (between 0.580 and 0.707). As such, the correlational coefficient between the PSPS total score and the factorial score was 0.99. The total score of the PSPS was used to reflect sociocultural pressure. Significant relationships were found between sociocultural pressure, drive for muscularity, narcissism, negative affect, muscle-enhancing behaviors and muscle dysmorphia symptoms.

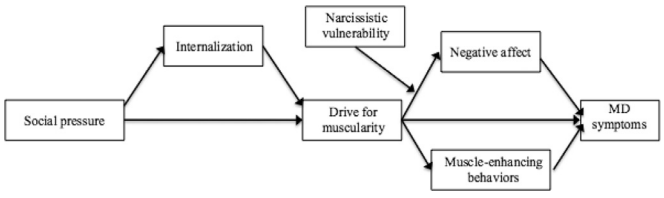

Fig. 2. Stice's dual pathway model modified version in the prediction of MD symptoms (Proposed model)

Note. The proposed model only included the variables of interest. The relationships between all the variables had simultaneously been tested.

Note. For social pressure (PSPS), only the total score was used. The factorial analysis confirmed that the PSPS was well represented by a unique factor as the eigenvalue for one factor is >1 and the loading of the different pressure sources under that factor were high (between 0.580 and 0.707). As such, the correlational coefficient between the PSPS total score and the factorial score was 0.99.

Then, path analyses were performed with MPlus statistical software program in order to test Stice's model adapted for muscle dysmorphia symptoms. The fit indices (i.e., CFI = 0.99, TLI = 0.99, RMSEA = 0.02, SRMR = 0.01) as well as the normed Chi-Square (χ^2 = 1.21 (*df* = 1), *p* = 0.27) showed that the model fits the data well. Results showed significant indirect effects between social pressure and drive for muscularity via internalization of the muscular ideal (IE = 0.128, CI 95% [0.077, 0.200]), as well as between drive for muscularity and muscle dysmorphia symptoms via muscle-enhancing behaviors (IE = 0.030, CI 95% [0.002, 0.070]). However, the indirect effect of the drive for muscularity on muscle dysmorphia symptoms via negative affect was not significant (IE = 0.026, CI 95% [−0.002, 0.066]).

Narcissistic vulnerability was included to the present model, as a potential moderator of the relationship between the drive for muscularity and negative affect. The model maintained good fit indices (CFI = 0.984; TLI = 0.950; RMSEA = 0.048; SRMR = 0.034) and showed a normed Chi-Square of 15.158 (*df* = 8), *p* = 0.0561. To assess the contribution of narcissistic vulnerability as a moderator of the relationship between the drive for muscularity and negative affect, a Robust Chi-Square Difference Test was performed between the present model where narcissistic vulnerability parameters were added and another one where narcissistic vulnerability parameters were fixed to zero (χ^2 = 99.422 (*df* = 14), *p* < 0.0001). The contrast between models using Maximum Likelihood Estimator with robust standard error (MLR) showed a Chi-Square difference of 89.85 (*df* = 6, *p* < 0.0001), indicating that adding up narcissistic vulnerability as a moderator represents a valuable contribution to the model (Model and standardized coefficients are displayed in Fig. 3).

Results showed that social pressure was directly related to the drive for muscularity, and indirectly through the internalization of the muscular ideal (IE = 0.128, CI 95% [0.077, 0.200]) Then, the drive for muscularity was related to muscle dysmorphia symptoms through two mediators: 1) muscle-enhancing behaviors (IE = 0.030, CI 95% [0.002, 0.070]), and 2) negative affect while moderated by narcissistic vulnerability (IE = 0.037, CI 95% [0.006, 0.082]). Indirect effect of negative affect on the relationship between the drive for muscularity and muscle dysmorphia symptoms was only significant at higher levels of narcissistic vulnerability (1 SD above the group mean). More precisely, it means that negative affect only mediated the relationship between drive for muscularity and muscle dysmorphia symptoms in men who also reported a higher levels of narcissistic vulnerability. The model explains 64% of the variance of muscle dysmorphia symptoms.

4. Discussion

The aim of the present study was to validate a modified version of Stice's dual pathway model (Stice, 1994,2002), in order to understand relationships between sociocultural variables and muscle dysmorphia symptoms in a sample of adult men. In fact, this is the first attempt to test a complete etiological model of eating disorders to examine underlying factors associated to muscle dysmorphia symptoms, while previous studies only examined isolated factors or segments of the model. It was expected that sociocultural variables would be related to the drive for muscularity, and the latter would be directly associated to muscle dysmorphia symptoms or indirectly through two distinct pathways: negative affect and muscle-enhancing behaviors. It was also proposed that narcissism, and more precisely narcissistic vulnerability, could moderate the relationship between the drive for muscularity and negative affect.

Results support the actual hypotheses and are in line with previous literature on that topic (Franko et al., 2015). The relationship between social pressures and body dissatisfaction (i.e., drive for muscularity), as well as the mediation of this relationship by the internalization of the ideal muscular body, clearly show the importance of sociocultural

Table 1
Descriptive statistics.

	N	*M*	*SD*
Perceived Sociocultural Pressure Scale (PSPS)	271	1.81	0.66
Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ)	272	46.31	14.21
Drive for Muscularity Scale (DMS)	311	3.96	1.27
Pathological Narcissism Inventory -Narcissistic Vulnerability (PNI-V)	273	2.10	0.78
Negative Affect subscale of the Positive and Negative Affect Scale (PANAS)	271	20.66	7.72
Muscle Building Techniques Scale (MBTS)	366	13.77	4.28
Muscle Dysmorphic Disorder Inventory -Drive for size (MDDI-DS)	278	11.11	4.73
Muscle Dysmorphic Disorder Inventory -Appearance Intolerance (MDDI-AI)	277	4.44	3.72
Muscle Dysmorphic Disorder Inventory -Functional Impairment (MDDI-FI)	276	3.95	3.92
Muscle Dysmorphic Disorder Inventory -Total (MDDI-Total)	269	19.48	8.41

PSPS = a high score indicates social pressure perceived by men to reach a mesomorphic body type, according to four distinct sources: parents, friends, significant others, and media (Stice et al., 1996); **SATAQ** = a higher score indicates a stronger internalization of beauty standards (Rousseau et al., 2010);
DMS = A higher score indicates a stronger drive for muscularity (McCreary and Sasse, 2000); **PNI-Narcissistic Vulnerability** = a higher score indicate a higher level of narcissistic vulnerability (Da Silva Luis, 2014); **PANAS** = a higher score indicates a higher level of negative affect (Gaudreau et al., 2006);
MBTS = a higher score indicates more frequent muscle-enhancing behaviors; **MDDI-Total** (Muscle Dysmorphic Disorder Inventory-Total score) = a higher score indicates more cognitions, emotions, and behaviors related to body image (Hildebrandt et al., 2004).

influences on men's body image. Young men are massively pressured by their surroundings to reach a more muscular and leaner body, and media have a prominent role in the promotion of this ideal (Frederick et al., 2005; McCabe et al., 2015; Ricciardelli et al., 2010). Internalization of the ideal muscular body in men illustrates the process by which they integrate and pursue the socially promoted body image. Our results non only supported those obtained by numerous researchers in eating disorders domain (Dual pathway and Tripartite models) suggesting that the internalisation of social pressure (measured by different sources such as parents, friends, media or measured by a global score) is associated to body dissatisfaction, muscle enhancing-behaviors and disordered eating behaviors but they extended it more specifically to muscle dysmorphia symptoms. By internalizing this muscular ideal, men are more likely to be dissatisfied with their own body image which may become a risk factor for body image disorders, especially muscle dysmorphia.

As expected, results of the present study confirmed the major contribution of the drive for muscularity in muscle dysmorphia symptomatology. Indeed, it is directly and significantly associated to muscle dysmorphia symptoms. Thus, drive for muscularity seems to result in drastic measures to modify body shape. Besides this direct effect, two indirect pathways related to muscle dysmorphia symptoms have been observed: an affective (negative affect) and a behavioral pathway (muscle-enhancing behaviors).

According to the negative affect pathway, results are similar to those observed in previous studies on muscle dysmorphia (Lamanna et al., 2010). Negative affect did not represent a significant mediator of the relationship between the drive for muscularity and muscle dysmorphia symptoms. It means that the relationship between drive for muscularity and muscle dysmorphia symptoms did not gone

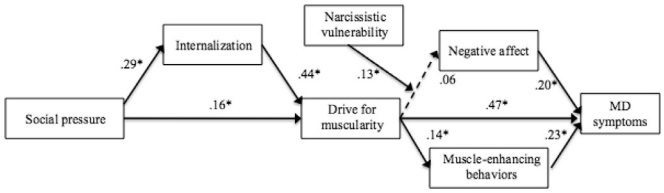

Fig. 3. Stice's dual pathway model modified version in the prediction of MD symptoms (final model).

through negative affect. Some hypotheses have been proposed for the absence of a significant link between body dissatisfaction (measures in our study by drive for muscularity) and negative affect. Lamanna et al. (2010) proposed that body dissatisfaction in men was not associated to general negative affect, but rather with a body-related one as if the negative affect measure was not specific enough. Another possible explanation that has been developed is that the present measure of negative affect assesses an every-day negative affect whereas muscle dysmorphia's negative affect may be characterized by more clinical symptoms, like depressive or anxiety symptoms, which are not captured by our measure (Mitchell et al., 2017). Despite these relevant hypotheses about the construct measurement, the present results showed that narcissistic vulnerability could partially moderate the relationship between the drive for muscularity and negative affect. Specifically, men with higher levels of narcissistic vulnerability and a drive for muscularity tended to report more negative affect, which could place them at greater risk to develop muscle dysmorphia. Higher levels of narcissistic vulnerability in men have been associated with a stronger feeling of shame following personal failures, criticism and inability to meet one's ideal self-image (Besser and Priel, 2010). Considering this

Table 2
Correlations between model's variables.

	PSPS	SATAQ	DMS	PNI-V	PANAS	MBTS	MDDI-DS	MDDI-AI	MDDI-FI	MDDI-Total
PSPS	1	0.28**	0.27**	0.29**	0.35**	0.03	0.25**	0.37**	0.08	0.35**
SATAQ		1	0.46**	0.35**	0.21**	0.35**	0.49**	0.26**	0.37**	0.57**
DMS			1	0.32**	0.23**	0.28**	0.77**	0.27**	0.25**	0.69**
PNI-V				1	0.49**	0.10	0.33**	0.35**	0.25**	0.46**
PANAS					1	< 0.01	0.26**	0.38**	0.14*	0.39**
MBTS						1	0.32**	−0.11	0.59**	0.40**
MDDI-DS							1	0.14*	0.36**	0.79**
MDDI-AI								1	0.02	0.53**
MDDI-FI									1	0.68**
MDDI-Total										1

* $p < 0.05$.
** $p < 0.001$.

sensitivity about self-image, physical appearance could represent a more important part of those men's self-representation and be overestimated when it comes to assess one's own personal value. Narcissistic vulnerability could strengthen the relationship between the drive for muscularity, which is an expression of body dissatisfaction, and negative affect in those men. More precisely, taking into account the possible overinvestment of their physical appearance in their self-representation, the discrepancy between their actual body image and the unrealistic body ideal they are trying to reach could result in more negative affect among those men.

The behavioral pathway, which implies muscle-enhancing behaviors, has also been supported. It means that an important drive for muscularity would lead to more commitments towards muscle-enhancing behaviors as excessive exercising, dieting, and muscle-building supplements intake. Indeed, previous studies showed that the internalization of appearance ideals predicted excessive exercising and dieting (Homan, 2010). Thus, muscle-enhancing behaviors would have a growing place in one's schedule, resulting in a gradual withdrawal from social and professional activities, which is a central diagnostic criterion of muscle dysmorphia. Therefore, a greater devotion to muscularity could contribute to an excessive attempt to reach a body ideal (Hill, 2015; Miller et al., 2010). The indirect relationship between the drive for muscularity and symptoms of muscle dysmorphia through muscle-enhancing behaviors suggests that those behaviors could be the main way to cope with this body dissatisfaction. According to the most severe muscle-enhancing behaviors, like the use of anabolic steroids, previous research did not show significant relationships with symptoms of muscle dysmorphia in a non-clinical sample (Longobardi et al., 2017). In the present study, there was a relationship between anabolic steroids consumption and muscle dysmorphia symptoms ($r = 0.19$, $p < 0.05$, data not shown). Even though we cannot conclude specifically to the relationship with the use of anabolic steroids, it is possible to think that even if that is the most extreme example of muscle-enhancing behaviors, it remains in the same behavioral range and represents a fast and dangerous way to gain muscle mass. Thus, we should be aware of the vulnerability associated to muscle dysmorphia, as well as the negative impacts that anabolic steroids could have on physical and mental health (Casavant et al., 2007).

Finally, the present study has some limitations. First, because of the cross-sectional design of the study, it is impossible to make formal conclusions about causal relationships between the studied factors, as well as their contribution in muscle dysmorphia onset. Future longitudinal studies would provide a better understanding of muscle dysmorphia developmental process. Also, we have not examined the specific sources of pressure and their association to muscle dysmorphia variables, which prevents us to determine their potential differential effects. Further, the actual sample is almost entirely composed of Caucasian men recruited in a Canadian university, which does not allow a generalization of the present results. Moreover, even if this study focuses on muscle dysmorphia, a psychological disorder from the DSM-5′s diagnostic classification, men of the present sample were not recruited in a clinical setting considering their reluctance to seek treatment for muscle dysmorphia. In addition, we cannot rule out the fact that our recruitment advertisement untitled “Never muscular enough” may have resulted in a biased sample of men that presents higher concerns about body weight and appearance around muscularity than the general community participants. In that sense, our sample may represented more a sub-clinical sample. Nonetheless, results of the present study provide an overview of body concerns in men from the general population, as well as processes that could possibly result in muscle dysmorphia symptoms.

5. Conclusion

Constant social pressures to reach an ideal body are increasingly observed in men. Muscle dysmorphia and eating disorders seem to share common features. A dual pathway model that was initially developed for eating disorders has been adapted for muscle dysmorphia and suggests that sociocultural influences are associated to a drive for muscularity, which could be related to muscle dysmorphia symptoms. Muscle-enhancing behaviors and negative affect, via narcissistic vulnerability, represent two distinct pathways that are associated to muscle dysmorphia symptoms. The present results proposed that the central features of eating disorders and muscle dysmorphia might be similar (when we considered the adaptation for the specificity of the disorder). However, longitudinal studies are needed to ensure the causality of the links. In addition, future studies are needed to improve the understanding of muscle dysmorphia, and to develop preventive strategies and efficient treatment to target it.

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Supplementary materials

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