AMERICAN PSYCHOLOGICAL ASSOCIATION

Psychology of Sexual Orientation and Gender Diversity

ISSN: 2329-0382

2022, Vol. 9, No. 2, 236–243
https://doi.org/10.1037/sgd0000472

Confirmatory Factor and Measurement Invariance Analyses of the Drive for Muscularity Scale in Sexual Minority Men and Women

Patrycja Klimek[1], Alexandra D. Convertino[1], Manuel Gonzales IV[1], Scott C. Roesch[1, 2], and Aaron J. Blashill[1, 2]

[1] San Diego State University/University of California San Diego Joint Doctoral Program in Clinical Psychology
[2] Department of Psychology, San Diego State University

The Drive for Muscularity Scale (DMS) is a commonly used measure used to assess the pursuit of muscularity. However, the factor structure of this measure has yet to be confirmed in a sample of sexual minority women. Moreover, the invariance of this measure across gender has also yet to be explored. The aim of the present study was, therefore, to conduct a confirmatory factor analysis (CFA) of the DMS in samples of both cisgender sexual minority men and women, and subsequently evaluate the measurement invariance by gender. The sample consisted of 962 cisgender sexual minority young adult men ($N = 479$) and women ($N = 483$). A series of CFAs were conducted, assessing both the one-factor and two-factor solutions of the DMS, with and without the inclusion of item 10 ("I think about taking anabolic steroids"). Across cisgender sexual minority young adult men and women, the 14-item 2-factor solution demonstrated most appropriate fit, although the 15-item 2-factor solution was also adequate among only women. Measurement invariance analyses indicated that the 14-item 2-factor DMS can be used in samples of both cisgender sexual minority men and women. The present study was novel in exploring the factor structure of the DMS in sexual minority women and measurement invariance by gender; however, future research is needed to further corroborate these findings and assess measurement invariance by sexual orientation and race.

Public Significance Statement
The present study supports the use of the Drive for Muscularity Scale to assess the pursuit of muscularity in sexual minority men and women. The study also demonstrates that this self-report measure performs similarly across both men and women in a sexual minority sample.

Keywords: drive for muscularity, sexual minority, confirmatory factor analysis, measurement invariance

Drive for Muscularity in Men and Women

Body image concerns have been linked to negative health outcomes, including depression and eating disorders (e.g., Bucchianeri & Neumark-Sztainer, 2014). Body image concerns are typically conceptualized as gendered, such that men endorse the mesomorphic ideal—a body type characterized by low body fat and high muscularity (Pope et al., 1999), and women endorse the thin-ideal, which is characterized by a slender physique, low body fat, and low weight (e.g., Owen & Laurel-Seller, 2000; Swami & Tovée, 2005). Drive for muscularity, or the attitudinal and behavioral preoccupation with increased muscularity (McCreary & Sasse, 2000), is often used as a marker of muscularity-based concerns. Men typically endorse greater drive for muscularity than women (McCreary & Saucier, 2009), and drive for muscularity has been linked to exercise dependence (Hale et al., 2010), symptoms of muscle dysmorphia (Grieve & Helmick, 2008), poorer self-esteem, and symptoms of depression (McCreary & Sasse, 2000), in men and adolescent boys. Prior research has, therefore, focused on the distinctions between men and women in body image ideals and concerns.

However, there is new, emerging evidence that women also endorse an ideal that includes some form of muscularity or lean muscle enhancement (Bozsik et al., 2018; Karazsia et al., 2017). For example, women experienced decreased body satisfaction when exposed to images that were both lean and muscular, but not images that were overly muscular (Benton & Karazsia, 2015) or "normal" weight (Homan et al., 2012), suggesting that the combination of thinness and muscle tone may be the new emerging

This article was published Online First April 22, 2021.

Patrycja Klimek https://orcid.org/0000-0002-3134-7328
Alexandra D. Convertino https://orcid.org/0000-0003-0073-6053

This work was partially supported by 5R25GM058906-16, awarded to Manuel Gonzales IV. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Correspondence concerning this article should be addressed to Aaron J. Blashill, Department of Psychology, San Diego State University/ University of California, San Diego, Joint Doctoral Program in Clinical Psychology, 6363 Alvarado Court, Suite 101, San Diego, CA 92120, United States. Email: ajblashill@sdsu.edu

body ideal for women. Drive for muscularity may, therefore, be a concern for both men and women.

Drive for Muscularity in Sexual Minority Individuals

Prior research has also indicated there is a greater drive for muscularity in sexual minority men and women compared with their heterosexual counterparts (Yean et al., 2013), indicating its salience for examination among this population. In sexual minority men, drive for muscularity has been associated with mental health concerns, such as increased depressive symptoms (Parent & Bradstreet, 2017), disordered eating (Brennan et al., 2012), and intent to misuse anabolic steroids (Brewster et al., 2017). Although drive for muscularity, to our knowledge, has not been examined in its association with mental health concerns among sexual minority women, a recent study in women of unknown sexual orientation found that drive for muscularity was associated with greater eating disorder, depressive, and stress symptoms (Cunningham et al., 2019), indicating that, similar to the thin-ideal pursuit, the pursuit of muscularity is also associated with negative psychological outcomes among women. Therefore, drive for muscularity appears to be associated with mental health concerns for both sexual minority men and women and should be further examined in this community.

Factor Structure of the Drive for Muscularity Scale

The Drive for Muscularity Scale (DMS; McCreary & Sasse, 2000) is a 15-item measure that was designed to assess the pursuit of muscularity. An initial exploratory factor analysis in a separate mixed gender sample of Canadian youths and adults with unknown sexual orientation status (McCreary et al., 2004) found a two-factor solution with the following subscales: (a) Muscle-Oriented Body Image (MBI), which captured muscularity dissatisfaction; and (b) Muscle-Oriented Behavior (MB), which captured muscle-building behavior, omitting Item 10 ("I think about taking anabolic steroids"). An additional exploratory factor analysis among Scottish, primarily heterosexual men further corroborated the two-factor solution, although they found support for inclusion of item 10. The men in this sample were participants in a sporting event and were, on average, older than McCreary et al.'s (2004) sample—characteristics that may increase the relevance of appearance and performance-enhancing drug use (Hildebrandt et al., 2007; Irving et al., 2002). Of note, the authors also found support for a global factor, which represented the omnibus drive for muscularity construct. Although the two-factor and one-factor solutions were supported among men, the authors suggested that only the one-factor solution (i.e., global factor) should be used among women. The DMS has, therefore, demonstrated varying factor structures dependent on gender.

Subsequent examinations of the DMS have corroborated this identified factor structure. Among men, the DMS has been examined cross-nationally in various samples (e.g., Compte et al., 2015; Swami et al., 2018), none of which reported sexual orientation. Of particular note, two studies have examined the DMS in sexual minority samples: one in the United States (DeBlaere & Brewster, 2017) and one in Italy (Nerini et al., 2016). These studies found support for the two-factor solution, with one study reporting a large interfactor correlation ($r = .54$; Nerini et al., 2016); there was also some support for the inclusion of Item 10 (DeBlaere & Brewster, 2017) and a one-factor solution (Nerini et al., 2016). Therefore, the factor structure among sexual minority men may mirror the original sample, demonstrating appropriate fit for a two-factor solution and a global factor. Moreover, support for Item 10 in a sexual minority sample of men and lack of support in prior factor analyses may reflect evidence suggesting increased risk of anabolic-androgenic steroid use in sexual minority adolescent boys compared with their heterosexual counterparts (Blashill et al., 2017). However, the factor structure of the DMS has yet to be examined in sexual minority women. Investigations of the factor structure of the DMS in women of unknown sexual orientation demonstrated support for a one-factor solution, excluding item 10, and a lack of appropriate fit for a two-factor solution (de Carvalho et al., 2019; McCreary et al., 2004). It is unclear if the same factor structures of the DMS apply to samples of sexual minority women.

Present Study

The primary purpose of the present study was to examine the factor structure and measurement invariance of the DMS in sexual minority men and women. The study aims were to initially compare one-factor and two-factor models of the 14-item (excluding item 10) and 15-item DMS, separately in sexual minority men and women. The best fitting model, across men and women, would then be used to investigate measurement invariance by gender. Finally, concurrent validity and internal consistency of the DMS were also investigated for both sexual minority men and women.

Method

Participants and Procedures

The present study involved secondary data analysis from a parent study, which had a primary aim of examining racial and ethnic disparities in body image and eating disorders (Gonzales & Blashill, 2021). Participants were 479 sexual minority men and 483 sexual minority women aged 18–30 years ($M = 23.68$, $SD = 3.73$), who were recruited from across the United States through Qualtrics Panels. Qualtrics Panels is a service provided by Qualtrics, an online survey-based platform, in which individuals can create accounts and participate in surveys. A summary of sample demographics is provided in Table 1. Inclusion criteria for the current study were (a) self-identify as cisgender man or woman; (b) self-identify as gay, lesbian, bisexual, or any other nonheterosexual identity; (c) between the ages of 18 and 30 years; (d) self-identify as either African American, Non-Hispanic White, Asian American/Pacific Islander, or Hispanic with any other race; and (e) English speaking. Sexual orientation was assessed by asking participants to describe their (a) sexual orientation ("How would you describe your sexual identity?") and (b) sexual attraction ("How would you describe your sexual attraction?"). If individuals met predetermined criteria based on their Qualtrics profile, they were sent a de-identified invitation to participate in a survey. If potential participants accepted the invitation to participate in the survey, they were then consented and subsequently given a prescreener to confirm that they met eligibility criteria. Eligible participants completed a 15–20 min survey. Participants were given $4 of e-reward currency, which is administered and redeemed by

Table 1
Demographic Characteristics of the Sample

Variable	SM men *N* (%)	SM women *N* (%)	Total sample *N* (%)
Race[a]			
White	184 (38.6%)	187 (38.7%)	371 (38.6%)
Black/African American	146 (30.5%)	148 (30.6%)	294 (30.6%)
Asian/Pacific Islander	134 (28.1%)	138 (28.6%)	272 (28.3%)
Native American/American Indian	13 (2.7%)	10 (2.1%)	23 (2.4%)
Ethnicity			
Hispanic/Latino/a	120 (25.1%)	114 (23.6%)	234 (24.3%)
Sexual Identity			
Lesbian/Gay	239 (49.9%)	97 (20.1%)	336 (34.9%)
Bisexual	206 (43.0%)	358 (74.1%)	564 (58.6%)
Asexual	10 (2.1%)	10 (2.1%)	20 (2.1%)
Other[b]	24 (5%)	18 (3.7%)	42 (4.4%)
Sexual attraction			
Only attracted to same sex	203 (42.4%)	92 (19.0%)	295 (30.7%)
Mostly attracted to same sex	89 (18.6%)	53 (11.0%)	142 (14.8%)
Equally attracted to same sex	187 (39.0%)	338 (70.0%)	525 (54.5%)
	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
Age	24.03 (3.76)	23.33 (3.68)	23.68 (3.73)

Note. SM = sexual minority.
[a] Missing race data for two men. [b] Other sexual identities included but were not limited to Pansexual, Demisexual, Queer.

Qualtrics, for example, for airline miles or various gift cards. All procedures were reviewed and approved by the University's Institutional Review Board.

Measures

Drive for Muscularity

The 15-item Drive for Muscularity Scale (DMS; McCreary & Sasse, 2000) was used to assess an individual's motivations, behaviors, and attitudes toward a more muscular body (e.g., "I wish I were more muscular;" "I try to consume as many calories as I can in a day"). Response options were on a 6-point Likert scale, ranging from 1 (*never*) to 6 (*always*). The original factor structure of the DMS consisted of two subscales: Muscle-Oriented Body Image (MBI) and Muscle-Oriented Behavior (MB; McCreary et al., 2004). The two-factor model, with item 10 omitted, has been supported in high school and college samples of men and women (McCreary et al., 2004) as well as a community sample of sexual minority men (DeBlaere & Brewster, 2017). The inclusion of item 10 has also been supported in sexual minority men (DeBlaere & Brewster, 2017). A higher order factor, averaging across the 14 items of the DMS, has also been tested and supported in high school and college sample of men and women (McCreary et al., 2004). The internal consistency was adequate for both the 14-item DMS (MBI: $\alpha = .93$; MB: $\alpha = .87$; global score: $\alpha = .93$) and the 15-item DMS (MBI: $\alpha = .93$; MB: $\alpha = .87$; global score: $\alpha = .90$) in a sample of sexual minority men (DeBlaere & Brewster, 2017). The internal consistency was also adequate for the 14-item DMS subscales in high school and college samples of men of unknown sexual orientation (MBI: $\alpha = .88$; MB: $\alpha = .81$), as well as for the global score in both men ($\alpha = .87$) and women ($\alpha = .82$; McCreary et al., 2004).

Appearance and Performance Enhancing Drug Use

Appearance and performance enhancing drug (APED) use was assessed using seven items derived from the Growing Up Today Study (see Field et al., 1999)—a national study of adolescent children of women participating in the Nurse's Health Study 2 (Solomon et al., 1997). These seven items assess frequency of protein powder or shake, weight loss shake/drinks, creatine, amino acids, beta-hydroxy-beta-methylbutyrate (HMB), dehydroepiandrosterone (DHEA), growth hormone (without Doctor's prescription), and anabolic/injectable steroids (without Doctor's prescription) use during the past year. Response options ranged from 0 (*never*) to 4 (*daily*), and the mean frequency of use was calculated for each individual APED.

Statistical Analysis

Univariate normality of item distributions was assessed by examining frequency histograms and multivariate normality was assessed with Mardia's test, using the MVN package in RStudio (Version 1.2.1335). Results indicated a nonnormal distribution of DMS items in both men (skewness = 2173.66, $p < .001$; kurtosis = 25.66, $p < .001$) and women (skewness = 4120.32, $p < .001$; kurtosis = 58.04, $p < .001$). Therefore, confirmatory factor analysis (CFA) was conducted using the robust weighted least squares mean and variance adjusted estimator (WLSMV) and entering the DMS items as ordinal variables. CFA was conducted using the lavaan package in RStudio.

Prior research has indicated support for a one-factor and two-factor structure of the DMS in both men and women (McCreary et al., 2004). Therefore, in the present study, the fit of a single-factor and two-factor model—consisting of MBI and MB factors—were compared. Although some findings have supported the exclusion of item 10 ("I think about taking anabolic steroids"), others have advocated for its inclusion, including in samples of sexual minority men (DeBlaere & Brewster, 2017). DeBlaere and Brewster (2017), therefore, advised researchers to evaluate validity and factor structure of both the 14- and 15-item DMS. CFA models were conducted separately for men and women prior to assessing measurement invariance. If the CFA models, conducted separately in men and women, demonstrated acceptable fit for a particular factor structure, multiple group analyses were then conducted to evaluate measurement invariance by gender (Vandenberg & Lance, 2000). Once configural invariance was established, metric and scalar invariance were assessed.

In the present study, single-factor and two-factor models of both the 14-item and 15-item DMS were tested, yielding a total of four models. Because there was less than 5% missing data on all DMS items, pairwise deletion processes were also implemented (Parent, 2013). First, model fit was assessed using the comparative fit index (CFI), root mean square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR). Given the exploratory nature of the present study's analyses, the following, more liberal, threshold values for descriptive fit indices were used to indicate reasonable acceptable fit: CFI $>$ .90, RMSEA $<$ .08, and SRMR $<$ .08 (Bentler, 1990; Steiger, 1990). Next, the descriptive fit indices of nonnested models, with and without item 10, were compared within both the single-factor and two-factor models. The chi-square test of exact fit was also reported, though researchers have advised against using the χ^2 statistic as a formal test of goodness-of-fit given its sensitivity to sample size (Schermelleh-Engel et al., 2003). The best fitting single-factor model was compared with the best fitting two-factor model with a Satorra-Bentler scaled χ^2 difference test (SB $\Delta\chi^2$; Satorra & Bentler, 2001) using the "lavTestLRT" command in R. A higher order CFA could not be conducted because there were less than three factors examined. Standardized and unstandardized factor loadings were reported for the best fitting model.

The best fitting model across both men and women was then used for assessment of measurement invariance by gender, using the marker method (Vandenberg & Lance, 2000). Significant differences between configural and metric invariance models were assessed using the recommended values of ΔCFI $<$ .010, in conjunction with either ΔRMSEA $<$ .015 or ΔSRMR $<$ .030, which would indicate invariance (Chen, 2007). Significant differences between metric and scalar invariance models were assessed using the recommended values of ΔCFI $<$ .010, in conjunction with either ΔRMSEA $<$ .015 or ΔSRMR $<$ .010 (Chen, 2007).

Internal consistency of the DMS was evaluated using Cronbach's alpha (α) and omega (ω; Dunn et al., 2014). Finally, concurrent validity was assessed between the DMS factors and the seven APED use variables, using Spearman correlations (ρ). Very small, small, medium, large, and very large correlations were established as .05, .10, .20, .30, and .40, respectively (Funder & Ozer, 2019). Correlation analysis was completed using SPSS (Version 26), and all other analyses were completed using RStudio (Version 1.2.1335).

Results

Confirmatory Factor Analysis

The model fit indices of all baseline models, for men and women separately, are summarized in Table 2. Based on descriptive fit indices, across both men and women, the 14-item factor models demonstrated better fit than the 15-item models. Therefore, the one- and two-factor 14-item models were then compared, in both men and women. The SB $\Delta\chi^2$ test indicated that the 14-item one-factor model fit significantly worse than the 14-item two-factor model in men (SB $\Delta\chi^2[1] = 180.79$, $p < .001$) and women (SB $\Delta\chi^2[1] = 126.79$, $p < .001$). Table 3 illustrates the standardized and unstandardized factor loadings for the 15-item two-factor model, demonstrating significant factor loadings on both factors. The interfactor correlation was very large and statistically significant for men, $r = .630$, $p < .001$ and women, $r = .786$, $p < .001$.

Measurement Invariance by Gender

The results of measurement invariance analyses are summarized in Table 4. The configural invariance model demonstrated reasonably acceptable fit based on one of three descriptive fit indices (CFI = .969, RMSEA = .108, SRMR = .086), although factor loadings appeared similar across men and women. Constraining factor loadings to be equal across groups led to ΔCFI, ΔRMSEA, and ΔSRMR within recommended thresholds, indicating metric invariance (Chen, 2007). Constraining item intercepts to also be equal across groups led to ΔCFI, ΔRMSEA, and ΔSRMR within recommended thresholds, indicating scalar invariance.

Concurrent Validity and Scale Reliability of Best Fitting Model

The total sample mean and standard deviation (*SD*) of the DMS MB subscale was 2.03 (*SD* = 1.10) and 2.61 (*SD* = 1.27) for the DMS MBI subscale, with individual scores ranging from 1 to 6. Internal consistency was adequate for the DMS MB subscale (α = .94, 95% CI [.93, .94]; ω = .94, 95% CI [.93, .94]) and the MBI subscale (α = .93, 95% CI [.92, .94]; ω = .93, 95% CI [.92, .94]).

Table 2
Model Fit Indices by Gender for 14-Item and 15-Item DMS Factor Structures

Model	χ^2	*df*	*p*	CFI	RMSEA	SRMR
14-item, one-factor						
Men	1194.087	77	<.001	.925	.174	.156
Women	842.838	77	<.001	.940	.144	.107
14-item, two-factor						
Men	480.980	76	<.001	.973	.106	.084
Women	524.293	76	<.001	.965	.111	.077
15-item, one-factor						
Men	1303.338	90	<.001	.921	.168	.164
Women	916.272	90	<.001	.943	.138	.114
15-item, two-factor						
Men	540.603	89	<.001	.971	.103	.091
Women	575.665	89	<.001	.967	.107	.08

Note. CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Table 3
Standardized and Unstandardized Factor Loadings From the 14-item Two-Factor CFA in Men and Women

DMS item	Men		Women	
	MB	MBI	MB	MBI
1. I wish I were more muscular		.695 (0.856)		.776 (0.90)
2. I lift weights to build more muscle	.804 (0.96)		.800 (1.01)	
3. I use protein or energy supplements	.838 (1.04)		.792 (0.99)	
4. I drink weight gain or protein shakes	.858 (1.07)		.852 (1.06)	
5. I try to consume as many calories as I can in a day	.691 (0.86)		.706 (0.88)	
6. I feel guilty if I miss a weight-training session	.806 (1.00)		.839 (1.05)	
7. I think I would feel more confident if I had more muscle mass		.813 (1.17)		.860 (1.11)
8. Other people think I work out with weight too often	.764 (0.95)		.855 (1.07)	
9. I think I would look better if I gained 10 points of bulk		.780 (1.12)		.820 (1.06)
11. I think I would feel stronger if I gained a little more muscle mass		.798 (1.15)		.821 (1.06)
12. I think that my weight-training schedule interferes with other aspects of my life	.730 (0.91)		.862 (1.08)	
13. I think that my arms are not muscular enough		.884 (1.27)		.846 (1.09)
14. I think that my chest is not muscular enough		.903 (1.30)		.800 (1.03)
15. I think that my legs are not muscular enough		.810 (1.17)		.791 (1.02)

Note. Unstandardized factor loadings are presented in parentheses; DMS = Drive for Muscularity Scale; MB = Muscularity-Oriented Behavior; MBI = Muscularity-Oriented Body Image.

As indicated in Table 5, DMS MB subscale demonstrated significant positive very large correlations and the DMS MBI subscale demonstrated significant positive small-to-large correlations with APED use, including frequency of protein, weight loss shakes, creatine, amino acids, DHEA, growth hormone, and AAS use, in both men and women.

Discussion

The factor structure of the DMS has been evaluated in heterosexual samples of men and women as well as in a sample of sexual minority men. The present study was the first known to confirm the factor structure in a sample of cisgender sexual minority women and explore measurement invariance by gender. Results indicated that a two-factor structure excluding item 10 demonstrated adequate fit for both sexual minority cisgender men and women. However, the two-factor model including item 10 also demonstrated good fit in the sample of sexual minority women. Using the 14-item two-factor model, measurement invariant analyses indicated that the DMS was invariant across men and women. The 14-item two-factor DMS also demonstrated appropriate reliability and validity, such that the MB and MBI subscales were strongly and positively correlated with the use of APEDs, including illicit substances such as AAS. The present study was novel in its assessment of criterion validity of the DMS through associations with frequency of APED use.

The current study is consistent with prior literature in that the two-factor solution was supported in sexual minority men (De Blaere & Brewster, 2017). Sexual minority men in the current sample also had comparable mean subscale scores to those of prior studies (e.g., DeBlaere & Brewster, 2017; McCreary et al., 2004). The similar mean scores and factor structures among men in the present study and prior studies may strengthen the reliability and generalizability of the factor structure and measurement invariance findings. However, DeBlaere and Brewster (2017) found support for the inclusion of item 10 ("I think about taking anabolic steroids"), whereas in the present study, the 15-item factor solution demonstrated poorer statistical and descriptive fit in sexual minority men, compared with the 14-item factor structure. Sexual minority men in the present study may have demonstrated better descriptive and statistical fit with the exclusion of item 10 because of the age range of the sample. The current sample ranged in age from 18 to 30 years, whereas DeBlaere and Brewster (2017) included a sample of sexual minority men ranging in age from 18 to 62 (M = 28.80, SD = 14.50)—a wider age range that is more representative of men who misuse AAS and individuals at risk for AAS misuse onset (Hildebrandt et al., 2007). Similarly, an exploratory factor analysis of the DMS among Scottish, primarily heterosexual men also supported the inclusion of item 10 with an older sample (M = 38.9, SD = 9.80; McPherson et al., 2010). Therefore, the inclusion of the item 10 may depend on the age

Table 4
Measurement Invariance by Gender: Model Fit Indices

Model	χ^2	df	p	CFI	RMSEA	SRMR	$\Delta\ \chi^2$	Δ CFI	Δ RMSEA	Δ SRMR
Configural model	1001.172	152	<.001	.969	.108	.086	—	—	—	—
Metric invariance: Factor loadings equal across groups	952.606	166	<.001	.971	.099	.089	−48.566	.002	−.009	.003
Scalar invariance: Factor loadings & intercepts equal across groups	1242.086	220	<.001	.963	.098	.086	240.914	−.008	−.001	−.003

Note. CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Table 5
Bivariate Spearman Correlations Between DMS Subscales and APED Use

Variable	1	2	3	4	5	6	7	8	9
1. DMS MB subscale	—	.653**	.636**	.497**	.502**	.509**	.473**	.506**	.481**
2. DMS MBI subscale	.519**	—	.397**	.284**	.359**	.354**	.338**	.361**	.368**
3. Protein use	.664**	.334**	—	.552**	.424**	.415**	.386**	.398**	.380**
4. Weight loss shake use	.533**	.210**	.508**	—	.532**	.509**	.514**	.542**	.498**
5. Creatine use	.572**	.256**	.473**	.615**	—	.685**	.725**	.677**	.505**
6. Amino acids use	.585**	.279**	.494**	.525**	.683**	—	.705**	.593**	.566**
7. DHEA use	.537**	.205**	.425**	.632**	.691**	.730**	—	.721**	.681**
8. Human growth hormone use	.499**	.164**	.352**	.575**	.592**	.576**	.758**	—	.780**
9. Anabolic-Androgenic steroid use	.500**	.132**	.323**	.576**	.624**	.583**	.739**	.775**	—
Mean (*SD*)									
Men	2.55 (1.20)	3.45 (1.35)	1.26 (1.35)	0.97 (1.28)	0.76 (1.17)	0.80 (1.22)	0.63 (1.13)	0.60 (1.12)	0.53 (1.03)
Women	2.03 (1.10)	2.60 (1.27)	1.01 (1.24)	0.99 (1.32)	0.46 (1.00)	0.56 (1.09)	0.39 (0.94)	0.37 (0.93)	0.37 (0.94)

Note. Correlations are above the diagonal for women and below the diagonal for men. DMS MB = Drive for Muscularity, Muscularity-Oriented Behavior; DMS MBI = Drive for Muscularity, Muscularity-Oriented Body Image; DHEA = Dehydroepiandrosterone.
** $p < .01$.

group of men being assessed. Nevertheless, in the present study, the differences in descriptive fit indices between the 14- and 15-item two-factor models are marginal, which also indicates that further research is needed to confirm the most appropriate factor structure of the DMS in sexual minority men.

Although confirmation of the two-factor solution corroborates prior CFAs, the lack of support for a one-factor solution is inconsistent with findings from a CFA of the Italian version of the DMS, among sexual minority men (Nerini et al., 2016), and with findings from studies with samples of unknown sexual orientation (e.g., McCreary et al., 2004). This inconsistency may indicate cultural bias or noninvariance of the DMS across sexual orientation groups. An additional difference between studies was the racial breakdown of the sample; the present study included a more diverse sample such that only 38.6% identified as White. The DMS may, therefore, perform differently as a function of race. Future research is needed to evaluate measurement invariance by sexual orientation and race.

The present study also deviates from investigations of the factor structure of the DMS in women of unknown sexual orientation, among whom only a 14-item one-factor solution was supported (de Carvalho et al., 2019; McCreary et al., 2004). In contrast, the current study found support for the two-factor structure with or without item 10. This difference may be explained by the characteristic differences between the current sample and previous investigations of the DMS factor structure in women. For example, in the present study, 25.5% of women indicated illicit APED use during the past year, and the sample was more racially diverse than the majority White samples of prior studies (de Carvalho et al., 2019; McCreary et al., 2004). Additionally, the MB and MBI subscale mean scores endorsed by the sexual minority women in this sample are comparable to women with medium to high levels of body image concerns (Hoffmann & Warschburger, 2018). Although prior literature has indicated that risk for disordered eating and thinness-oriented behaviors may be similar among sexual minority and heterosexual women (Matthews-Ewald et al., 2014), sexual minority women have demonstrated higher drive for muscularity than heterosexual women (Yean et al., 2013). Therefore, the DMS may have a different factor structure in sexual minority versus heterosexual women, although future research is needed to test differences by sexual orientation. Alternatively, the current study's sample of sexual minority women may not be reflective of the average drive for muscularity in the sexual minority female population. Further research is needed to better understand muscularity attitudes and behaviors in sexual minority women. Future investigations of the DMS factor structure should also consider APED use among their samples, in order to better understand the performance of item 10 in different populations.

Although the present study was novel in its analysis of the factor structure in sexual minority women and measurement invariance by gender, there were several limitations. Heterosexual men and women were not recruited for the current study, which would have allowed for an evaluation of measurement invariance by sexual orientation in addition to gender. Another limitation is the lack of consensus in guidelines for model fit comparisons as well as for evaluating measurement invariance, when using the WLSMV estimator. For example, recent literature cautioned against the use of descriptive fit indices to assess measurement invariance using this estimator (Sass et al., 2014). In addition, although model comparison tests have been developed to compare the fit of nested models, no such tests have been developed for nonnested model comparison using the WLSMV estimator. Therefore, the present study compared nonnested models (14-item DMS vs. 15-item DMS) by exploring descriptive fit indices. Moreover, cutoff values for descriptive fit indices and change in descriptive fit indices should be used and interpreted with caution, despite their common use in the field (Barrett, 2007; Marsh et al., 2004). Additionally, although the present study provided support for criterion validity of the DMS in sexual minority men and women, convergent and discriminant validity could not be investigated. Finally, the present study did not include individuals who identify as transgender. Prior literature has indicated that transgender sexual minority compared with cisgender heterosexual individuals may be at elevated risk for disordered eating behaviors (Diemer et al., 2015). This group is, therefore, important to investigate in the context of drive for muscularity, and the DMS may perform differently in this population. Given limitations, the findings from the present study should be interpreted with caution and treated as exploratory.

Conclusion

The present study confirms the factor structure of the DMS in cisgender sexual minority men and women and establishes that the 14-item two-factor DMS performs similarly in both men and women. The two-factor DMS with the inclusion of item 10 may also be supported in sexual minority women and needs further examination in men. Thus, researchers interested in exploring gender differences in the DMS among sexual minority population are encouraged to use the 14-item two-factor solution of the DMS. The present study is unique not only in its inclusion of sexual minority women but also in its racial diversity. Future research is needed to explore the factor structure of the DMS in transgender individuals and the measurement invariance by sexual orientation and race.

References

Barrett, P. (2007). Structural equation modelling: Adjudging model fit. *Personality and Individual Differences*, *42*(5), 815–824. https://doi.org/10.1016/j.paid.2006.09.018

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Benton, C., & Karazsia, B. T. (2015). The effect of thin and muscular images on women's body satisfaction. *Body Image*, *13*, 22–27. https://doi.org/10.1016/j.bodyim.2014.11.001

Blashill, A. J., Calzo, J. P., Griffiths, S., & Murray, S. B. (2017). Anabolic steroid misuse among U.S. adolescent boys: Disparities by sexual orientation and race/ethnicity. *American Journal of Public Health*, *107*(2), 319–321. https://doi.org/10.2105/AJPH.2016.303566

Bozsik, F., Whisenhunt, B. L., Hudson, D. L., Bennett, B., & Lundgren, J. D. (2018). Thin is in? Think again: The rising importance of muscularity in the thin ideal female body. *Sex Roles*, *79*(9–10), 609–615. https://doi.org/10.1007/s11199-017-0886-0

Brennan, D. J., Craig, S. L., & Thompson, D. E. A. (2012). Factors associated with a drive for muscularity among gay and bisexual men. *Culture, Health & Sexuality*, *14*(1), 1–15. https://doi.org/10.1080/13691058.2011.619578

Brewster, M. E., Sandil, R., DeBlaere, C., Breslow, A., & Eklund, A. (2017). "Do you even lift, bro?" Objectification, minority stress, and body image concerns for sexual minority men. *Psychology of Men & Masculinity*, *18*(2), 87–98. https://doi.org/10.1037/men0000043

Bucchianeri, M., & Neumark-Sztainer, D. (2014). Body dissatisfaction: An overlooked public health concern. *Journal of Public Mental Health*, *13*(2), 64–69. https://doi.org/10.1108/JPMH-11-2013-0071

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(3), 464–504. https://doi.org/10.1080/10705510701301834

Compte, E. J., Sepúlveda, A. R., de Pellegrin, Y., & Blanco, M. (2015). Confirmatory factor analysis of the Drive for Muscularity Scale-S (DMS-S) and Male Body Attitudes Scale-S (MBAS-S) among male university students in Buenos Aires. *Body Image*, *14*(?), 13–19. https://doi.org/10.1016/j.bodyim.2015.02.005

Cunningham, M. L., Szabo, M., Kambanis, P. E., Murray, S. B., Thomas, J. J., Eddy, K. T., . . . Griffiths, S. (2019). Negative psychological correlates of the pursuit of muscularity among women. *International Journal of Eating Disorders*, *52*(11), 1326–1331. https://doi.org/10.1002/eat.23178

Diemer, E. W., Grant, J. D., Munn-Chernoff, M. A., Patterson, D. A., & Duncan, A. E. (2015). Gender identity, sexual orientation, and eating-related pathology in a national sample of college students. *Journal of Adolescent Health*, *57*(2), 144–149. https://doi.org/10.1016/j.jadohealth.2015.03.003

DeBlaere, C., & Brewster, M. E. (2017). A confirmation of the Drive for Muscularity Scale with sexual minority men. *Psychology of Sexual Orientation and Gender Diversity*, *4*(2), 227–232. https://doi.org/10.1037/sgd0000224

de Carvalho, P. H. B., da Oliveira, F. C., Neves, C. M., Meireles, J. F. F., & Ferreira, M. E. C. (2019). Is the Drive for Muscularity Scale a valid and reliable instrument for young adult women? *Body Image*, *29*(?), 1–5. https://doi.org/10.1016/j.bodyim.2019.02.001

Dunn, T. J., Baguley, T., & Brunsden, V. (2014). From alpha to omega: A practical solution to the pervasive problem of internal consistency estimation. *British Journal of Psychology*, *105*(3), 399–412. https://doi.org/10.1111/bjop.12046

Field, A. E., Camargo, C. A., Jr., Taylor, C. B., Berkey, C. S., Frazier, A. L., Gillman, M. W., & Colditz, G. A. (1999). Overweight, weight concerns, and bulimic behaviors among girls and boys. *Journal of the American Academy of Child & Adolescent Psychiatry*, *38*(6), 754–760. https://doi.org/10.1097/00004583-199906000-00024

Funder, D. C., & Ozer, D. J. (2019). Evaluating effect size in psychological research: Sense and nonsense. *Advances in Methods and Practices in Psychological Science*, *2*(2), 156–168. https://doi.org/10.1177/2515245919847202

Gonzales, M., & Blashill, A. J. (2021). Ethnic/racial and gender differences in body image disorders among a diverse sample of sexual minority U.S. adults. *Body Image*, *36*, 64–73. https://doi.org/10.1016/j.bodyim.2020.10.007

Grieve, R., & Helmick, A. (2008). The influence of men's self-objectification on the Drive for Muscularity: Self-Esteem, body satisfaction and muscle dysmorphia. *International Journal of Men's Health*, *7*(3), 288–298. https://doi.org/10.3149/jmh.0703.288

Hale, B. D., Roth, A. D., DeLong, R. E., & Briggs, M. S. (2010). Exercise dependence and the drive for muscularity in male bodybuilders, power lifters, and fitness lifters. *Body Image*, *7*(3), 234–239. https://doi.org/10.1016/j.bodyim.2010.02.001

Hildebrandt, T., Langenbucher, J. W., Carr, S. J., & Sanjuan, P. (2007). Modeling population heterogeneity in appearance-and performance-enhancing drug (APED) use: Applications of mixture modeling in 400 regular APED users. *Journal of Abnormal Psychology*, *116*(4), 717–733. https://doi.org/10.1037/0021-843X.116.4.717

Hoffmann, S., & Warschburger, P. (2018). Patterns of body image concerns in adolescence and early adulthood: A latent profile analysis. *Eating Behaviors*, *29*, 28–34. https://doi.org/10.1016/j.eatbeh.2018.02/002

Homan, K., McHugh, E., Wells, D., Watson, C., & King, C. (2012). The effect of viewing ultra-fit images on college women's body dissatisfaction. *Body Image*, *9*(1), 50–56. https://doi.org/10.1016/j.bodyim.2011.07.006

Irving, L. M., Wall, M., Neumark-Sztainer, D., & Story, M. (2002). Steroid use among adolescents: Findings from Project EAT. *Journal of Adolescent Health*, *30*(4), 243–252. https://doi.org/10.1016/S1054-139X(01)00414-1

Karazsia, B. T., Murnen, S. K., & Tylka, T. L. (2017). Is body dissatisfaction changing across time? A cross-temporal meta-analysis. *Psychological Bulletin*, *143*(3), 293–320. https://doi.org/10.1037/bul0000081

Marsh, H. W., Hau, K. T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999). findings. *Structural Equation Modeling*, *11*(3), 320–341. https://doi.org/10.1207/s15328007sem1103_2

Matthews-Ewald, M. R., Zullig, K. J., & Ward, R. M. (2014). Sexual orientation and disordered eating behaviors among self-identified male and female college students. *Eating Behaviors*, *15*(3), 441–444. https://doi.org/10.1016/j.eatbeh.2014.05.002

McCreary, D. R., & Sasse, D. K. (2000). An exploration of the Drive for Muscularity in adolescent boys and girls. *Journal of American College Health*, *48*(6), 297–304. https://doi.org/10.1080/07448480009596271

McCreary, D. R., Sasse, D. K., Saucier, D. M., & Dorsch, K. D. (2004). Measuring the drive for muscularity: Factorial validity of the Drive for Muscularity Scale in men and women. *Psychology of Men & Masculinity*, *5*(1), 49–58. https://doi.org/10.1037/1524-9220.5.1.49

McCreary, D. R., & Saucier, D. M. (2009). Drive for muscularity, body comparison, and social physique anxiety in men and women. *Body Image*, *6*(1), 24–30. https://doi.org/10.1016/j.bodyim.2008.09.002

McPherson, K. E., McCarthy, P., McCreary, D. R., & McMillan, S. (2010). Psychometric evaluation of the Drive for Muscularity Scale in a community-based sample of Scottish men participating in an organized sporting event. *Body Image*, *7*(4), 368–371. https://doi.org/10.1016/j.bodyim.2010.06.001

Nerini, A., Matera, C., Baroni, D., & Stefanile, C. (2016). Drive for muscularity and sexual orientation: Psychometric properties of the Italian version of the Drive for Muscularity Scale (DMS) in straight and gay men. *Psychology of Men & Masculinity*, *17*(2), 137–146. https://doi.org/10.1037/a0039675

Owen, P. R., & Laurel-Seller, E. (2000). Weight and shape ideals: Thin is dangerously in. *Journal of Applied Social Psychology*, *30*(5), 979–990. https://doi.org/10.1111/j.1559-1816.2000.tb02506.x

Parent, M. C. (2013). Handling item-level missing data: Simpler is just as good. *The Counseling Psychologist*, *41*(4), 568–600. https://doi.org/10.1177/0011000012445176

Parent, M. C., & Bradstreet, T. C. (2017). Integrating self-concept into the relationship between drive for muscularity, and disordered eating and depression, among men. *Psychology of Men & Masculinity*, *18*(1), 1–11. https://doi.org/10.1037/men0000038

Pope, H. G., Olivardia, R., Gruber, A., & Borowiecki, J. (1999). Evolving ideals of male body image as seen through action toys. *International Journal of Eating Disorders*, *26*(1), 65–72. https://doi.org/10.1002/(SICI)1098-108X(199907)26:1<65::AID-EAT8>3.0.CO;2-D

Sass, D. A., Schmitt, T. A., & Marsh, H. W. (2014). Evaluating model fit with ordered categorical data within a measurement invariance framework: A comparison of estimators. *Structural Equation Modeling: A Multidisciplinary Journal*, *21*(2), 167–180. https://doi.org/10.1080/10705511.2014.882658

Satorra, A., & Bentler, P. M. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika*, *66*(4), 507–514. https://doi.org/10.1007/BF02296192

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online*, *8*(2), 23–74

Solomon, C. G., Willett, W. C., Carey, V. J., Rich-Edwards, J., Hunter, D. J., Colditz, G. A., . . . Manson, J. E. (1997). A prospective study of pregravid determinants of gestational diabetes mellitus. *Journal of the American Medical Association*, *278*(13), 1078–1083. https://doi.org/10.1001/jama.1997.03550130052036

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research*, *25*(2), 173–180. https://doi.org/10.1207/s15327906mbr2502_4

Swami, V., & Tovée, M. J. (2005). Female physical attractiveness in Britain and Malaysia: A cross-cultural study. *Body Image*, *2*(2), 115–128. https://doi.org/10.1016/j.bodyim.2005.02.002

Swami, V., Vintila, M., Tudorel, O., Goian, C., & Barron, D. (2018). Factor structure and psychometric properties of a Romanian translation of the Drive for Muscularity Scale (DMS) in university men. *Body Image*, *25*(?), 48–55. https://doi.org/10.1016/j.bodyim.2018.02.004

Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods*, *3*(1), 4–70. https://doi.org/10.1177/109442810031002

Yean, C., Benau, E. M., Dakanalis, A., Hormes, J. M., Perone, J., & Timko, C. A. (2013). The relationship of sex and sexual orientation to self-esteem, body shape satisfaction, and eating disorder symptomatology. *Frontiers in Psychology*, *4*, 887. https://doi.org/10.3389/fpsyg.2013.00887

Received July 22, 2020
Revision received December 5, 2020
Accepted December 7, 2020 ■