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Prevalence of Disordered Eating and Muscle Dysmorphia in College Students by Predominant Exercise Type

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ABSTRACT

International Journal of Exercise Science 12(4): 989-1000, 2019. Many young adults experience distorted body image and decreased body satisfaction. To attain more "ideal" bodies, negative alterations in eating and/or exercise habits are common. This study's objective was to compare disordered eating and muscle dysmorphia in undergraduates who participate in aerobic-, anaerobic-, or flexibility-predominant exercise; mixed exercise; or no exercise. One hundred twelve undergraduate students (age 21.2 ± 4.8 years; BMI 25.0 ± 4.6 kg/m^2) were recruited from the student union and recreation center. The Eating Attitudes Test (EAT-26), Muscle Dysmorphic Disorder Inventory (MDDI), and demographic/exercise questions were administered via iPad. Exercisers reported ≥ 150 minutes/week of exercise. Predominant exercise type was defined as ≥ 50% reported minutes from one type. Between-sex differences were assessed by t-tests, while exercise type differences were assessed using analysis of variance. Disordered eating was exhibited in 25.9% of undergraduates. Females had higher EAT-26 total and dieting subscale scores ($p < 0.05$ for both). EAT-26 total, dieting subscale, and bulimia and food preoccupation subscales were higher in aerobic-predominant compared to anaerobic-predominant exercisers ($p < 0.05$ for all). Muscle dysmorphia was exhibited in 7.1% of undergraduates. Males had higher MDDI total and drive for size subscale scores, while females scored higher on the appearance intolerance subscale ($p < 0.05$ for all). Aerobic- and anaerobic-predominant exercisers had higher MDDI total and functional impairment subscale scores than non-exercisers ($p < 0.05$). Non-exercisers were largely unaffected by disordered eating and muscle dysmorphia. Females and aerobic-predominant exercisers exhibited more symptoms of disordered eating, while males exhibited more symptoms of muscle dysmorphia. University campuses should consider targeted education for these groups.

KEY WORDS: Body image, compulsive exercising, diet, eating behaviors, eating disorders, excessive exercise, exercise addiction, exercise behaviors, undergraduate, university students

INTRODUCTION

The current media driven society today uses images to construct what constitutes an "ideal" body. Excessively thin females (e.g., protruding clavicles, hollow cheeks, temporal wasting) and hyper-muscular males (e.g., large/defined muscles, protruding veins) are prominent in magazines and abundant in advertisements (12). Although unrealistic, the general population often feels the need to attain these body shapes to be deemed attractive and "normal" (27). Unfortunately, this ideal can lead to distorted body image and result in negative behaviors, such as disordered eating and excessive exercise. These behaviors are particularly prevalent in college-aged individuals, who may be going through a time of uncertainty, self-discovery, and change (6).

The American Psychiatric Association has developed criteria for the diagnosis of various eating disorders. The most recent Diagnostic and Statistical Manual of Mental Disorders (DSM-5) defines criteria for each type of eating disorder (3). It is possible to have disordered eating behaviors without meeting the criteria for an eating disorder. Eating behaviors that interfere with an individual's life but do not meet the criteria for an eating disorder can be referred to as disordered eating (3). Eating disorders typically develop between the ages of 12 and 26 and are more common in females than males (2). However, eating disorders among males are often overlooked and underrepresented in research due to lower rates of treatment seeking in this population (15). In addition to stringent eating habits, exercise plays a key role in the development and continuation of eating disorders.

Excessive exercise, termed exercise abuse, is seen in 33 to 100% of individuals diagnosed with eating disorders (5). Those suffering from these disorders view working out solely as a means of weight control. Consequently, they tend to prefer aerobic forms of activity, such as running or cycling, allowing them to burn the highest number of calories and fat (5). Relative Energy Deficiency in Sport (RED-S) is a syndrome that may occur in individuals who participate in a high level of physical activity (19). RED-S is typically caused by insufficient energy intake and is characterized by dysmenorrhea, impaired metabolic rate, impaired bone health, and cardiovascular complications (19). One study of patients treated for eating disorders found a greater weight preoccupation and drive for thinness among individuals participating in aerobic activities (28). Patients in this study spent an average of seven hours per week engaging in aerobic exercise and two hours per week on anaerobic exercise (28). These findings suggest that disordered eating may be associated with a pre-occupation with calorie- and fat-burning aerobic activities and overall excessive physical activity.

Muscle dysmorphia often parallels eating disorders in its distortion of body image. Muscle dysmorphia is characterized by a preoccupation with becoming disproportionately large and muscular (11) and is concentrated in the male population (14). Onset of symptoms occurs most commonly during the college years (30). Individuals exhibiting muscle dysmorphia may drastically alter their diet. Oftentimes, diet changes include focusing on a very high-protein diet, limiting non-protein foods, and forcing oneself to eat even when not hungry (11, 20). Similar to eating disorders, muscle dysmorphia is accompanied by an unhealthy relationship with exercise. Individuals with the disorder often participate in excessive weightlifting and experience feelings of extreme anxiety when their workout routine is disrupted (20).

The Physical Activity Guidelines for Americans (24), issued by the United States Department of Health and Human Services, recommend that adults engage in at least 150 minutes of moderate-intensity physical activity or 75 minutes of high-intensity physical activity per week. Moderate-intensity activities include brisk walking or raking the yard. High-intensity activities include jogging, shoveling snow, or participating in a strenuous fitness class. Exercise can be divided into several categories, including aerobic, anaerobic (also referred to as muscle-strengthening), and flexibility. Aerobic activities include jumping rope, bicycling, jogging/running, cardio classes, or any other activity that causes a faster heartbeat and increased rate of breathing. Anaerobic activities include resistance training and lifting weights. Yoga and other stretching exercises are included in the category of flexibility activities. Mixed exercise is when an individual engages in a combination of activities throughout the week, without one predominant exercise type.

The goal of this project was to evaluate the prevalence of disordered eating and muscle dysmorphia in college students who engage in at least 150 minutes of exercise per week versus those who do not. The World Health Organization defines exercise as any type of physical activity that is "planned, structured, repetitive, and purposeful," meaning that the objective of this physical activity is to maintain or improve upon some aspect of physical fitness (31). Differences between sex (male vs. female) and primary exercise type (aerobic-predominant, anaerobic-predominant, flexibility-predominant, mixed vs. none) were also characterized. We hypothesized that aerobic-predominant exercisers would have a higher prevalence of disordered eating and anaerobic-predominant exercisers would have a higher rate of muscle dysmorphia when compared with other exercise types and non-exercisers. We also hypothesized that females would have a higher incidence of disordered eating, while males would have a higher drive for size, including a higher self-perceived ideal body weight and increased rate of muscle dysmorphia.

METHODS

Participants

The exercise group (n = 54) was recruited at the university's recreation center, while the non-exercise group (n = 58) was recruited at the university's student union. After voluntarily expressing interest in the study, informed consent was obtained. The university's institutional review board approved the study. A power analysis was conducted using G*Power 3.1 statistical software (University of Kiel, Germany) for a difference between two independent means (7). Parameters included an $\alpha = 0.05$, a power of 0.80, a medium effect size of 0.5, and a large effect size of 0.8. The total sample size required to detect a medium effect was 128 (64 per group), with 52 (26 per group) participants needed to detect a large effect.

Individuals who reported ≥ 150 minutes of exercise per week were categorized as "exercisers," while those reporting < 150 minutes of exercise were categorized as "non-exercisers." Exercisers were further grouped based on their primary mode of exercise. Individuals reporting 50% or more of their time spent in aerobic, anaerobic, or flexibility activities were considered a predominant exerciser of that specific type (e.g., an individual reporting 140 minutes of aerobic, 30 minutes of anaerobic, and 30 minutes of flexibility activities would be classified as aerobic-predominant based on 70% of time spent in aerobic activities). Individuals reporting less than 50% of exercise minutes in a single activity were classified as having a "mixed" exercise type (e.g., an individual reporting 80 minutes of aerobic, 60 minutes of anaerobic, and 60 minutes of flexibility activities would be classified as mixed based on 40%, 30%, and 30% of time spent in aerobic, anaerobic, and flexibility activities, respectively). Exclusions (n = 19) were based on reported exercise status not matching weekly reported exercise minutes (e.g., reported exerciser engaging in < 150 minutes of exercise per week). Participants received a cell phone car charger as an incentive for their participation in the project.

Protocol

A three-part survey was administered. This included: 1) Eating Attitudes Test (EAT-26) questionnaire to assess degree of disordered eating (8), 2) Muscle Dysmorphic Disorder Inventory (MDDI) questionnaire to assess degree of muscle dysmorphia (10), and 3) a demographic and physical activity questionnaire to assess sex, age, height, weight (current, highest, lowest, and ideal), primary mode(s) (aerobic, anaerobic, flexibility, mixed, or none), and amount of exercise. The survey was delivered online via iPad using Qualtrics (Provo, UT).

The EAT-26 (8) is a self-report survey that includes 26 questions to assess behaviors and thoughts consistent with eating disorders. Subscales include dieting, bulimia and food preoccupation, and oral control. EAT-26 has been validated using DSM-defined criteria for disordered eating (18). Total scores on the EAT-26 range from 0 (low) to 80 (high). Subscale scores range from 0 to 39 for dieting, 0 to 18 for bulimia and food preoccupation, and 0 to 21 for oral control. In the original scoring method, total scores greater than 20 indicated eating disorder risk based on dieting, weight, and problematic eating concerns (8). However, new research indicates a more appropriate cut-off score of 11 or greater (23), which was implemented in this study.

The MDDI (10) is a self-report survey that includes 13 questions to assess body image disturbance. Subscales include drive for size, appearance intolerance, and functional impairment. The MDDI has been evaluated and found to be reliable and valid (10). Total scores on the MDDI range from 13 (low) to 65 (high). Subscales scores range from 0 to 25 for drive for size and 0 to 20 for both appearance intolerance and functional impairment. Total scores greater than 39 are indicative of muscle dysmorphia (30) and were used as the cut-off in this study.

Statistical Analysis

IBM SPSS Statistics for Windows Version 24.0 (Armonk, NY) was used to evaluate the data. Between sex differences were assessed by t-tests, while differences in exercise type were assessed using analysis of variance (ANOVA) with the Bonferroni correction. These statistical methods were used to discern if a relationship existed between A) exercise type and disordered eating, B) exercise type and muscle dysmorphia, C) sex and disordered eating, and D) sex and muscle dysmorphia. A p-value of < 0.05 was used to determine statistical significance. P-values between 0.05 and 0.10 were considered trends worthy of further investigation. Eta squared (η^2) values were used to evaluate effect size (small = 0.01 to 0.05, medium = 0.06 to 0.13, large = 0.14 or more).

RESULTS

Demographics

Participant characteristics by sex and exercise type are displayed in Table 1. As expected, males had greater current, highest, and lowest adult weights and greater self-perceived ideal body weight ($p < 0.001$ for all). Males participated in more total ($p = 0.002$) and anaerobic exercise minutes ($p < 0.001$) than females. Males and females did not vary in age, body mass index (BMI), and aerobic- and flexibility-based exercise minutes (p = 0.194, 0.800, 0.883, and 0.227, respectively). Three participants did not specify sex. These participants are represented in overall demographics and were included in exercise type comparisons. As shown in Table 1, effect sizes were small for age, BMI, and flexibility minutes (η^2 = 0.010-0.025); medium for total and anaerobic exercise minutes (η^2 = 0.096-0.138); and high for current, highest, lowest, and ideal weight (η^2 = 0.187-0.451).

One-way ANOVA revealed significant differences in age, weight, and exercise minutes based on predominant exercise type. BMI did not vary based on exercise type ($p = 0.571$). After using the Bonferroni method to correct for multiple comparisons, significant differences remained for age, weight, and exercise minutes. Mixed exercisers tended to be older than non-exercisers (p = 0.054). Current, highest, and lowest weight was greater in anaerobic-predominant than non-exercisers (p = 0.031, 0.025, and 0.002, respectively). Self-perceived ideal weight was greater in anaerobic-predominant exercisers than non-exercisers ($p < 0.001$) and tended to be greater compared to mixed exercisers ($p = 0.058$). As predicted, total exercise minutes were significantly greater in all exercise groups (i.e., aerobic-predominant, anaerobic-predominant, and mixed) compared to non-exercisers ($p < 0.001$ for all). Aerobic-predominant and mixed exercisers spent significantly more time engaging in aerobic activity compared to anaerobic-predominant exercisers and non-exercisers ($p < 0.001$ for all). Similarly, anaerobic-predominant exercisers spent significantly more time engaging in anaerobic activity than all the other groups ($p < 0.001$ vs. aerobic-predominant exercisers, 0.002 vs. mixed exercisers, and < 0.001 vs. non-exercisers). Additionally, anaerobic-predominant exercisers participated in more aerobic exercise minutes than non-exercisers ($p < 0.001$). Mixed exercisers spent more time in anaerobic and flexibility activities than non-exercisers ($p < 0.001$ for both), as well as more time in flexibility activities than anaerobic-predominant exercisers ($p = 0.006$). As shown in Table 1, effect sizes were small for BMI (η^2 = 0.027); medium for age and current, highest, and lowest weight (η^2 = 0.071-0.110); and high for ideal weight and total, aerobic, anaerobic, and flexibility exercise minutes (η^2 = 0.198-0.645).

Table 1. Participant characteristics by sex and exercise type.

	Overall (n = 112)	Female (n = 62)	Male (n = 47)	P-value	η²	Aerobic (n = 8)	Anaerobic (n = 35)	Mixed (n = 11)	None (n = 58)	P-value	η²
Age (yrs)	21.2 ± 4.8	21.6 ± 6.2	20.5 ± 2.1	0.194	0.020	23.5 ± 6.5	20.9 ± 2.0	24.6 ± 11.7	20.4 ± 3.3	0.032 *	0.079 †
BMI (kg/m²)	25.0 ± 4.6	25.1 ± 4.7	24.8 ± 4.5	0.800	0.010	25.2 ± 5.3	25.5 ± 3.8	26.2 ± 4.6	24.5 ± 4.9	0.571	0.027
Weight											
Current (lbs)	162.6 ± 36.3	148.0 ± 30.0	179.7 ± 35.1	< 0.001 *	0.199 †	163.6 ± 45.7	175.9 ± 38.0	163.3 ± 37.6	154.2 ± 32.0	0.048 *	0.071 †
Highest (lbs)	172.7 ± 42.4	156.7 ± 33.4	190.6 ± 43.7	< 0.001 *	0.187 †	176.5 ± 55.8	188.9 ± 46.0	169.2 ± 42.0	163.1 ± 35.7	0.038 *	0.077 †
Lowest (lbs)	147.8 ± 32.2	134.9 ± 25.2	163.6 ± 33.8	< 0.001 *	0.200 †	147.3 ± 38.4	163.1 ± 33.3	146.1 ± 31.2	139.0 ± 28.1	0.006 *	0.110 †
Ideal (lbs)	155.0 ± 35.5	133.4 ± 21.7	180.6 ± 30.4	< 0.001 *	0.451 †	156.3 ± 43.2	177.4 ± 39.5	148.1 ± 29.2	142.3 ± 25.5	< 0.001 *	0.198 †
Exercise											
Total (min)	231.6 ± 259.3	161.1 ± 191.1	325.2 ± 305.1	0.002 *	0.096 †	350.5 ± 166.1	452.7 ± 206.0	470.0 ± 278.2	36.5 ± 83.7	< 0.001 *	0.624 †
Aerobic (min)	65.0 ± 82.5	64.5 ± 79.3	66.9 ± 89.2	0.883	0.002	220.0 ± 86.4	73.9 ± 39.3	182.3 ± 113.6	15.9 ± 24.9	< 0.001 *	0.644 †
Anaerobic (min)	138.8 ± 190.0	74.5 ± 109.5	222.2 ± 234.9	< 0.001 *	0.138 †	86.3 ± 94.6	347.9 ± 190.2	199.1 ± 100.4	8.4 ± 25.5	< 0.001 *	0.645 †
Flexibility (min)	27.8 ± 53.8	22.0 ± 33.7	36.0 ± 72.8	0.227	0.025	44.3 ± 39.6	31.0 ± 25.9	88.6 ± 98.9	12.1 ± 48.1	< 0.001 *	0.279 †

Mean ± SD. * Indicates $p < 0.05$. † Indicates medium (0.06-0.13) to large (≥ 0.14) effect sizes. 3 participants did not specify sex. Aerobic-predominant exercisers engaged in ≥ 150 minutes of exercise per week with ≥ 50% of time spent in aerobic activities. Aerobic-predominant exercisers engaged in ≥ 150 minutes of exercise per week with ≥ 50% of time spent in aerobic activities. Anaerobic-predominant exercisers engaged in ≥ 150 minutes of exercise per week with ≥ 50% of time spent in anaerobic activities. Mixed exercisers engaged in ≥ 150 minutes of exercise per week with < 50% of time spent in aerobic, anaerobic, and flexibility activities. None or non-exercisers reported < 150 minutes of exercise per week.

Disordered Eating

Disordered eating was exhibited in 25.9% of undergraduates. Table 2 shows EAT-26 total and subscale scores based on sex and predominant exercise type. Females had higher EAT-26 total and dieting subscale scores (p = 0.033 and 0.022, respectively). Bulimia and food preoccupation and oral control subscales did not differ between sexes (p = 0.130 and 0.921, respectively). As shown in Table 2, effect sizes were small for EAT-26 total, dieting subscale, and bulimia and food preoccupation subscale scores (η^2 = 0.024-0.051).

One-way ANOVA revealed significant differences in EAT-26 total and all subscale scores based on exercise type. After using the Bonferroni method to correct for multiple comparisons, significant differences remained for EAT-26 total score ($p = 0.002$), as well as dieting and bulimia and food preoccupation subscale scores ($p = 0.015$ and 0.040, respectively), which were all higher in aerobic-predominant compared to anaerobic-predominant exercisers. Differences in oral control between exercise types were not significant after Bonferroni correction ($p = 0.163$ for aerobic- vs. anaerobic-predominant exercisers; 0.275 for aerobic-predominant vs. mixed exercisers; 0.110 for anaerobic-predominant exercisers vs. non-exercisers; 0.503 for mixed exercisers vs. non-exercisers; 1.000 for aerobic-predominant exercisers vs. non-exercisers and anaerobic-predominant exercisers vs. mixed exercisers). As shown in Table 2, effect sizes were medium for EAT-26 total and all subscale scores ($\eta^2 = 0.089$-0.133).

Muscle Dysmorphia

Muscle dysmorphia was exhibited in 7.1% of undergraduates. Table 2 shows MDDI total and subscale scores based on sex and predominant exercise type. Males had higher MDDI total ($p = 0.043$) and drive for size subscale ($p < 0.001$) scores, while females scored higher on the appearance intolerance subscale ($p < 0.001$). Functional impairment subscale scores did not differ between sexes ($p = 0.171$). As shown in Table 2, effect sizes were small for MDDI total and functional impairment subscale scores ($\eta^2 = 0.022$-0.032), and high for drive for size and appearance intolerance subscale scores ($\eta^2 = 0.203$-0.345).

Aerobic- and anaerobic-predominant exercisers had higher MDDI total ($p = 0.001$ and < 0.001, respectively) and functional impairment ($p < 0.001$ for both) subscale scores than non-exercisers. MDDI drive for size and appearance intolerance subscale scores were significantly higher in anaerobic-predominant exercisers than non-exercisers ($p < 0.001$ for both). Functional impairment subscale scores were significantly higher in all exercise groups compared to non-exercisers ($p < 0.001$ for aerobic- and anaerobic-predominant, 0.010 for mixed exercisers). As shown in Table 2, effect sizes were medium for MDDI appearance intolerance subscale score ($\eta^2 = 0.125$), and high for MDDI total, drive for size subscale, and functional impairment subscale scores ($\eta^2 = 0.024$-0.051).

Table 2. EAT-26 and MDDI scores by sex and exercise type.

	Overall (*n* = 111 - 112)	Female (*n* = 61 - 62)	Male (*n* = 46 - 47)	P-value	η^2	Aerobic (*n* = 7 - 8)	Anaerobic (*n* = 34 - 35)	Mixed (*n* = 11)	None (*n* = 57 - 58)	P-value	η^2
EAT-26 Total [a]	7.9 ± 7.5	9.2 ± 8.3	6.1 ± 6.0	0.033 *	0.045	15.6 ± 14.1	5.1 ± 5.0	7.4 ± 5.6	8.5 ± 7.1	0.002 *	0.133 †
Dieting	4.9 ± 5.2	5.9 ± 5.6	3.6 ± 4.4	0.022 *	0.051	9.6 ± 9.1	3.5 ± 4.1	6.1 ± 4.7	4.9 ± 4.9	0.020 *	0.094 †
Bulimia & Food Preoccupation	1.3 ± 2.6	1.6 ± 3.0	0.9 ± 1.7	0.130	0.024	3.3 ± 5.0	0.6 ± 1.1	0.4 ± 0.9	1.6 ± 2.8	0.017 *	0.091 †
Oral Control	1.7 ± 2.0	1.7 ± 2.0	1.6 ± 2.0	0.921	0.000	2.8 ± 2.4	1.0 ± 1.3	0.9 ± 2.1	2.0 ± 2.2	0.024 *	0.089 †
MDDI Total [b]	29.1 ± 7.8	27.8 ± 6.5	30.8 ± 9.0	0.043 *	0.032	35.5 ± 11.1	33.0 ± 7.0	30.5 ± 6.3	25.6 ± 6.1	< 0.001 *	0.250 †
Drive for Size	10.8 ± 4.9	8.2 ± 3.1	14.1 ± 5.0	< 0.001 *	0.345 †	12.3 ± 6.5	13.8 ± 4.7	9.9 ± 4.4	9.0 ± 3.9	< 0.001 *	0.204 †
Appearance Intolerance	10.4 ± 4.4	12.1 ± 4.4	8.3 ± 3.4	< 0.001 *	0.203 †	12.4 ± 7.0	8.3 ± 3.2	11.8 ± 3.9	11.1 ± 4.3	0.006 *	0.125 †
Functional Impairment	7.9 ± 3.9	7.4 ± 3.7	8.4 ± 4.0	0.171	0.022	10.9 ± 4.8	10.8 ± 3.4	8.8 ± 2.8	5.6 ± 2.5	< 0.001 *	0.415 †

Mean ± SD. * Indicates $p < 0.05$. † Indicates medium (0.06 - 0.13) to large (≥ 0.14) effect sizes. 3 people did not specify sex. Ranges in the sample size indicate sections where EAT-26 or MDDI questions were not answered by participants. Aerobic-predominant exercisers engaged in ≥ 150 minutes of exercise per week with ≥ 50% of time spent in aerobic activities. Aerobic-predominant exercisers engaged in ≥ 150 minutes of exercise per week with ≥ 50% of time spent in aerobic activities. Anaerobic-predominant exercisers engaged in ≥ 150 minutes of exercise per week with ≥ 50% of time spent in anaerobic activities. Mixed exercisers engaged in ≥ 150 minutes of exercise per week with < 50% of time spent in aerobic, anaerobic, and flexibility activities. None or non-exercisers reported < 150 minutes of exercise per week.

[a] EAT-26 total scores ranged from 0 (minimum) to 80 (maximum). Possible subscales scores ranged from 0 to 39 for dieting, 0 to 18 for bulimia and food preoccupation, and 0 to 21 for oral control.

[b] MDDI total scores ranged from 0 (minimum) to 65 (maximum). Possible subscale scores ranged from 0 to 25 for drive for size and 0 to 20 for both appearance intolerance and functional impairment.

DISCUSSION

This study sought to evaluate the prevalence of disordered eating and muscle dysmorphia in college students who engage in at least 150 minutes of regular exercise per week and those who do not. Specifically, differences in these conditions between sex (male vs. female) and primary exercise type (aerobic-predominant, anaerobic-predominant, flexibility-predominant, mixed vs. none) were characterized. As hypothesized, the present study found that males had a higher self-perceived ideal body weight than females. This finding is similar to previous research, indicating males' preference for a larger, more muscular physique compared to females who desire a smaller, thinner body (9). Males in this study engaged in more anaerobic activities than females, but total aerobic and flexibility minutes between sexes did not significantly vary. These results indicate that males exercise for a greater amount of time than females, when combining aerobic, anaerobic, and flexibility exercise minutes.

Aligning with previous research (2, 14), this study found an increased risk for disordered eating in females and muscle dysmorphia in males. Males expressed a greater desire to be bigger compared to females, as their drive for size subscale scores were higher. Previous studies found that men feel the need to gain weight and become heavier, whereas women oppose this notion (1). Again, this corresponds to the media's popular depiction of what defines an "ideal" male and female body.

Much variability was found between exercise types. Anaerobic-predominant exercisers expressed the greatest current, highest, lowest, and self-perceived ideal body weight in comparison to other groups. This is likely due to a focus on gaining muscle mass and power through these types of workouts. Additionally, the anaerobic group engaged in not only more total anaerobic exercise minutes, but also more total aerobic exercise minutes compared to non-exercisers. These findings suggest that predominantly anaerobic exercisers spent the most total time exercising compared to all other groups. As predicted, mixed exercisers expressed the most balanced workout schedule.

Aerobic-predominant exercisers expressed the highest risk for disordered eating in this study. As previously mentioned, this could be a result of aerobic activities' focus on burning calories and losing weight, much like the mentality of patients with eating disorders (5). Interestingly, both aerobic and anaerobic exercisers were identified to be at an increased risk for muscle dysmorphia. This is a novel finding, as most research has focused on muscle dysmorphia in weightlifters and body builders (22, 29, 30). In fact, functional impairment scores were higher in all exercise groups compared to non-exercisers. This finding indicates that all types of regular exercise may change how an individual prioritizes daily activities and may reach a level that could be considered disordered.

Taken together, non-exercisers were largely unaffected by disordered eating and muscle dysmorphia. A previous study found a positive correlation between self-objectification and frequency of working out at the gym (26). Thus, the more an exerciser visited the gym, the more negatively they felt about their bodies. Similarly, it has been previously noted that it is not uncommon to find pathological behaviors amongst regular gym goers (27). In fact, individuals who engage in regular physical activity tend to pay extra attention to their body shapes, eating, and exercise habits (13). This suggests that abstaining from exercise could help prevent distorted body image and the possible resulting conditions of disordered eating and muscle dysmorphia. However, this should be interpreted with caution since exercising is part of a healthy lifestyle and most people do not even meet exercise recommendations.

Limitations: Several limitations must be noted. This study has low generalizability to the general population since a college-aged sample was used. Additionally, the university where the sample was drawn from consists of predominantly white, middle class individuals, creating a lack of demographic diversity. Measures, including time spent engaging in specific activities, were self-reported, creating the possibility of inaccurate results. Furthermore, this study only had participants evaluate their total exercise minutes rather than total physical activity minutes. Participants were not asked to characterize exercise intensity (e.g., moderate, high), or instructed to include lifestyle activities (e.g., parking farther away, taking stairs). This could have led to active individuals being excluded from the exerciser group. Also, this study was not powered to detect a small effect size. Using an $\alpha = 0.05$ and a power of 0.80, a total sample size of 788 (394 per group) participants would have been required to detect an effect size of 0.2. Finally, there was a lack of flexibility predominant-exercisers so levels of disordered eating and muscle dysmorphia in this group could not be assessed.

Implications: This study found that both aerobic and anaerobic exercisers are at an increased risk for muscle dysmorphia, which is a novel finding. Future research should focus on expanding the current knowledge on the prevalence of disordered eating and muscle dysmorphia in all individuals who regularly exercise, not just college students. Since this is the first study identifying muscle dysmorphia in aerobic exercisers, more studies should be conducted looking specifically at this population.

Conclusions: Overall, disordered eating was found in over a quarter of undergraduate participants, and muscle dysmorphia was exhibited in approximately seven percent. A higher degree of disordered eating and muscle dysmorphia was found in exercisers, which warrants early detection and treatment screenings in this group of individuals. This study is noteworthy because it identifies that all regular exercisers are at a greater risk for muscle dysmorphia when compared with non-exercisers. Furthermore, results from this study support the need for appropriate resources for those suffering from these disorders. This could come in the form of hiring a part-time or full-time registered dietitian onto the recreational sports center's staff. It may also be beneficial for college gyms to advertise additional resources for mental health, such as free psychological counseling for students.

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