2018, 1 (3) OPEN ACCESS

Development of the Muscle Mass Obtainment Inventory

Original Research

Davis Hale[1], Roger O. Kollock[2], Portia Resnick [3]

[123]*The University of Tulsa, Tulsa, OK USA*

Abstract

Introduction: Muscle Dysmorphia (MD) is a sub-type of a body dysmorphic disorder where symptoms include dissatisfaction with current muscular appearance and the perception of small stature, despite a mesomorphic physique. The purpose of this study was to develop a measurement instrument of MD using empirical data reduction techniques.

Methods: A set of 325 items were constructed by assessing commonalities with various dimensions/models of MD and reviewed by subject matter experts. Following subject matter review, a 180-item survey was administered to 827 college aged participants for data reduction. A Principle Axis Factor analysis with Oblimin and Kaiser normalization rotation was used to examine the factor structure of the 180-item survey.

Results: A final 85-item, nine factor scale emerged with factor loadings ≥.50 and reliability values ≥.80 called the Muscle Mass Obtainment Inventory (MMOI). Nine factors exist within this new scale with alpha ranging from .809 to .962. The composite alpha for all nine dimensions is .912.

Conclusions: The MMOI is an 85-item questionnaire with nine dimensions: MD internalization, Risky Steroid Use, Desire for Muscle Mass, Dietary Supplementation, Idealization of the Perfect Body, Body and Sport, Workout Priority, Physique Concern, and Social Constraints.

Key Words: Muscle Dysmorphia; Body Image, Body Dysmorphia

Corresponding author: Davis Hale, wdh1231@utulsa.edu

Introduction

Perceived body image is an important area of study. As trends on the ideal body type currently present themselves in the media, there will be a continued need to empirically investigate various perspectives on body dysmorphia. The construct Muscle Dysmorphia (MD) is a sub-type of body dysmorphic disorder where symptoms include dissatisfaction with current muscular appearance and the perception of small stature, despite actual mesomorphic physique [1]. Individuals exhibiting characteristics of MD are likely to engage in risky health behaviors, such as excessive exercise, under or overeating, and/or taking anabolic steroids [2] [3].

Persons with MD will expend great efforts to obtain a perceived ideal physique that may not be genetically possible. Other characteristics of MD include the obsession that one's body is not sufficiently lean and muscular, clinical depression, and impaired social and occupational functioning [4] [5] [6]. Individuals

with MD often cope with the disorder by taking pharmacological aids and/or dietary supplements. In addition, they often wear baggy clothes to mask their bodies out of fear of being perceived as too small [7].

Thompson and Cafri distinguish three trends within the past decade which have contributed to muscle obsession [8]. First, various pressures for appearance have evolved recently in our culture. These pressures have been induced by the media and interpersonal forces which have produced a society which places extreme pressure for the ideal level of attractiveness [1]. According to Thompson and Cafri[8], this has led to a rise in the preoccupation on physical perfection in not only females, but males as well. A second justification for the current preoccupation with the muscular ideal is the recent surge in popularity of professional and amateur sports [8 9]. The desire for fame and recognition has resulted in obtaining physical advantages by any means possible. The most apparent example is the use of performance enhancing drugs [10]. The third justification for the current interest in the muscular ideal is the evolvement of clinical and empirical approaches for measuring types of body dysmorphic disorder.

Muscle Dysmorphia was first researched in the early 1990's by researchers Pope, Katz, and Hudson [2]. These researchers examined the dissatisfaction of body type in weightlifters who perceived themselves as muscularly small but realistically possessed high muscle striation. Pope, Phillips, and Olivardia [11] described individuals with a type of body dysmorphic disorder as susceptible to various health problems. These problems included excessive steroid use, severe depression, low self-esteem, and social avoidance. Conceptualization of MD began with qualitative interviews. In the early 2000's…researchers [7,12,13] were able to hypothesize prospective models diagramming relationships and emergence of latent variables associated with MD. These researchers then proposed scales based on their models to assess characteristics of MD. A major shortcoming with most commonly used scales is their orthogonal nature. The scales have intended to measure latent variables of MD but have not been exposed to standard scale developmental techniques suggested in social science literature. Suffolk and colleagues [14] have suggested a more psychometric scale be developed and validated to measure MD.

Only a few scales are currently recognized as "suggested" means for assessing MD in a general population [9,14]. Two of the most widely used scales to assess MD are the Muscle Dysmorphia Inventory and the Drive for Muscularity Scale. Both of these scales possess acceptable psychometric properties[15,16]. However, neither scale explored proposed models of MD when determining item retention. Thus, the purpose of this study was to develop a measurement instrument of MD using recognized scale development techniques[17]. It was the goal of the researchers to (a) Develop a universal pool of items based on all dimensions within all proposed models of MD; (b) Have the universal pool of items be reviewed by experts recognized with the field of MD; (c) Administer the revised items to a population which contains an extensive amount of variance; (d) Use data reduction techniques, with SPSS, to explore commonalities among MD items; (e) Evaluate the reliability statistic for each dimension of the new scale along with a composite value; (f) Label each new dimension relative to its pool of common items which it represents; (g) Construct a final revised scale to be used in future research for assessing traits of MD within a general population; (h) and Make future research recommendations for confirming the newly developed scale in other populations..

Methods

Participants

Data collection was limited to physically active undergraduate students within a Midwestern University during a six month period. Prior to data collection, the study was examined and approved by the University's Institutional Review Board. Participants were recruited via the University's electronic subject pool recruitment system. This procedure yielded 827 valid cases (males = 518, females = 305) that could be used for the analyses. Each participant (mean age = 19.7 years) completed a 180-item survey with each item reflecting a possible emerging factor of MD. A final subject to variable ratio of 4.59 was determined. The 827 subjects represented an appropriate amount of total variance as determined by Bartlett's Test of Sphericity (chi = 105663; p = .000).

Protocol

The development of an over inclusive set of 325 items was constructed by assessing commonalities with various dimensions/models of MD, specifically the psychobehavioral model, the sociocultural model [13] [12], and the etiological model [7] [18]. The 325 items were reviewed by six subject matter experts (MD researchers) to reduce the data set from 325 to 180 items. Items were structured in a five-point Likert format with 1 being "disagree", 3 being "neutral", and 5 being "agree". The remaining 180 items were administered to the 827 study participants and then exposed to an exploratory factor analysis. The factors were then interpreted, evaluated for inter-item correlations, and labeled. The steps followed were: determine clearly what it is to be measured, generate an item pool, determine the format for measurement, have the initial item pool reviewed by experts, consider the inclusion of validation items, administer items to a developmental sample, evaluate the items, and optimize scale length.

Statistical Analysis

A Principle Axis Factor analysis with Oblimin and Kaiser normalization rotation was used to examine the factor structure for the 180-item survey. The first method used to determine item correlations was the original correlation matrix. The researchers scanned the matrix for indications of a simple structure. This was determined by scanning the original correlation matrix to ensure it was not similar to an identity matrix. Second, the amount of variance explained by each factor was analyzed. A 32-factor solution appeared with eigenvalues >1.0. The researcher then determined to use eigenvalues >2.0, which would account for 50% of the total variance. A 13-factor solution was determined by appropriate eigenvalues and a Catell's scree plot analysis [19]. The Factor Structure Matrix generated by SPSS was analyzed for factor loadings following rotation. For the purpose of this study, a cutoff value for factor loadings on the Structure Matrix was set at 0.50 due to the large sample size[20].

Following item retention based on the Factor Structure Matrix (values retained greater than + or - 0.50), each of the 13 factors were exposed to a reliability analysis. A Cronbach's Alpha value of 0.80 or greater was determined to be acceptable. The researchers examined alpha values for each factor based on items retained from the Structure Matrix. After obtaining this value, the researchers eliminated factors that had smaller loadings to evaluate change in alpha. Items that seemed to contribute less to the factor were eliminated and the reliability analysis was conducted until the maximum alpha was obtained with an appropriate amount of items. Since items in exploratory factor analysis are seen as dependent variables, a listwise reduction in items cannot depend solely on reliability values. More emphasis was placed on factor loadings than reliability values[17]. Item retention was based on the optimal amount of items (based on factor loadings) and the highest amount of reliability. Factor loading values and reliability values are reported in the following section as the factors are subjected to interpretation.

Results

Factor Interpretations

The results of this analysis provided evidence to support the exploration of a new instrument for identifying characteristics of MD. Following examination of the Factor Structure Matrix and reliability values, a set of nine latent variables was determined. Therefore, the final scale derived from the previously mentioned scale developmental techniques, yielded a multidimensional scale with nine dimensions with factor loadings ≥ 0.50 and reliability ≥ 0.80. These dimensions are grounded in theory, have been exposed to subject matter expert reviews, and exposed to statistical, data reduction procedures. The following section explains the nature of the factors based on interpretations of the item commonalities. Table 1 contain more detail concerning factor loading values associated with each item and its related factor. The nine factors chosen for the new MD instrument are discussed below.

Factor One- MD Internalization

Factor one was labeled as "MD Internalization". Factor loadings for this construct ranged from 0.504 to 0.757. The 13 items chosen for this factor indicate common feelings of low self-esteem, negative body internalization, and low body imaging. Examples of the items include "If I have a bad workout, I feel bad the rest of the day," and "The more muscular I am, the better I feel about myself." Cronbach's Alpha for this factor was 0.924.

Factor Two- Risky Steroid Use

Factor two was labeled as "Risky Steroid Use". This factor aligns with factors mentioned in the previous models of MD. Factor loadings for this construct ranged from 0.522 to 0.881. The 13 items chosen for this factor indicate common behaviors for obtaining the ideal body type, specifically on of mesomorphic stature. Examples of the items include "I have used steroids for non-medical purposes," and "I use steroids even though I am aware of the side effects." Cronbach's Alpha for this factor was 0.946.

Factor Three- Desire for Muscle Mass

Factor three was labeled as "Desire for Muscle Mass". This factor corresponds with an individual's feelings to obtain a more muscular physique, specifically an increase in muscle size. As discussed previously, individuals who exhibit MD type behaviors are determined to build muscle size not necessarily lean muscle. Factor loadings for this construct ranged from 0.504 to 0.761. The seven items chosen for this factor indicate common behaviors for obtaining a body with increased muscle hypertrophy. Examples of the items include "I would like to gain more muscle in my upper body," and "I wish I had more muscle mass." Cronbach's Alpha for this factor was 0.873.

Factor Four- Dietary Supplementation

Factor four was labeled as "Dietary Supplementation". This factor represents feelings and behaviors of dietary restrictions and supplementation. An individual, who is concerned with increasing musculature, consistently ponders methods to alter diet enhancing striations of muscle appearance. Dietary restrictions and supplementation are "legal" methods to speed recovery and drastically increase muscle size. Factor loadings for this construct ranged from 0.771 to 0.864. The 14 items retained for this factor indicate common thoughts and behaviors an individual with MD may present in order to increase muscle mass. Examples of the items include "Most foods I eat are to enhance the muscle I have," and "I supplement protein shakes to add weight." Cronbach's Alpha for this factor was 0.962.

Factor Five- Idealization of the Perfect Body

Factor five was labeled as "Idealization of the Perfect Body." This factor represents feelings of comparisons an individual has concerning their body and the "ideal body". Such feelings lead to negative thoughts and low self-esteem, both related to MD like symptoms. Pressures to obtain the perfect body correspond with negative thoughts and behaviors. Factor loadings for this construct ranged from 0.525 to 0.779. The 11 items retained for this factor indicate common thoughts of body comparisons to the ideal body type. Examples of the items loading on this factor include "My workout goal is to obtain the perfect body," and "I feel pressure to obtain the ideal body type." Cronbach's Alpha for this factor was 0.921.

Factor Six- Body and Sport

Factor six was labeled as "Body and Sport". This factor represents the impact an individual's sport preference and/or participation has on her/his body size. Participation in sport and/or preference of sport will impact feelings and behaviors an individual has toward obtaining the preferred body type of that sport. This is not a factor that is limited to professional or recreational athletes. Individuals may play the role as spectator and still be influenced by the sport's ideal body type. Factor loadings for this construct ranged from 0.500 to 0.685. The five items retained for this factor indicate a relationship between sport and MD. Examples of the items loading on this factor include "My body size is determined by the sport which I play or played," and "My workout program is centered on the sport which I am interested in." Cronbach's Alpha for this factor was 0.809.

Factor Seven- Workout Priority

Factor seven was labeled as "Workout Priority". This factor represents the influence of the desire for muscle has on an individual's daily routine. Individuals who exhibit these thoughts and behaviors depend on exercise as a part of daily functioning. Any and all barriers which inhibit this exercise will be overcome in the pursuit of the perfect body. Individuals with MD like symptoms have a high priority for their workouts. Factor loadings for this construct ranged from 0.502 to 0.813. The 11 items retained for this factor indicate a relationship between the desire for muscles and overcoming barriers to meet this desire. Examples of the items loading on this factor include "My workout is high priority," and "Pretty much nothing will get in the way of my workout." Cronbach's Alpha for this factor was 0.921.

Factor Eight- Physique Concern

Factor eight was labeled as "Physique Concern". This factor represents the impact perceptions have on one's physique (muscle mass). Individuals who possess MD symptoms will either hide or attempt to accentuate their physique to improve self-esteem. The pursuit of the ideal body type comes with many consequences. Individuals who attempt to protect their physique are masking underlying psychological disorders such as low self-esteem and negative affect. Factor loadings for this factor indicate a desire to either accentuate or hide one's musculature from others. Factor loadings for this construct ranged from 0.532 to 0.633. Examples of the items loading on this factor include "I wear bulky clothes when going to and from the gym," and "I flex in front of the mirror at home." Cronbach's Alpha for this factor was 0.819.

Factor Nine- Social Constraints

Factor nine was labeled as "Social Constraints." This factor represents the pressures and fears an individual with MD has in public situations. To mask these feelings of inadequacy, strange behaviors of physique protection are exhibited.

Individuals with MD like symptoms are highly concerned with others' perceptions of their body type and body size. These feelings of inadequacy lead to social avoidance and/or awkward social behavior. Factor loadings for this factor indicate a desire to hide ones physique from others; also referred to as physique protections on the previously mentioned models of MD. Factor loadings for this construct ranged from 0.504 to 0.641. Examples of the items loading on this factor included "I will not take off my shirt unless I have recently worked out," and "I will avoid certain social situations if I feel out of shape." Cronbach's Alpha for this factor was 0.836.

Final Factor Solution

The previous sections in this chapter identified methods used for item retention for the final factor solution. The composite Cronbach's Alpha for the nine factor solution was 0.911. The final scale determined by exploratory factor analysis techniques is to be viewed by readers as a new scale, identifying common feelings from individuals with MD like characteristics. This is not a proposition for a new model in MD nor is it a confirmatory study on already existing model. This new scale represents a collection of ideas and perceptions into new areas of research for identifying and treating individuals with MD.

Table 1. Muscle Mass Obtainment Inventory (MMOI)	Factor Loadings
Factor 1-MD Internalization	
1. I feel pressure to be muscular.	0.50
2. If I have a bad workout, I feel bad the rest of the day.	0.55
3. My muscle size determines how I feel about myself.	0.76
4. The more muscle mass I have, the better I feel about myself.	0.65
5. Less muscle mass equals poor self-esteem.	0.64
6. My self-esteem is influenced by my muscle mass.	0.71
7. The more muscular I am, the better I feel about myself.	0.58
8. I am a foul mood if I miss a training session.	0.62
9. My mood is determined by the amount of muscle I have.	0.76
10. My mood is bad if I feel small.	0.64
11. I become angry if I feel bad about my body.	0.55
12. I think about my musculature many times throughout the day.	0.58
13. I become angry if I miss a workout.	0.71
Factor 2- Risky Steroid Use	
14. I have used steroids not prescribed by a doctor.	0.80
15. I cycle steroids more than once a year.	0.66
16. I have purchased steroids over the internet.	0.71
17. I have purchased steroids from a member of the gym I workout in.	0.88
18. I have injected steroids with a needle.	0.79
19. I have ingested steroids orally.	0.65
20. I prefer to use steroids over other types of supplements.	0.87
21. I have bought steroids from a country other than the one in which I live.	0.79
22. I use steroids even though I am aware of the side effects.	0.82
23. I have used steroids for non-medical purposes.	0.81
24. I prefer to stack steroids with other muscle building supplements.	0.81
25. I have used over-the-counter steroid precursors to build muscle mass.	0.75
26. I currently use "Andro" or a similar steroid precursor.	0.65
Factor 3- Desire for Muscle Mass	

27. I wish I had more muscle mass.	0.75
28. I would like to build muscle.	0.76
29. I wish my arms were more muscular.	0.74
30. I wish my chest was more muscular.	0.66
31. I would like to gain more muscle in my upper body.	0.73
32. I am not muscular enough.	0.62
33. I am worried about not being muscular enough	0.59
Factor 4- Dietary Supplementation	
34. I have used meal replacements to add weight.	0.71
35. I supplement protein shakes to add weight.	0.77
36. I have tried "weight gainer" products.	0.83
37. Most foods I eat are to gain more muscle mass.	0.60
38. I restrict my diet to enhance my muscle striations.	0.77
39. I restrict my diet to enhance my muscle striations.	0.85
40. I eat foods which will enhance muscle recovery.	0.75
41. I eat foods which will speed muscle growth.	0.86
42. Most foods I eat are to enhance the muscles I have.	0.82
43. Most foods I eat are to enhance the muscles I have.	0.83
44. I use supplements to add muscle mass.	0.85
45. Supplementation is critical to gaining muscle mass.	0.82
46. I discuss supplement use with my peers.	0.77
Factor 5- Idealization of the Perfect Body	
47. I would like to have the perfect body.	0.70
48. Obtaining the perfect body is a goal of mine.	0.72
49. My workout goal is to obtain the perfect body.	0.71
50. I want to close the gap between my body and the perfect body.	0.73
51. Other people influence the way I feel about my body.	0.61
52. I want to obtain the ideal body.	0.77
53. I am constantly thinking about my body type.	0.64
54. I feel there are always improvements I can make to my body type.	0.53
55. If my body is not perfect, I feel dissatisfied.	0.60
56. I compare my body with those of movie stars.	0.64
57. I feel pressure to obtain the ideal body.	0.52
Factor 6- Body and Sport	
58. My body size is determined by the sport which I play or played.	0.63
59. I will add muscle mass if playing a sport which requires more size.	0.65
60. I will lose weight if playing a sport which requires lean mass.	0.50
61. My muscle mass is determined by which sport is in season.	0.65
62. My workout program is centered on the sport which I am interested in.	0.69
Factor 7- Workout Priority	
63. I exercise more than 5 days per week.	0.67
64. I will exercise even if my body is sore.	0.60
65. My workout is a high priority.	0.80
66. I schedule my workouts days in advance.	0.62
67. Lifting weights is a very important part of my life.	0.81
68. Pretty much nothing will get in the way of my workout.	0.63
69. I would feel lost without exercise.	0.73
70. My recovery/off days seem to last forever.	0.74
71. I want to lift weights my entire life.	0.65

72. I will do whatever it takes to obtain the perfect body	0.60
Factor 8- Physique Concern	
73. I wear bulky clothes when going to and from the gym.	0.57
74. I flex in front of the mirror at home.	0.64
75. Most days I exercise my upper body.	0.58
76. I prefer to wear sleeveless shirts when lifting my upper body.	0.56
77. I would like to gain 5-15 pounds of muscle.	0.56
78. I sometimes feel people are checking out my muscle size in public.	0.59
Factor 9-Social Constraints	
79. I am constantly thinking of new ways to lose weight.	0.53
80. I will not take off my shirt unless I have recently worked out.	0.50
81. I feel depressed on days which I am bloated.	0.53
82. I workout before going to the beach or pool.	0.63
83. If I have not worked out recently, I will wear baggy clothes.	0.64
84. I will avoid certain social situations if I feel "out of shape".	0.64
85. I will try any extreme of dieting to lose weight.	0.56

Discussion

A psychometrically sound instrument to assess MD from a theoretical perspective is inherently needed for MD research [14]. The result of this study is a new scale for MD recognition developed with proper scale developmental techniques prior to statistical data reduction (Table 1). The name of this new instrument is the Muscle Mass Obtainment Inventory (MMOI). Nine factors (85 items total) exist within this new scale with alpha ranging from 0.809 to 0.962. The composite alpha for all nine dimensions is 0.912. These new factors represent commonalities of feelings reflected by the samples within the proposed sample parameters. The nine factors are: MD internalization, Risky Steroid Use, Desire for Muscle Mass, Dietary Supplementation, Idealization of the Perfect Body, Body and Sport, Workout Priority, Physique Concern, and Social Constraints. A more intensive analysis of the factors is recommended to examine causal relationships and the predictive nature of the variables.

The MMOI was developed with empirical data reduction procedures. However, various limitations exist before its usage can be inferred to other populations containing individuals with MD. The next step is to analyze convergent validity with a similar type of muscle dysmorphic and/or body dysmorphic instrument. Future confirmatory analyses could then detect the effectiveness of the MMOI in various populations. The MMOI should be viewed as an important piece of scale development eliminating perceptions of MD as a novelty and unrecognized disorder. This scale needs to be validated in other populations, specifically populations with high potential for characteristics of MD.

In conclusion, the scale presented is a preliminary approach for measurement within the etiology of MD. Its development represents psychometrically sound techniques for exploratory purposes. The development of the MMOI is proposed to initiate the research process and further the exploration of MD. The newness of this disorder begins with promoting awareness, analyzing tendencies, and recommending interventions for prevention and treatment. The MMOI is not a solution but a tool within the process of psychological evaluation.

Media-Friendly Summary

A new scale called the Muscle Mass Obtainment Inventory has been developed to measure a body image disorder called muscle dysmorphia. Muscle dysmorphia, sometimes called reverse anorexia, is a perceived body disturbance in which a

person feels like he or she is of small stature with low muscle mass, when in reality, they are actually very muscular. The development of a new scale to measure muscle dysmorphia allows for a big picture assessment of thoughts and behaviors towards obtaining the "ideal" body type that may interfere with activities of daily living.

References

1. Cash TF, Pruzinsky T. *Body image: A handbook of theory, research, and clinical practice.* The Guilford Press; 2004.
2. Pope Jr HG, Katz DL, Hudson JI. Anorexia nervosa and "reverse anorexia" among 108 male bodybuilders. *Comprehensive psychiatry.* 1993;34(6):406-409.
3. Nieuwoudt JE, Zhou S, Coutts RA, Booker R. Symptoms of muscle dysmorphia, body dysmorphic disorder, and eating disorders in a nonclinical population of adult male weightlifters in Australia. *The Journal of Strength & Conditioning Research.* 2015;29(5):1406-1414.
4. Muller SM, Dennis DL, Schneider SR, Joyner RL. Muscle dysmorphia among selected male college athletes: An examination of the Lantz, Rhea, and Mayhew model. *International Sports Journal.* 2004;8(2):119.
5. Cunningham ML, Griffiths S, Mitchison D, Mond JM, Castle D, Murray SB. Muscle Dysmorphia: An Overview of Clinical Features and Treatment Options. *Journal of Cognitive Psychotherapy.* 2017;31(4):255-271.
6. dos Santos Filho CA, Tirico PP, Stefano SC, Touyz SW, Claudino AM. Systematic review of the diagnostic category muscle dysmorphia. *Australian & New Zealand Journal of Psychiatry.* 2016;50(4):322-333.
7. Grieve FG. A conceptual model of factors contributing to the development of muscle dysmorphia. *Eating disorders.* 2007;15(1):63-80.
8. Thompson J, Cafri GE. *The muscular ideal: Psychological, social, and medical perspectives.* American Psychological Association; 2007.
9. Tod D, Edwards C, Cranswick I. Muscle dysmorphia: current insights. *Psychology research and behavior management.* 2016;9:179.
10. Mooney R, Simonato P, Ruparelia R, Roman- Urrestarazu A, Martinotti G, Corazza O. The use of supplements and performance and image enhancing drugs in fitness settings: A exploratory cross- sectional investigation in the United Kingdom. *Human Psychopharmacology: Clinical and Experimental.* 2017;32(3).
11. Pope H, Phillips KA, Olivardia R. *The Adonis complex: The secret crisis of male body obsession.* Simon and Schuster; 2000.
12. Cafri G, van den Berg P, Thompson JK. Pursuit of muscularity in adolescent boys: Relations among biopsychosocial variables and clinical outcomes. *Journal of Clinical Child & Adolescent Psychology.* 2006;35(2):283-291.
13. Lantz CD, Rhea DJ, Cornelius AE. Muscle dysmorphia in elite-level power lifters and bodybuilders: a test of differences within a conceptual model. *Journal of strength and conditioning research.* 2002;16(4):649-655.
14. Suffolk MT, Dovey TM, Goodwin H, Meyer C. Muscle dysmorphia: Methodological issues, implications for research. *Eating disorders.* 2013;21(5):437-457.
15. Rhea D, Lantz CD, Cornelius A. Development of the muscle dysmorphia inventory (MDI). *Journal of Sports Medicine and Physical Fitness.* 2004;44(4):428.

16. McCreary DR, Sasse DK. An exploration of the drive for muscularity in adolescent boys and girls. *Journal of American college health.* 2000;48(6):297-304.
17. DeVellis R. *Scale development: Guidelines in scale development.* Vol 26. Chapel Hill, NC: Sage; 2017.
18. Baghurst T, Kissinger DB. Perspectives on muscle dysmorphia. *International Journal of Men's Health.* 2009;8(1):82.
19. Cattell RB. The scree test for the number of factors. *Multivariate behavioral research.* 1966;1(2):245-276.
20. Peterson RA. A meta-analysis of variance accounted for and factor loadings in exploratory factor analysis. *Marketing Letters.* 2000;11(3):261-275.