MUSCLE DYSMORPHIA IN NORWEGIAN GYM-GOING MEN: AN INITIAL INVESTIGATION

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Abstract:

The aims of the present study were to validate the Norwegian translated Muscle Dysmorphic Disorder Inventory (MDDI) and explore the presence of muscle dysmorphia (MD) symptomatology in Norwegian gym-going men. A secondary aim was to examine differences in MD symptomatology and weekly training duration (WTD) according to the participants' body mass index (BMI), and further investigate relationships between all measured variables. Participants (N = 124; M_{age} = 24.8, SD = 6.7 years) completed the translated MDDI, and according to BMI, 65 participants were of normal weight and 59 were overweight. A good fit from the confirmatory factor analysis, the results from the construct validity from the principal components analysis, and the detected good internal consistency indicate that the Norwegian translated MDDI is a valid and reliable measure for MD symptomatology. Moreover, MD symptomatology was present with mean scores of 33.7 (SD = 6.6), 15.2 (SD = 3.9), 10.4 (SD = 3.5), and 8.1 (SD = 2.6) for the MDDI total, and for the subscales: drive for size (DFS), functional impairment (FI), and appearance intolerance (AI), respectively. Statistical significant differences were detected between the normal weight and overweight participants in DFS, AI, FI (d≤.4, p<.01) and in WTD (d=.7, p<.01), but not significant for the MDDI total score (d=.1, p>.05). Lastly, WTD had a statistically significant correlation with FI and BMI (p<.01), whereas BMI had a statistical significant correlation with DFS, FI, and AI (p<.05). In conclusion, the translated Norwegian MDDI was found to be valid, but additional validations are needed with larger sample sizes. The presence of MD symptomatology and WTD was higher in the overweight compared to the normal weight participants. The findings further suggest that the subscale scores might better assist practitioners in evaluating MD concerns and offer appropriate care, as a MDDI cut-off score have yet to be validated.

Key words: *strength training, Muscle Dysmorphic Disorder Inventory, body mass index, training duration*

Introduction

Muscle dysmorphia (MD) is a condition in which individuals (predominantly men) focus on muscularity and hold a pathological belief of not being muscular enough (Choi, Pope, & Olivardia, 2002; Pope, Gruber, Choi, Olivardia, & Phillips, 1997; Pope, et al., 2005; Pope, Katz, & Hudson, 1993). Despite the observed disagreement in the literature around the diagnostic classification of MD amongst researchers (Dos Santos Filho, Tirico, Stefano, Touyz, & Claudino, 2016; Maida & Armstrong, 2005; Murray, et al., 2012; Murray, Rieger, Touyz, & De la Garza Garcia Lic, 2010; Nieuwoudt, Zhou, Coutts, & Booker, 2012), MD is currently recognized as a specifier for the body dysmorphic disorder in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (American Psychiatric Association, 2013). In recent years, Tod, Edwards, and Cranswick (2016) suggested that MD had sparked a global interest among researchers providing evidence of the presence of MD symptomatology across different cultures. This global interest will enable cross-cultural comparison research and might add further understanding to the societal role in MD development and prevalence (Sandgren & Lavallee, 2018; Tod, et al., 2016). Absence of MD research in the Scandinavian population compared to other European populations are notably observed, and particularly in the Norwegian population. Previous research from Scandinavia, however, have investigated symptoms of eating disorders and body dissatisfaction in adolescent boys and girls (Bratland-Sanda & Sundgot-Borgen, 2012; Børresen & Rosenvinge, 2003; Kjelsås,

Bjørnstrøm, & Götestam, 2004). Higher scores of drives for muscularity in boys compared to girls were found in the Norwegian sample (Bratland-Sanda & Sundgot-Borgen, 2012), indicating that it is possible that symptoms of MD are present in the Norwegian population. However, more research is needed to understand the presence of MD in Norwegian samples.

Earlier research has outlined the characteristics of MD, such as appearance checking (e.g., constant mirror checking), extreme dieting, high levels of anxiety and stress, impaired functioning, and spending a significant amount of time training to increase levels of muscularity due to feeling dissatisfied with the current level of muscularity (Blouin & Goldfield, 1995; Leone, Sedory, & Gray, 2005; Mosley, 2009). Guidi, Clementi, and Grandi (2013) reported that the participants with a high addiction to exercise scored higher on MD symptoms and related psychopathology (i.e., patterns of disordered eating) compared to the control participants, and Soler, Fernandes, Damasceno, and Novaes (2013) suggested that higher scores of MD symptomatology was correlated with a higher exercise dependency in 151 male gym-goers and 25 male bodybuilders.

Indeed, men with current MD, and men with a history of MD reveal notably greater levels of body dissatisfaction compared to men with no history of MD (Cafri, Olivardia, & Thompson, 2008). Research has shown that the drive and desire for muscle size, and behaviors indicating functional impairment (e.g., arranging one's schedule around training and dieting regimen) may predict MD in physically active men and women (Robert, Munroe-Chandler, & Gammage, 2009). In addition to the drive and desire for muscle size, these individuals also desire greater muscle leanness and definition (e.g., having large muscles in the absence of body fat; Cafri, Blevins, & Thompson, 2006). The risk of using anabolic androgenic steroids to achieve larger muscles have also been associated with MD (González-Martí, Fernández-Bustos, Contreras, & Sokolova, 2017; Segura-Garcia, et al., 2010). Hildebrandt, Schlundt, Langenbucher, and Chung (2006) aimed to evaluate different types of body image disturbance among male weightlifters, and revealed five different types of respondents: dysmorphic, muscle concerned, fat concerned, normal behavioral, and normal. The dysmorphic and muscle concerned groups reported higher levels of body image disturbances, related psychopathology, steroid abuse, and appearance-checking behaviors consistent with MD symptomatology compared to the other groups.

The body mass index (BMI) is an anthropometric measure commonly used for estimating the body size (under-/normal/overweight) in individuals and is often used to describe physical characteristics in research participants. Early research noted a lack of support for the relationship between BMI and MD symptomatology (Cafri, et al., 2005), and Grieve (2007) suggested body mass was a risk factor for MD, but stated the relationship needed further evaluation. Others have reported that body dissatisfaction in college men was stronger associated with overweight BMI's compared to normal weight or underweight BMI's (e.g., Watkins, Christie, & Chally, 2008); and in a recent study of 141 weight training males classified according to their BMI and somatotype, 17 of 68 normal weight, 22 of 66 overweight, and 6 of 7 obese participants were classified with potential cases of MD (Martinez Segura, Rizo Baeza, Sánchez Ferrer, Reig Garcia-Galbis, & Cortes Castell, 2014). Murray et al. (2012) measured the BMI of 21 men with MD, 24 men with anorexia nervosa and a control group of 15 gym-going men; the BMI was statistically significantly higher in the MD group compared to the other groups. The absence of reporting lean muscle mass and fat mass combined with the number of obese participants in Martinez et al. (2014) limits inference of MD being associated with obesity, and Murray et al. (2012) only reported the participants' BMI for descriptive purposes, which further limits inference of the relationship between BMI and MD. Tod et al. (2016) suggested examining physical characteristics with social and psychological variables, rather than treating them as individual predictors, which might add to a greater understanding. Hence, further examination of BMI's relationship with MD symptomatology, and with other variables such as training duration, could advance knowledge of such relationships.

With regard to the prevalence of MD, estimates have been proposed, although generalizable figures are lacking. The reported estimates include 13.6% prevalence of MD in 88 weight-training men using the Graduate Hannover Scale (Behar & Molinari, 2010), 110 of 648 (17%) male weightlifters at risk of developing MD using the Muscle Appearance Satisfaction Scale, and 60 (9.3%) at risk of developing both MD and eating disorders (Nieuwoudt, Zhou, Coutts, & Booker, 2015). Furthermore, 45 out of 141 (31.9%) gym-going men were classified with MD when given the Muscle Appearance Satisfaction Scale (Martinez Segura, Cortes Castell, Rizo Baeza, & Gil Guillen, 2015), and significantly severe MD symptoms were reported in 33 of 472 (6.9%) young male students using the Drive for Muscularity Scale (Compte, Sepulveda, & Torrente, 2015). The variations observed in prevalence are likely due to the various instruments used and employing measurements that do not measure all features associated with MD (e.g., Drive for Muscularity Scale and Graduate Hannover Scale; Suffolk, Dovey, Goodwin, & Meyer, 2013). However, a widely used measurement for the assessment of

MD symptomatology is the Muscle Dysmorphic Disorder Inventory (MDDI; Hildebrandt, Langenbucher, & Schlundt, 2004). To date, the MDDI is considered to target MD as a disorder, and has identified MD symptomatology across various study samples, including: gym-goers (Soler, et al., 2013), competitive and non-competitive bodybuilders (Fabris, Longobardi, Prino, & Settanni, 2017; Longobardi, Prino, Fabris, & Settanni, 2017), male anabolic steroids users (Murray, Griffiths, Mond, Kean, & Blashill, 2016), university students (Bo, et al., 2014), and patients with MD (Murray, Rieger, Karlov, & Touyz, 2013).

Therefore, to be able to establish a Norwegian sample norm and allow for future cross-cultural comparisons, the primary purpose of the present study was (a) to provide a further validation of the MDDI, and (b) to explore the presence of MD symptomatology in Norwegian gym-going men. The secondary purpose of this study was to examine differences in MD symptomatology according to participants' BMI, and further investigate the relationships between MD symptomatology, BMI, and weekly training duration (WTD).

Methods

Participants

The participants were recruited from five gyms in the region of Stavanger, Norway, and consisted of 124 Norwegian gym-going men, with a self-reported M_{age} = 24.8, SD = 6.7 years; M_{weight} = 83.6, SD = 13.6 kg; M_{height} = 181.2, SD = 6.6 cm, and M_{WTD} = 6.9, SD = 3.7 hours. Furthermore, 35.5% of participants were students, 39.5% were full- or part-time employed, 22.6% were both employed and students, and 2.4% were neither employed nor students at the time of participation. Participants had to be 18 years or older with an active gym-membership of at least six months to be included in the current study. They were further classified into two groups according to the World Health Organization (2000) adult classification for BMI (normal weight: 18.5–24.9 kg/m^2, and overweight: >25 kg/m^2). Sixty-five participants (52.4%; M_{BMI} = 23.0, SD = 1.6) were of normal weight (M_{age} = 23.9, SD = 5.8 years; M_{weight} = 74.8, SD = 7.5 kg; M_{height} = 180.3, SD = 6.1 cm; M_{WTD} = 5.9, SD = 2.8 hours), and 59 (47.6%; M_{BMI} = 28.1, SD = 3.2) were overweight (M_{age} = 25.9, SD = 1.0 years; M_{weight} = 93.3, SD = 12.2 kg; M_{height} = 182.2, SD = 7.1 cm; M_{WTD}= 8.0, SD = 4.3 hours). The study was conducted in line with the ethical guidelines at the University of Stavanger, and written informed consent was obtained from every participant.

Measurement

Participants completed the MDDI developed by Hildebrandt et al. (2004) to examine MD symptomatology. In the present study, the MDDI was translated from its original language (English) to Norwegian, and the validity and reliability of the translated MDDI was assessed using three steps: (1) face validity was tested by having language experts conducting the translation and then present the translated questionnaire to researchers who understand the topic to carefully read the questionnaire; (2) data were collected; and (3) a confirmatory factor analysis (CFA), and the principal components analysis (PCA) approach was carried out.

Instrument

The MDDI is grounded in previously published MD diagnostic criteria (Pope, et al., 1997), and consists of 13 self-report statements in three subscales pertaining to main MD symptomatology: drive for size (DFS), appearance intolerance (AI), and functional impairment (FI). The DFS subscale consists of statements pertaining to drive for larger muscles, and thoughts of being less muscular than desired. The AI subscale consists of statements regarding negative beliefs about one's body, resulting in body exposure avoidance and appearance anxiety. The FI subscale consists of statements pertaining to training-behavior patterns, avoidance of social or occupational situations because of negative feelings and a preoccupation with one's body, and stress and anxiety when deviating from exercise routines (Hildebrandt, et al., 2004). The MDDI English and Italian versions have demonstrated good test-retest reliability, internal consistency, and convergent and divergent validity (Hildebrandt, et al., 2004; Santarnecchi & Dettore, 2012).

Procedure

Data collection was performed in the gyms' reception areas where the lead researcher approached and recruited the participants. Participants were given details about the study and the procedure of participation. Those who agreed to participate in the study first signed consent, thereafter provided demographic information, and lastly completed the Norwegian MDDI.

Statistical analysis

Raw data were transferred to IBM SPSS statistics version 25 for further analysis. To examine the construct validity of the MDDI, PCA was applied. To examine if the PCA would produce a reliable result from the translated MDDI, the sampling adequacy and the suitability of the data reduction was examined using the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity (Tavakol & Dennick, 2011). The KMO measure of sampling adequacy ranges from 0 to 1, and the accepted index was set to >.6; and the significance level for acceptance of the Bartlett's test of sphericity was set to p<.05. The PCA were performed using corre-

lation matrix with the extraction method based on the eigenvalue greater than 1 and with the direct *oblimin* rotation method. Small coefficients below .30 were suppressed and not considered in the analysis. Furthermore, the CFA was executed using IBM SPSS Amos version 25, where a model was developed, and the CFA was evaluated by calculating chi-square, incremental fit index (IFI), Tucker-Lewis index (TLI), Comparative fit index (CFI), and root mean square error of approximation (RMSEA). Values closer to 1 and above .9 for the IFI, TLI (Bollen, 1989) and CFI (Bentler, 1990) would be considered as a good fit. Furthermore, a RMSEA value of about .05 or less would indicate a close fit of the model in relation to the degrees of freedom. However, a value of about .08 or less for the RMSEA would indicate a reasonable error of approximation (Browne & Cudeck, 1993). The minimum discrepancy (CMIN) and the degree of freedom for the CMIN (CMIN/DF) have also been reported as an indication of the overall model fit, and a degree of freedom between 1 and 3 was set as an indicative of an acceptable fit between the hypothetical model and the sample data (Carmines & McIver, 1981).

The internal consistency was measured using Cronbach's α, which ranges from 0 to 1 where α>.9 = excellent; α>.8 = good; α>.7 = acceptable; α>.6 = questionable; α>.5 = poor; and α<.5 = unacceptable (George & Mallery, 2003). Furthermore, the normality of the data was examined using the Shapiro-Wilk and Kolmogorov-Smirnov tests, and results revealed that the variables were not normally distributed. Therefore, chi-square and nonparametric Kruskal-Wallis tests were performed to examine differences in MDDI total and subscale scores and WTD between the normal weight and overweight participants. To determine the size of these differences, effect sizes (Cohen's *d*) were calculated, with *d*=0.2, *d*=0.5, and *d*=0.8 considered small, moderate, and large, respectively (Cohen, 1988). The significance level was set at $p<.05$, and the results were expressed as means and standard deviations. In addition, 95% confidence intervals were calculated for all measurements. Correlations matrix between the MDDI total and subscale scores, BMI, and WTD were determined using the Spearman's rho (r_s) correlation coefficient.

Results

The results of the PCA confirmed the construct validity of the translated questionnaire extracting three-component matrix (DFS, AI, FI; Table 1). Furthermore, the PCA correlation matrix using the *oblimin* revealed that the extracted components in Table 1 assessed different dimensions (Table 2). Finally, the results of the internal consistency indicated that sampling adequacy (KMO index) for the MDDI was .721, and Bartlett's test of sphericity was significant at $p<.001$. Cronbach's αs for total MDDI, DFS, AI, and FI were .72, .78, .67, and .77, respectively.

The results from the CFA indicated that the model passed the local minimum for Amos with a chi-square of 92.029 and degrees of freedom of 62 with a probability of <.05. Furthermore, the examination indicated a good fit based on the IFI, TLI and CFI with .925, .901 and .922, respectively (Figure 1). However, the RMSEA value was .063 (PCLOSE = .209), indicating a reasonable error of approximation (Figure 1). The CMIN was found to be 92.029

Table 1. Construct validation of the MDDI using the principal component analysis extraction method combined with the oblimin with the Kaiser normalization rotation method

	Component Matrix			Pattern Matrix			Structure Matrix		
Questions	1	2	3	1	2	3	1	2	3
DFS 1	0.566			0.821			0.808		
DFS 4	0.552			0.747			0.741		
DFS 5	0.457			0.688			0.681		
DFS 6	0.516			0.642			0.644		
DFS 8	0.741			0.720			0.759		
AI 2			0.587			0.686			0.683
AI 3			0.598			0.762			0.779
AI 7			0.671			0.754			0.733
AI 9			0.555			0.675			0.689
FI 10		0.544			0.790			0.783	
FI 11		0.605			0.838			0.838	
FI 12		0.456			0.702			0.717	
FI 13		0.555			0.762			0.739	

Note. MDDI = Muscle Dysmorphic Disorder Inventory; DFS = drive for size; AI = appearance intolerance; FI = functional impairment.

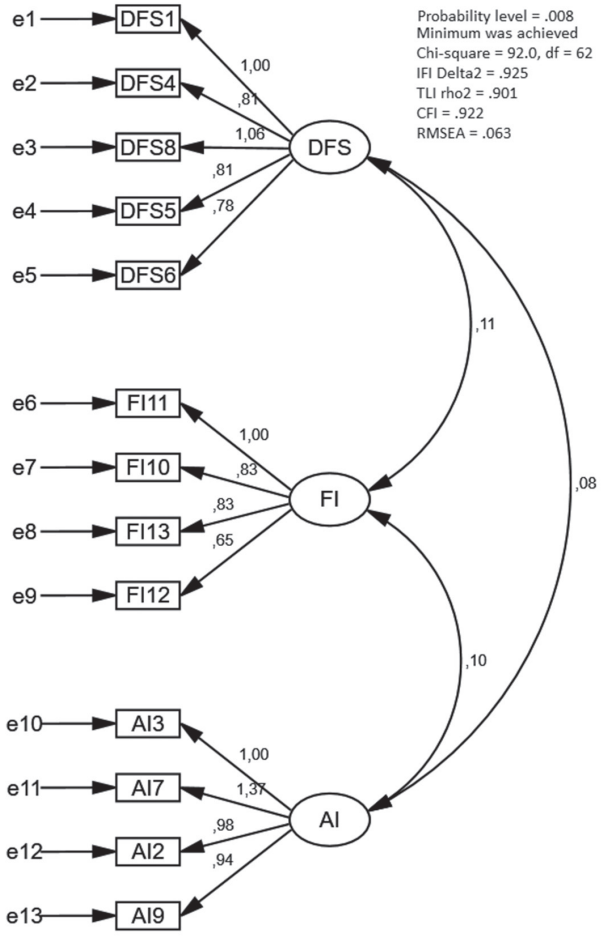
Table 2. Principal component analysis correlation matrix using the oblimin with the Kaiser normalization

Component	Component 1	Component 2	Component 3
DFS (Component 1)	1.000	0.105	0.126
FI (Component 2)	0.105	1.000	0.118
AI (Component 3)	0.126	0.118	1.000

Note. DFS = drive for size; AI = appearance intolerance; FI = functional impairment.

and the CMIN/FD = 1.484. The model correlation matrix presented in Figure 1 indicated that all associations were above .7, except for the item number 12 with .65. The factor loading (fixed to 1) showed that the indicator variables loaded significantly on all factors (Table 3).

The mean MDDI total score for all participants was 33.7 (*SD* = 6.6) and the mean scores for all participants on the MD symptomatology were for the DFS 15.2 (*SD* = 3.9), for the FI 10.4 (*SD* = 3.5), and for the AI 8.1 (*SD* = 2.6). Moreover, comparisons between the normal weight and overweight



Note. df = degrees of freedom; IFI = incremental fit index; TLI = Tucker-Lewis index; CFI = comparative fit index; RMSEA = root mean square error of approximation; DFS = drive for size; AI = appearance intolerance; FI = functional impairment

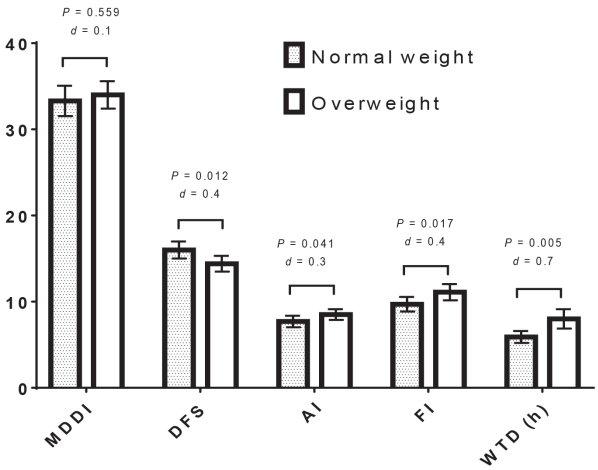
Figure 1. Fit model presented with covariances of the Norwegian MDDI confirmatory factor analysis.

Table 3. The confirmatory factor analysis regression weights (group number 1 – default model)

	Estimate	S.E.	C.R.	P
DFS1 ← DFS	1.000			
DFS4 ← DFS	.809	.131	6.182	***
DFS8 ← DFS	1.061	.158	6.721	***
DFS5 ← DFS	.811	.150	5.424	***
DFS6 ← DFS	.782	.152	5.157	***
FI11 ← FI	1.000			
FI10 ← FI	.832	.131	6.361	***
FI13 ← FI	.834	.123	6.810	***
FI12 ← FI	.647	.123	5.243	***
AI3 ← AI	1.000			
AI7 ← AI	1.372	.299	4.595	***
AI2 ← AI	.978	.219	4.469	***
AI9 ← AI	.945	.211	4.483	***

Note. S.E. = standard error; C.R. = critical ratio; DFS = drive for size; AI = appearance intolerance; FI = functional impairment.

participants (Figure 2) showed no significant or trivial difference (*d*=0.1) in the total MDDI score (*M* = .7, *SD* = 1.2). However, statistical significant but small (*d*≤.4) differences were observed between



Note. DFS = drive for size; AI = appearance intolerance; FI = functional impairment; WTD = weekly training duration; MDDI = muscle dysmorphic disorder inventory total score.

Figure 2. Differences between the normal weight and overweight participants on the MDDI total score, MDDI subscales (DFS, AI, FI) and WTD.

Table 4. Relationships between MDDI total score, MDDI subscales (DFS, AI, FI), WTD, and BMI

	MDDI total	DFS	FI	AI	WTD	BMI
MDDI total	–	.723**	.635**	.519**	.161	-.090
DFS		–	.122	.219*	-.022	-.298**
FI			–	.096	.420**	.305*
AI				–	-.081	.260*
WTD					–	.317**
BMI						–

Note. ** = p<.01; * = p<.05; MDDI = Muscle Dysmorphic Disorder Inventory; DFS = drive for size; AI = appearance intolerance; FI = functional impairment; WTD = weekly training duration; BMI = body mass index.

the groups in DFS (M = 1.6, SD = .7, p<.01), AI (M = .8, SD = .5, p<.01), FI (M = 1.4, SD = .6, p<.01), and a moderate significant (d=.7) difference was observed in WTD (M = 2.1, SD = .7, p<.01).

All the MDDI subscales were significantly correlated with the total MDDI score (p<.01). Furthermore, WTD was significantly correlated with FI (p<.01), and with BMI (p<.01). Finally, BMI was significantly correlated with DFS, FI, and AI (p<.05; Table 4).

Discussion and conclusion

The examination of the construct validity of the Norwegian translated MDDI resulted in extracting the three-component matrix (Table 1). The Cronbach's αs calculated for all the MDDI subscales were acceptable with a questionable AI (α=.67), but very close to being acceptable compared to the α=.45 reported in Santarnecchi and Dettore (2012). However, the KMO index for the MDDI was close to those reported previously, and the Bartlett's test of sphericity was significant (p<.001; Hildebrandt, et al., 2004; Santarnecchi & Dettore, 2012), indicating that the PCA results were reliable and the data were suitable for reduction from the translated MDDI (Tavakol & Dennick, 2011). Furthermore, the PCA correlation matrix (Table 2) strengthened the construct validity by indicating that the extracted component assessed different qualities, and the relationship between one component and another was observed to be weak.

The examination of the CFA revealed acceptable values for IFI, TLI and CFI that were higher than the threshold of .9 (Bollen, 1989; Bentler, 1990). The results further indicate a RMSEA value (Figure 1) of .063 (PCLOSE = .209) indicating a reasonable error of approximation (Browne & Cudeck, 1993). Adding to the reported results, the CMIN/FD of 1.484, the model correlation matrix, the lack of association between the three dimensions, and the significant loading of the items to the factors (Table 3) suggest the usability and confirm the MDDI Norwegian version. However, since the overall fit (CMIN, CIMIN/DF) is "indicative of an acceptable fit between the hypothetical model and the sample data" (Carmines & McIver, 1981, p. 80) with a significant p value, it is suggested that the model need further confirmation using a larger sample size. Nevertheless, a good fit result from the CFA and the construct validity assessment results from the PCA strengthen the evidence for the MDDI being a reliable measure for MD symptomatology in Norwegian gym-going men.

The MDDI revealed that MD symptomatology was present in a sample of Norwegian gym-going men, with the mean MDDI total score of 33.7 (SD = 6.6) and means for the subscales 15.2 (SD = 3.9), 10.4 (SD = 3.5) and 8.1 (SD = 2.6) for DFS, FI and AI, respectively. Previous research on the American male weightlifters classified as dysmorphic (n = 40) revealed higher mean MDDI subscale scores for FI 15.49 (SD = 4.37) and AI 13.67 (SD = 5.17), but lower for DFS 14.87 (SD = 4.12) compared to that observed in the present study (Hildebrandt, et al., 2006). Hildebrandt et al. (2006) reported lower results in American male weightlifters classified as muscle concerned (n = 63) with mean subscale scores of 11.31 (SD = 4.80), 9.51 (SD = 4.83), and 7.06 (SD = 3.73) for DFS, FI and AI, respectively, which were more similar to the present study except for the DFS subscale. The observed variations in mean scores could be a result of different sample sizes, where Hildebrandt et al. (2006) divided the 237 participants into five groups using latent class analysis that generated class membership probabilities leaving them with few participants in each group. Comparing the presence of MD symptomatology in the present study with other studies is difficult to make, as means and SDs for MDDI subscale scores were not reported (e.g., Murray, et al., 2013; Bo, et al., 2014). The current study and previous investigations suggest the need to develop a valid and reliable cut-off score for the total MDDI score and subscale scores based on clinical examinations to allow for the discrimination of categorizing a participant as 'dysmorphic (with MD)' or 'non-dysmorphic (without MD)' (Sandgren & Lavallee, 2018; Suffolk, et al., 2013; Tod, et al., 2016). A recent study utilized a cut-off score (threshold value) of >39 for the total MDDI score (M

= 29.4, *SD* = 6.3), classifying participants (competitive and non-competitive bodybuilders; *n* = 145) as at risk (25%) or not at risk (75%) of MD (Longobardi, et al., 2017). Although, the proposed cut-off score employed was retrieved from a conference poster, and the figure has yet to be empirically validated. Importantly, with validated cut-off scores on MD measurements, reporting prevalence across different samples (e.g., gym-goers versus professional bodybuilders), and cross-cultural comparisons (e.g., North America versus Scandinavia) will be significantly advanced.

When comparing the BMI of the classified normal weight and overweight participants according to MD symptomatology scores and WTD, statistical significant differences (p<.01) in DFS (*M* = 1.6, *SD* = 0.7, *d*=.4), AI (*M* = 0.8, *SD* = 0.5, *d*=.3), FI (*M* = 1.4, *SD* = 0.6, *d*=.4) and WTD (*M* = 2.1, *SD* = 0.7, *d*=.7) were detected (Figure 2). The normal weight participants scored significantly higher on DFS compared to the overweight participants, but the difference is considered small (*d*=.4, p<.01), and should therefore be interpreted carefully. However, the results suggest that overweight participants have a large body mass at current, hence they may not want to increase their body mass any further compared to that of normal weight participants who possess a high drive for increasing their body mass. Hildebrandt et al. (2006) reported higher DFS (*M* = 11.31, *SD* = 4.80) among muscle concerned weightlifters with a mean normal weight BMI compared to lower DFS (*M* = 5.50, *SD* = 4.82) in fat concerned weightlifters with a mean overweight BMI. On the contrary, Hildebrandt et al. (2006) reported even higher DFS (*M* = 14.87, *SD* = 4.12) in dysmorphic weightlifters with a mean overweight BMI, but were lower than the DFS scores (*M* = 16.09, *SD* = 4.02) detected in the normal weight participants in the present study, providing support for that DFS may be higher in normal weight individuals training at the gym.

Furthermore, the overweight participants scored significantly higher, but the difference was considered small (*d*=≤.4, p<.01), on the FI and AI subscales compared to the normal weight participants. In addition, the overweight participants reported significantly longer WTD compared to the normal weight participants, with a moderate (*d*=.7, p<.01) meaningful difference between the groups. The results may indicate that overweight participants experience a greater intolerance towards appearance, spend more hours training in the gym, and thus are more likely exposed to experiences of impairment in social and occupational settings, in line with previous research on male weightlifters with a mean overweight BMI and meeting criteria for MD (Cafri, et al., 2008). Given the limitation of BMI not accounting for fat mass and lean muscle mass, the results must be interpreted with caution. However, it is possible that the overweight participants in the present study were already muscular, and thus their goal might be to, for example, become leaner and lose excess body fat (Choi, et al., 2002; Pope, et al., 2005; Robert, et al., 2009; Cafri, et al., 2006). Martinez-Segura et al. (2014) concluded that the risk of developing MD increases with the degree of obesity (according to BMI), indicating that higher MD symptomatology scores were associated with having a large body mass which was in line with the present study. Hildebrandt et al. (2006) also reported higher DFS, FI, and AI scores among dysmorphic weightlifters with a mean overweight BMI compared to muscle concerned weightlifters with a mean normal weight BMI. Nevertheless, the lack of a statistical significant difference (p>.05, *d*=.1) between the MDDI total scores of the normal weight (*M* = 33.3, *SD* = 7.1) and overweight (*M* = 34.0, *SD* = 6.1) participants in the present study, combined with the absence of a cut-off score further support that the MDDI subscales could be more important than the total score in evaluating presence of MD (Robert, et al., 2009).

Significant relationships were detected between the measured variables in the current study (Table 4). As expected, the total MDDI significantly correlated (p<.01) with all the three subscales, providing further evidence for the measurement validity. WTD was significantly correlated with BMI (r_s = .317, p<.01), suggesting that gym-going men with higher BMIs also spend longer time training, perhaps due to the elevated exposure to AI and FI in these individuals as indicated in Figure 2. WTD was significantly correlated with FI (r_s = .420, p<.01), which was in line with Hildebrandt et al. (2004) who reported that the FI subscale was significantly correlated with the time spent lifting weights, and others have confirmed the association between MD symptomatology and longer training duration and exercise dependence (e.g., Soler, et al., 2013; Guidi, et al., 2013). Moreover, a significant negative relationship was detected between BMI and DFS (r_s = -.298, p<.01) suggesting that higher scores of DFS were more present in those with lower BMIs. Significant relationships between BMI and FI (r_s = .305, p<.05), and between BMI and AI (r_s = .260, p<.05) were also observed, suggesting higher scores of FI and AI were more present in those with higher BMIs. Some support for the results exists where Watkins et al. (2008) found that higher BMIs are associated with a negative body image and appearance concerns in 188 college men. These significant relationships provide further support for that the MD symptomatology DFS may be stronger associated with the normal weight participants, and MD symptomatology FI and AI may be stronger associated with the overweight participants, as also indicated in Figure 2. Future research is encouraged to investigate these relationships further by

including participants' own perceptions of current and desired body size, muscle size, and leanness, and other measures of, for example, body dissatisfaction. Such findings may further advance knowledge of the relationship between MD and BMI, beyond solely treating BMI as a physical characteristic and predictor (Tod, et al., 2016).

In conclusion, the Norwegian translated MDDI was found to be a valid and reliable measure of MD symptomatology in Norwegian gym-going men, consistent with that of previous validations in American and Italian populations. However, additional confirmations are needed with a larger sample size to strengthen the validity results. MD symptomatology was present in the current sample, although to what extent the presence is of concern has yet to be determined with a need for future research to validate cut-off scores for the MDDI total and subscale scores. With no cut-off scores, it is difficult to make assumptions about prevalence. Moreover, the significant differences between the two groups according to BMI, and indicated by the significant relationships, could suggest that overweight gym-going men have the desired body size, but spend more hours training to e.g., improve leanness or lose excess body fat, which might expose them to higher FI and AI scores. Normal weight gym-going men might experience that they do not have the desired body size, and thus want to become bigger compared to that of overweight gym-going men. The current study suggests that classifying individuals according to their BMI enables the identification of notable statistical differences in MD symptomatology related to their current body size. As such, practitioners may wish to consider the physical characteristics, the WTD, and evaluate concerns based more on the MDDI subscale scores rather than the global score when evaluating the presence of MD in gym-going men in order to assist in offering appropriate care and support.

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