

ORIGINAL ARTICLE

Muscle dysmorphia symptomatology is prospectively associated with suicidal thoughts, suicidal behaviors, and non-suicidal self-injury among a sample of Canadian adolescents and young adults

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Abstract

Introduction: Limited, primarily cross-sectional research has identified associations between muscle dysmorphia and suicidal thoughts suicidal behaviors, and non-suicidal self-injury (NSSI). This study aimed to investigate the associations between muscle dysmorphia and suicidal thoughts, suicidal behaviors, and NSSI prospectively over a 1-year period among a large, diverse sample of Canadian adolescents and young adults.

Methods: Data from wave one (2021) and wave two (2022) of the Canadian Study of Adolescent Health Behaviors were analyzed ($N=912$). Multiple modified Poisson regression analyses were used to determine the associations between muscle dysmorphia symptomatology at wave one and three items of suicidal thoughts and behaviors and one item of NSSI at wave two. Unadjusted models and adjusted models were estimated.

Results: Total muscle dysmorphia symptomatology and symptoms of Appearance Intolerance were prospectively associated with suicidal ideation and suicide planning at 12-month follow-up. These findings were significant across unadjusted and adjusted models.

Conclusions: Findings from this study expand prior research and underscore the clinical complexity of muscle dysmorphia. Future research should investigate mechanisms explaining the association between muscle dysmorphia and suicide and develop interventions to prevent suicide among people with muscle dysmorphia.

KEYWORDS

adolescents, Canada, muscle dysmorphia, suicidal ideation, suicide attempts, suicide planning

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INTRODUCTION

Muscle dysmorphia is categorized as a specifier of body dysmorphic disorder (*American Psychiatric Association, 2022*). There are several core features of muscle dysmorphia, which overall encompass the pathological pursuit of muscularity, including compulsive exercise and weight training, dieting practices to build and maintain muscularity, use of appearance- and performance-enhancing drugs and substances (APEDS), and overall functional impairment (Cafri et al., 2008; Pope et al., 1997, 2005). Additionally, a primary characteristic of muscle dysmorphia is the significant preoccupation with insufficient muscle size and definition, resulting in marked distress, as well as a significant drive for muscularity (*American Psychiatric Association, 2022*; Pope et al., 1997). Muscle dysmorphia is a severe psychiatric condition with significant comorbidity, including mood and anxiety disorders and polysubstance use (Cafri et al., 2008; Ganson et al., 2023; Olivardia et al., 2000; Pope et al., 2005). Much of the prior research on muscle dysmorphia has focused on bodybuilders (Cafri et al., 2008; Mitchell et al., 2017; Olivardia et al., 2000; Pope et al., 2005), and there has been little data on large community samples, including in Canada. Thus, research is needed to describe the presentation of muscle dysmorphia using epidemiological data, which will inform prevention efforts and assessment and treatment procedures.

Studies examining the prevalence of muscle dysmorphia among the general population remain sparse. However, one recent study among a population-based sample of Australian adolescents between the ages 11 and 20 years estimated a point prevalence of muscle dysmorphia based on clinical diagnostic criteria to be 2.2% and 1.4% among adolescent boys and girls, respectively (Mitchison et al., 2021). Among a community sample of Canadian adolescents and young adults ages 16–30 years, it has recently been reported that 26% of boys and young men, 18% of transgender and gender-expansive people, and 11% of girls and young women were at clinical risk for muscle dysmorphia (i.e., displaying clinically relevant symptomatology based on the Muscle Dysmorphic Disorder Inventory) (Ganson et al., 2023). In a research review, it has been documented that roughly 2% of males in the United States have body dysmorphic disorder, and of those with body dysmorphic disorder between 9% and 25% have muscle dysmorphia (Phillips et al., 2010). These data underscore, first, that there are no well-established assessment procedures for muscle dysmorphia, and second, that future investigation on muscle dysmorphia in the general population is warranted.

While prior research has documented that those with muscle dysmorphia experience significant psychiatric

comorbidity, a limited body of research has begun to investigate the association between muscle dysmorphia and suicidal thoughts and behaviors, including suicidal ideation and suicide attempts. For example, among a clinical sample of men diagnosed with muscle dysmorphia, 50% had reported a lifetime suicide attempt (Pope et al., 2005). Recent research has documented the association between muscle dysmorphia symptomatology, suicidal ideation, and a history of suicide attempts among males (Grunewald, Troop-Gordon, & Smith, 2022; Ortiz et al., 2021; Ortiz, Grunewald, Forrest, & Smith, 2023). Using a cohort study, prior research reported associations between muscle dysmorphia and suicidal ideation among males cross-sectionally, and that suicidal ideation predicted increased Appearance Intolerance and Drive for Size symptomatology prospectively over a 6-week period (Grunewald, Ortiz, et al., 2022; Grunewald, Troop-Gordon, & Smith, 2022). Additionally, among an adult sample of individuals meeting clinical criteria for muscle dysmorphia, the prevalence of suicidal ideation and a history of suicide attempts was higher than national averages (Ortiz, Grunewald, Forrest, & Smith, 2023). This study also found that disgust, body dissatisfaction, perceived burdensomeness, and intrusive thoughts were key components of both muscle dysmorphia and comorbidity networks (Ortiz, Grunewald, Forrest, & Smith, 2023). Finally, muscle dysmorphia symptomatology have been reported to be associated with suicidal ideation through the mechanism of perceived burdensomeness (Ortiz, Grunewald, Morgan, & Smith, 2023), a core construct of the Interpersonal Theory of Suicide (Van Orden et al., 2010). Aside from research on muscle dysmorphia and suicidal thoughts and behaviors, prior research has documented that people with body dysmorphic disorder are more likely to report suicidal ideation and suicide attempts compared to those without the disorder (Buhlmann et al., 2010; Phillips et al., 2005; Rief et al., 2006).

Muscle dysmorphia and suicidal thoughts, suicidal behaviors, and non-suicidal self-injury (NSSI) may be connected via multiple theoretical explanations. For example, experiencing muscle dysmorphia symptomatology may cause significant distress and impairment (Cafri et al., 2008; Ganson et al., 2023; Olivardia et al., 2000; Pope et al., 2005), as well as impact one's ability to regulate emotions (Murray et al., 2012). The combination of distress, impairment, and emotion regulation challenges may lead to suicidal thoughts, suicidal behaviors, and NSSI as grounded in theories of suicide and self-injury (Klonsky et al., 2018; Nock, 2010). Furthermore, aligning with notions of the Interpersonal-Psychological Theory of Suicide (Van Orden et al., 2010), individuals who experience muscle dysmorphia symptomatology

may also experience significant impairments in social functioning, which may in turn lead to experiences of thwarted belongingness from reduced social relationships due to pursuits of muscularity (i.e., excessive exercise). Additionally, these individuals may experience perceived burdensomeness, particularly if the symptoms impair occupational functioning, resulting in financial burden and interpersonal conflict related to the obsessive-compulsive nature of the symptoms (i.e., obsessions and control related to food, relying on others to provide reassurance on one's body) (Ortiz, Grunewald, Forrest, & Smith, 2023). Given these theoretical underpinnings, this study specifically conceptualized that muscle dysmorphia symptomatology would predict suicidal thoughts, suicidal behaviors, and NSSI, despite prior research investigating the reverse directionality (Grunewald, Ortiz, et al., 2022; Grunewald, Troop-Gordon, & Smith, 2022).

The research on muscle dysmorphia and suicidal thoughts, suicidal behaviors, and NSSI indicates that future investigation is needed to fill important gaps in the knowledge base. First, most studies investigating the association between muscle dysmorphia and suicidal thoughts and behaviors are limited to relatively small samples of males, often neglecting to include girls and women and transgender and gender-expansive people. Additionally, most studies are limited to cross-sectional analyses, with few studies assessing the association between muscle dysmorphia and suicidal thoughts and behaviors prospectively over time (i.e., 6 weeks). Analyzing data over a longer period (i.e., 1 year) may allow for greater suicidal thoughts and behaviors to emerge. Finally, prior research has primarily focused on suicidal ideation and suicide attempts, and neglects to include suicide planning and NSSI (i.e., direct and intended self-harm without the intent to die) (Nock, 2010), both of which have important implications for suicide intervention given they may represent an escalation of suicide risk (Hawton et al., 2012; O'Connor & Kirtley, 2018).

Given these gaps, this study aimed to determine the association between muscle dysmorphia symptoms and suicidal ideation, suicide planning, suicide attempts, and NSSI prospectively over 1 year among a large, diverse sample of Canadian adolescents and young adults. We specifically assess the associations between Functional Impairment, Appearance Intolerance, and Drive for Size symptoms, as well as total muscle dysmorphia symptomatology, and suicidal thoughts, suicidal behaviors, and NSSI given that there may be unique associations that cluster around specific muscle dysmorphia symptomatology. Identifying these unique associations may provide important areas of prevention and intervention, as well as future investigation. It was hypothesized that

there would be significant associations between muscle dysmorphia symptomatology and suicidal thoughts, suicidal behaviors, and NSSI. Additionally, we conduct sensitivity analyses to determine the reverse directionality of the associations.

MATERIALS AND METHODS

The study utilized data from waves one and two of the Canadian Study of Adolescent Health Behaviors. This research involved participants from across Canada, focusing on adolescents and young adults between the ages of 16 and 30 years. The recruitment of the first wave occurred in November and December 2021 through Instagram and Snapchat advertisements, with no specific target criteria. The second wave of data collection took place 1 year later (i.e., November and December 2022). Participants who chose to participate in wave two from the first wave were contacted via email. Wave one included 2731 valid participants, of which 940 completed wave two. Twenty-eight participants were excluded from this analysis due to completing the survey in ≤ 10 min, resulting in a final analytic sample of 912 valid participants. Survey data were collected using the online platform Qualtrics. To incentivize participation, participants had the opportunity to enter a draw for one of three Apple iPads. To ensure the quality of data, several measures were implemented, including the use of reCAPTCHA verification, attention checks, and honeypot items (i.e., survey items that are only visible to bots) (Xu et al., 2022). Additionally, Qualtrics features were enabled to prevent participants from taking the survey multiple times and to ensure that the survey would not appear in search engine results. The study received ethics approval from the University of Toronto research ethics board (#41707), and informed consent was obtained from all participants through a checkbox option.

Measures

Muscle dysmorphia symptomatology

The Muscle Dysmorphic Disorder Inventory (MDDI) is a 13-item measure that assesses symptoms of muscle dysmorphia (Hildebrandt et al., 2004). The MDDI uses a five-point Likert-type scale (1 = never; 5 = always) and scores are calculated by summing the 13 scale items, with a higher score indicating greater symptom severity of muscle dysmorphia. Additionally, the MDDI encompasses three subscales. First, the Drive for Size

subscale was designed to measure a desire to increase the muscular bulk (e.g., “I wish I could get bigger.”). Second, the Appearance Intolerance subscale was designed to measure both dissatisfaction and avoidance associated with appearance (e.g., “I feel like I have too much body fat.”). Finally, the Functional Impairment subscale was designed to measure the impairment associated with muscle dysmorphia symptomatology, such as excessive exercising (e.g., “I feel depressed when I miss one or more workout days.”) (Hildebrandt et al., 2004). MDDI scores were assessed at wave one. Internal reliability using Cronbach's alpha was good for the MDDI total score ($\alpha = 0.79$), Drive for Size subscale ($\alpha = 0.87$), Appearance Intolerance subscale ($\alpha = 0.85$), and Functional Impairment subscale ($\alpha = 0.84$) among the sample at wave one.

Suicidal thoughts, suicidal behaviors, and NSSI

Three domains of suicidal thoughts and behaviors, including suicidal ideation, suicide planning, and suicide attempts and NSSI were measured for the past 12-months at wave one and two. To measure suicidal ideation, participants were asked over the past 12 months, “did you ever seriously think about attempting suicide,” with response options, “no” and “yes”. To measure suicide planning, participants were asked over the past 12 months, “did you make a plan for how you would attempt suicide,” with response options, “no” and “yes”. To measure suicide attempts, participants were asked over the past 12 months, “how many times did you actually attempt suicide,” with response options ranging from “0 times” to “15 or more times,” increasing incrementally by one. Given small cell sizes, this item was dichotomized as no suicide attempts and one or more suicide attempts. To measure NSSI, participants were asked, whether they engaged in any self-harming behaviors with 12 response options, including “bit myself,” “burned myself,” “cut myself,” and “had others hurt me,” among others. This item was dichotomized to no NSSI and any NSSI. These items align with prior survey research (Centers for Disease Control and Prevention, 2023; Eisenberg & Lipson, 2023).

Sociodemographic variables

Sociodemographic variables included self-reported age, race/ethnicity, gender (cisgender girl and young woman, cisgender boy and young man, transgender/gender expansive), sexual orientation, personal income, and highest level of education completed.

Statistical analysis

Descriptive statistics were used to characterize the sample. Multiple modified Poisson regression analyses with robust error variance, with coefficients transformed to prevalence ratios (which are equivalent to risk ratios) (Zou, 2004), were used to determine whether there were significant associations between wave one muscle dysmorphia symptomatology, including separate analyses for the three subscales and total score, and wave two suicidal thoughts and behaviors (suicidal ideation, suicide planning, suicide attempts) and NSSI. Modified Poisson regression analyses were used given that the outcome variables are binary and that three of the four dependent variables occurred over 10%, which ensures that the effect sizes are not overinflated (Zou, 2004). Additionally, this approach is considered an appropriate alternative to logistic regression given that the prevalence ratio is easier to interpret (Fekedulegn et al., 2010). For each analysis, three models were used to examine (1) unadjusted associations, (2) associations adjusting for the sociodemographic variables and for the corresponding wave one suicidal thoughts, suicidal behavior, and NSSI, and (3) associations adjusting for the sociodemographic variables and excluding those with the corresponding wave one suicidal thoughts, suicidal behavior, and NSSI (to maximize the robustness of the analyses and to identify new-onset suicidal thoughts, suicidal behaviors, and NSSI). Thus, there were a total of 48 individual models. We tested for interaction by gender and there were no significant findings. Therefore, we did not stratify our analyses by gender.

Additionally, we conducted sensitivity analyses to determine the reverse directionality of the associations (i.e., wave one suicidal thoughts, suicidal behaviors, and NSSI and wave two MDDI scores). For each supplementary analysis, three models were used to examine (1) unadjusted associations, (2) associations adjusting for the sociodemographic variables only, and (3) associations adjusting for the sociodemographic variables and corresponding MDDI score at wave one. Statistical significance was determined using the Benjamini–Hochberg procedure with a 10% false-discovery rate (FDR) (Benjamini & Hochberg, 1995; Thissen et al., 2002; Williams et al., 1999). Note that 20% and 25% FDRs were tested, and the results remained the same. Listwise deletion was used to handle missing data due the sample size being relatively large and the data being missing completely at random ($p > 0.05$ on Little's MCAR test). This technique is robust to the missing at random assumptions and raises minimal issues with statistical power given the sample size of the study (Allison, 2002; Parent, 2013). Additionally, using independent samples *t*-tests and chi-square tests, there were no significant

differences between those included versus those missing in this study (see Table S1 for missingness per study variable). All analyses were conducted using Stata 17.

RESULTS

The sample had an average age of 23.4 years ($SD = 3.8$), consisting of 57.4% cisgender girls and young women, 33.8% cisgender boys and young men, and 8.8% transgender or gender expansive individuals. Most participants identified as White (62.2%) and heterosexual (55.1%). The average MDDI total score in wave one was 31.1 ($SD = 7.9$). At wave two, 20.6% of participants experienced suicidal ideation in the past 12-months, 9.6% made a suicide plan in the past 12 months, 2.2% attempted suicide in the past 12 months, and 36.1% of participants engaged in NSSI in the past 12 months. See Table 1 for full sample characteristics.

There were several significant prospective associations between muscle dysmorphia symptomatology at wave one and suicidal thoughts, suicidal behaviors, and NSSI 12-months later at wave two (Table 2). Greater total symptoms of muscle dysmorphia and symptoms of Appearance Intolerance were prospectively associated with higher prevalence of suicidal ideation and suicidal planning across all three models. For example, in Model 2, a one unit increase on the Appearance Intolerance subscale at wave one is associated with an 8% (95% CI 1.03–1.14) increase in prevalence of suicidal ideation at wave two, adjusting for the sociodemographic variables and wave one suicidal ideation. Greater total symptoms of muscle dysmorphia and symptoms of Appearance Intolerance were prospectively associated with higher prevalence of NSSI in unadjusted models only, while only greater symptoms of Appearance Intolerance were associated with any suicide attempts in unadjusted models.

Results from sensitivity analyses (Table S2) showed similar findings to the main analyses. Specifically, significant findings clustered with Appearance Intolerance and total symptoms of muscle dysmorphia for unadjusted models and models adjusting for sociodemographic variables. Notably, however, there were no significant findings between suicidal thoughts, suicidal behaviors, and NSSI and muscle dysmorphia symptomatology when adjusting for sociodemographic variables and corresponding wave one MDDI scores.

DISCUSSION

The findings from this study extend the limited prior research on muscle dysmorphia and suicidal thoughts

TABLE 1 Demographic characteristics of participants from the Canadian Study of Adolescent Health Behaviors ($N = 912$).

	<i>n</i> (%)
Age (mean [SD])	23.4 (3.8)
Race/ethnicity	
White	567 (62.2)
Black	32 (3.5)
Asian	156 (17.1)
Multi-racial	100 (10.9)
Other	56 (6.2)
Gender	
Cisgender girl or young woman	520 (57.4)
Cisgender boy or young man	306 (33.8)
Transgender/gender expansive person	80 (8.8)
Sexual orientation	
Heterosexual	500 (55.1)
Gay/lesbian	84 (9.3)
Bisexual	160 (17.6)
Queer, questioning, or other	164 (18.1)
Personal income	
\$0–24 k	421 (46.6)
\$25–49 k	176 (19.5)
\$50–74 k	154 (17.0)
\$75 k+	153 (16.9)
Highest completed education	
High school diploma or less	304 (33.4)
Undergraduate/college degree	440 (48.4)
Master's degree or higher	165 (18.2)
MDDI scores (wave one)	
Drive for size (mean [SD])	10.5 (5.1)
Appearance Intolerance (mean [SD])	12.0 (4.3)
Functional Impairment (mean [SD])	8.5 (3.8)
MDDI total score (mean [SD])	31.1 (8.0)
At risk for muscle dysmorphia (≥ 40 on MDDI; wave one)	129 (14.3)
Suicidal thoughts and behaviors, past 12-months (wave one)	
Suicidal ideation	230 (25.3)
Suicide planning	117 (12.9)
Any suicide attempt	26 (2.9)
Any NSSI, past 12-months (wave one)	353 (39.8)
Suicidal thoughts and behaviors, past 12-months (wave two)	
Suicidal ideation	178 (20.6)
Suicide planning	81 (9.6)
Any suicide attempt	19 (2.2)
Any NSSI, past 12-months (wave two)	306 (36.1)

Abbreviations: MDDI, Muscle Dysmorphic Disorder Inventory; NSSI, Non-suicidal self-injury; SD, standard deviation.

TABLE 2 Associations between wave one MDDI scores and suicidal thoughts, suicidal behaviors, and NSSI at 1-year follow-up among participants in the Canadian Study of Adolescent Health Behaviors.

	Model 1: Suicidal thoughts, suicidal behaviors, and NSSI at 1-year follow-up, unadjusted		Model 2: Suicidal thoughts, suicidal behaviors, and NSSI at 1-year follow-up, adjusting for the sociodemographic variables and corresponding suicidal thoughts, suicidal behaviors, and NSSI at wave one		Model 3: Suicidal thoughts, suicidal behaviors, and NSSI at 1-year follow-up, adjusting for the sociodemographic variables and excluding participants endorsing the corresponding suicidal thoughts, suicidal behaviors, and NSSI at wave one	
	PR (95% CI)	<i>p</i> -value	PR (95% CI) ^a	<i>p</i> -value	PR (95% CI) ^a	<i>p</i> -value
Suicidal Ideation						
Drive for Size	0.98 (0.95–1.01)	0.126	1.01 (0.98–1.06)	0.436	1.03 (0.96–1.11)	0.377
Appearance Intolerance	1.15 (1.11–1.20)	<0.001	1.08 (1.03–1.14)	0.001	1.13 (1.05–1.22)	0.001
Functional Impairment	1.02 (0.98–1.06)	0.285	1.01 (0.97–1.05)	0.576	1.03 (0.95–1.12)	0.425
MDDI total score	1.04 (1.02–1.06)	<0.001	1.03 (1.01–1.05)	0.010	1.05 (1.01–1.11)	0.021
Suicide Plans						
Drive for Size	0.97 (0.93–1.02)	0.238	1.03 (0.97–1.10)	0.286	0.98 (0.88–1.10)	0.969
Appearance Intolerance	1.24 (1.17–1.32)	<0.001	1.12 (1.04–1.21)	0.003	1.24 (1.09–1.40)	0.001
Functional Impairment	1.02 (0.97–1.08)	0.425	1.02 (0.96–1.09)	0.428	1.03 (0.93–1.15)	0.572
MDDI total score	1.05 (1.02–1.08)	<0.001	1.05 (1.01–1.09)	0.006	1.07 (1.01–1.13)	0.026
Suicide Attempt						
Drive for Size	1.03 (0.95–1.12)	0.498	1.09 (0.94–1.28)	0.260	0.88 (0.67–1.15)	0.350
Appearance Intolerance	1.17 (1.05–1.31)	0.007	1.04 (0.88–1.22)	0.674	1.70 (0.91–3.19)	0.095
Functional Impairment	1.01 (0.90–1.13)	0.870	0.93 (0.79–1.08)	0.338	0.90 (0.68–1.19)	0.475
MDDI total score	1.06 (1.00–1.11)	0.039	1.01 (0.92–1.11)	0.835	1.00 (0.86–1.16)	0.987
Non-suicidal self-injury						
Drive for size	0.97 (0.95–0.99)	0.016	1.00 (0.96–1.03)	0.884	1.03 (0.96–1.11)	0.395
Appearance Intolerance	1.10 (1.07–1.13)	<0.001	1.03 (0.99–1.06)	0.088	1.09 (0.99–1.19)	0.057
Functional Impairment	1.01 (0.98–1.04)	0.611	1.00 (0.97–1.03)	0.931	1.04 (0.96–1.12)	0.366
MDDI total score	1.02 (1.00–1.03)	0.010	1.01 (0.99–1.03)	0.364	1.02 (0.98–1.07)	0.215

Note: Each cell represents the abbreviated outputs of 48 separate modified Poisson regression models with muscle dysmorphia symptomatology (measured using the MDDI total score and three subscales in separate models) as the independent variables and suicidal thoughts, suicidal behaviors, and NSSI as the dependent variables (in separate models). Boldface indicates statistical significance using the Benjamini–Hochberg procedure with a 10% false-discovery rate.

Abbreviations: NSSI, Non-suicidal self-injury; PR, prevalence ratio; CI, confidence interval; MDDI, Muscle Dysmorphic Disorder Inventory.

^aAdjusted for race/ethnicity, gender, sexual orientation, income, and highest completed education.

and behaviors. Overall, findings documented the prospective association between total muscle dysmorphia symptomatology and suicidal ideation and suicide planning. Importantly, these findings remained even when adjusting for relevant sociodemographic variables, as well as adjusting for, or removing, participants with the corresponding wave one suicidal thought or behavior. These results remained the same for symptoms of Appearance Intolerance. These findings partially align with study hypothesis and add to the growing literature on muscle dysmorphia and suicidal thoughts and behaviors by including a gender and racially/ethnically diverse, non-clinical sample of adolescents and young adults in Canada,

as well as including multiple items assessing suicidal thoughts, suicidal behaviors, and NSSI. Furthermore, the significant findings from sensitivity analyses underscore the bidirectional relationship between muscle dysmorphia symptomatology and suicidal thoughts and behaviors.

The findings from this study align with prior research among the US men that have shown that muscle dysmorphia symptomatology is associated with suicidal ideation (; Grunewald, Ortiz, et al., 2022; Ortiz et al., 2021). This prior research also found that there was a positive longitudinal relationship between suicidal ideation and Appearance Intolerance (Grunewald, Ortiz, et al., 2022; Grunewald, Troop-Gordon, & Smith, 2022), which

aligns with the findings of our study. The current study extends this research by showing associations between total muscle dysmorphia symptomatology and suicidal ideation and suicide planning over a 12-month period. The association between muscle dysmorphia symptomatology, specifically Appearance Intolerance, and suicidal ideation and suicide planning may be due to the significant distress related to body dissatisfaction. Thus, individuals may contemplate suicide as a means to alleviate this distress and their intense focus on their body. Indeed, prior research has documented that body dissatisfaction is a predictor of suicidal ideation (Perkins & Brausch, 2019; Rufino et al., 2018). Interestingly, however, the current study did not find any positive association between Drive for Size and suicidal thoughts and behaviors, which was positively associated in prior research (Grunewald, Ortiz, et al., 2022; Grunewald, Troop-Gordon, & Smith, 2022). It may be that the specific means to pursue muscularity (i.e., weight training and exercise) act as protective factors for suicidal thoughts and behaviors. For example, physical exercise may be a means of emotion regulation and stress reduction, which may reduce suicidal thoughts and behaviors.

The findings in this study may be explained by multiple mechanisms that link with important implications for intervention. First, the association between muscle dysmorphia symptomatology and suicidal ideation and suicide planning may be the result of the significant burden of muscle dysmorphia symptomatology, whereby individuals think about and plan for suicide as a means of ending psychological distress (Klonsky et al., 2016). It has previously been described that muscle dysmorphia causes individuals to experience significant distress and functional and social impairment (Pope et al., 1997; Tod et al., 2016), which may increase the risk of suicidal ideation and planning as outlined by the Three-Step Theory of suicide (Klonsky & May, 2015). Therefore, early identification and treatment of muscle dysmorphia is warranted as this may reduce the significant burden and distress individuals experience. While there is little data on effective clinical interventions for muscle dysmorphia (Grunewald & Blashill, 2021), cognitive behavioral therapy has strong empirical support for body dysmorphic disorder (Harrison et al., 2016), which aligns with cognitive behavioral approaches to treating suicidal thoughts and behaviors (Klonsky et al., 2016; Wu et al., 2022).

Second, intense symptoms related to Appearance Intolerance, which is operationalized as dissatisfaction and avoidance associated with appearance, may be a key factor linking muscle dysmorphia symptomatology and suicidal ideation and suicide planning. Indeed, it has previously been proposed that negative views of one's body increases the risk of suicidal thoughts and behaviors

(Orbach, 1996), which has been empirically demonstrated (Brausch & Muehlenkamp, 2007; Crow et al., 2008; Rufino et al., 2018). Therefore, reducing body dissatisfaction (i.e., Appearance Intolerance) through dissonance-based programming may be beneficial (Brown et al., 2017; Stice et al., 2019) to reducing future suicidal thoughts and behaviors.

Lastly, individuals who experience muscle dysmorphia symptomatology may perceive themselves to be a burden to others. This may occur if symptoms impair occupational functioning and reduce income or increase interpersonal conflict due to seeking reassurance from others regarding one's body. This perceived burdensomeness may further increase the risk of suicidal thoughts and behaviors, as outlined by the Interpersonal-Psychological Theory of Suicide (Van Orden et al., 2010). In fact, recent research has confirmed the link between perceived burdensomeness and suicidal thoughts and behaviors among people with muscle dysmorphia (Ortiz, Grunewald, Forrest, & Smith, 2023).

Interestingly, there was a lack of association between Functional Impairment scores and suicidal thoughts, suicidal behaviors, and NSSI in this study. Given the significant distress and impairment associated with muscle dysmorphia, it would be presumed that these individuals may experience suicidal thoughts, suicidal behaviors, and NSSI, underpinned by major theories of suicide and self-injury (Klonsky et al., 2018; Nock, 2010; Van Orden et al., 2010). It may be that the specific impairment that is being measured via the MDDI (i.e., displaced social and occupational time for exercise) is not aligned with the type of impairment that would increase the risk for suicide, such as emotional or psychological difficulties (Klonsky et al., 2016). Indeed, further investigation related to this lack of association is needed. While the findings were not significant across all models in our study, it should be noted that there were significant unadjusted, prospective associations between muscle dysmorphia symptomatology and suicide attempts (Appearance Intolerance) and NSSI (Appearance Intolerance and MDDI total score). Prior research has documented that individuals with muscle dysmorphia are significantly more likely to report a lifetime suicide attempt (Ortiz, Grunewald, Forrest, & Smith, 2023; Pope et al., 2005), and people with body dysmorphic disorder are also more likely to report a suicide attempt (Buhlmann et al., 2010; Phillips et al., 2005; Rief et al., 2006). Ultimately, future investigation is needed, particularly among a larger sample, to investigate these associations.

Furthermore, there were significant unadjusted, prospective associations between muscle dysmorphia symptomatology and NSSI, which represents a novel preliminary finding given that no prior research has

investigated this association. This finding is intriguing and may be explained by theoretical notions explaining of NSSI. For example, given the significant distress and impairment associated with muscle dysmorphia, NSSI may be a mechanism to regulate emotions (Nock, 2010). However, future research is warranted given that there were no significant associations between muscle dysmorphia symptomatology and NSSI in adjusted models.

Despite the important findings of this study, there are limitations to be noted. The data are from a convenience sample of participants, which reduces external validity. However, the sample is diverse across genders, racial and ethnic identities, and education levels, and prevalence of suicidal thoughts and behaviors closely matched national estimates (Gaylor et al., 2023; Government of Canada, 2023). Furthermore, participants represented all but 1 of the 13 provinces and territories in Canada (excluding Prince Edward Island). There was a significant amount of attrition from wave one to wave two, which introduces potential bias (i.e., non-response bias) that should contextualize the findings. The suicidal ideation item reflects active suicidal ideation but not passive suicidal ideation. Therefore, affirmative responses of suicidal ideation may be artificially decreased, which should contextualize the findings. For example, participants who wished they did not wake up in the morning or wished their life would end could have selected “no” to the suicidal ideation item if they did not interpret these as having “seriously considered” suicide. While the data in the study was analyzed prospectively across 1 year, the findings should not be interpreted as causally linked and there is the potential for unmeasured confounders. The data are based on self-report, which may increase the risk of reporting, social desirability, and recall bias. However, this study used multiple measures of suicidal thoughts and behaviors, including those used in prior research, as well as the most commonly used measure of muscle dysmorphia symptomatology (Grunewald & Blashill, 2021).

CONCLUSION

This study is the first to document prospective associations between muscle dysmorphia symptomatology and suicidal thoughts and behaviors, namely suicidal ideation and suicide planning, among a large, community sample of Canadian adolescents and young adults. These findings expand prior research and continue to emphasize the clinical complexity and severity of muscle dysmorphia symptomatology. Clinical assessments and interventions are needed to reduce the risk of suicidal thoughts and behaviors among people who experience muscle dysmorphia symptomatology, and future research is needed

to continue to identify mechanisms that explain these associations.

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CONFLICT OF INTEREST STATEMENT

All authors report no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data may be made available upon reasonable request.

ETHICS STATEMENT

This study received ethics approval from the University of Toronto Health Sciences Research Ethics Board (#41707).

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