

RESEARCH

Open Access



The association between comorbid body dysmorphic disorder and depression: moderation effect of age and mediation effect of body mass index and body image among Pakistani students

Arsalan Haider^{1,2,3*} , Zhang Wei¹, Shagufta Parveen² and Arshad Mehmood⁴

Abstract

Background American Psychological Association defined body dysmorphic disorder as being obsessed with observed (preoccupied) flaws in one's appearance. The observed flaws cause ample distress and/or worsening in the quality of life, isolation, lessening in social or professional functioning, while also being linked to depression and attempt suicide. Generally, younger individuals are more displeased and anxious about defects that can be seen or unseen. The study aimed to explore the predictive role of body mass index and body image in the relationship between comorbid body dysmorphic disorder and depressive symptoms among adults. A cross-sectional study used self-report measures; for depression, body apperception, and body dysmorphic disorder scale were administered to 281 undergraduate and post-graduate adults of Hazara division, Khyber Pakhtunkhwa, Pakistan, consisting male (54.80%) and women (45.19%).

Results Results indicated that body dysmorphic disorder was positively associated with body image and negatively with depression. As males are prone to stressors in Pakistani society, stressors overwhelm them more than females (Cohen's $d = .436$). On body mass index categories, depression, age, and gender were substantially different in three categories. Structural equation modeling evidenced that body dysmorphic disorder indirectly predicts depression when age is used as a moderator and mediation effect of body mass index.

Conclusions It is concluded that body dysmorphic disorder is prevalent at a younger age, overweight and underweight among adults. Therefore, the complexity of body dysmorphic disorder and its similarity with body image can be better understood within the specific context. The potential implication is it make easy to understand for the researchers and mental health care practitioners.

Keywords Body dysmorphic disorder, Body image, Depression, Body mass index, Path analysis

*Correspondence:

Arsalan Haider

arsalanhaider@m.scnu.edu.cn; arsalanhaiderpk@yahoo.com

¹ South China Normal University, Guangzhou, Guangdong, China

² Hazara University, Mansehra, Khyber Pakhtunkhwa, Pakistan

³ University of Buner, Swari, Buner, Khyber Pakhtunkhwa, Pakistan

⁴ Department of Neurology, The Second Hospital of Hebei Medical University, City Shijiazhuang 050000, Province Hebei, People's Republic of China



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

Background

Recently, in 2013, the diagnostic and statistical manual [DSM] has been updated, including body dysmorphic disorder [BDD] as an obsessive–compulsive spectrum as it shares four primary criteria: (i) preoccupation with one or more perceived flaws that are observable only to the individual in question however indiscernible to anyone else that is not observable, (ii) repetitive patterns in behavior; (iii) showing distress and impeded or impaired socially, professionally, or in another critical area of life; and (iv) preoccupation with appearance regardless of body fat percentage and/or weight among those who have met the diagnostic criteria for an eating disorder [1].

Thus, the American Psychological Association [2] defined BDD as being obsessed with observed (preoccupied) defects or flaws in one appearance, which causes substantial distress and/or deterioration in the quality of life, reduction in social or professional functioning, also linked to depression and attempt suicide. BDD is more commonly associated with females. Although previous studies have mixed findings, males were at slightly higher risk [3]. Overall, younger people are more depressed, concerned with unobservable, and/or observed flaws [4].

The experts concluded that individuals with BDD can be identified by observing, watching them, or through specific behavior, such as excessive grooming and camouflaging (using lipstick/makeup, wearing a costume mask, wearing sunglasses, or attempting to conceal the body part the individual believes is unattractive or otherwise deformed). These individuals compare themselves with others to validate the perceived flaw, splurging a substantial amount of time in front of the mirror in order to avoid social events [5].

Earlier studies found a substantial positive and negative correlation with BDD individuals for depression, such as the BDD symptoms decrease when depressive symptoms decrease and vice versa [6]. It indicates a connection between disorders. Depression is linked to societal pressure and imposed values of what a particular culture determines are conventionally attractive [7]. These prevailing ideals, mold an individual's perception of beauty, particularly in the case of BDD, perception of distorted self [8].

Individuals with unrealistic expectations are confident that surgery is the best solution to their presumed defects [9]. Previous research has reported dissatisfaction with surgeries and has taken legal and illegal actions against surgeons. It means that before surgery, they should be assessed by mental health professionals to ensure their health place mentally treated [10]. Although, cosmetic surgeries have risen by 300% [11], particularly in the UK, USA, Brazil, South Korea, India, and Mexico [12]. More than 60% of BDD sufferers reported harassment,

violence, and significant traumas. On the other hand, cultural pressure triggers insecurity and low self-esteem [13].

Numerous researchers have shown that social media significantly influences body appearance (B-App). For example, more than 30% of US adolescents are cyberbullied, which is a potent trigger for BDD. Some other factors, including socioeconomic status, support from friends and family.

Sands et al. [14] found that 10–11 years old boys and girls tend to be slender bodies. Body mass index (BMI) is directly proportional to body dissatisfaction [15]. However, increased females' dissatisfaction with body and opposite in males. It appears that weight, either gaining or losing, is significant for males and females. Notably, females of all ages aspire for a slender body with low BMI, while males over 18 years prefer to gain weight [16] and increase muscles [17].

Regardless of age, body image is a critical component for life satisfaction between males and females. BDD is not only a significant body image issue but also potentially overlaps with obsessive–compulsive disorder and depression. Researchers are interested in examining the prevalence of BDD, body image issues, and depression symptoms among university students through the moderation mediation effect of the variables.

Aim

The following are the aims of the present study:

1. To assess and identify the relationship among body dysmorphic disorder, depression, body image and body mass index among adults.
2. To screen the effect of body dysmorphic disorder on gender in term of depression and gender based differences among the adult population.

Methods

This is a cross-sectional study and conducted in the Department of Psychology, Hazara University, Mansehra, Khyber Pakhtun Khwah, Pakistan, during the academic year 2020–2021. The protocol was approved by the institutional review committee. The target population was undergraduate and post-graduate university students, 300 students participated voluntarily in this study with age 18–24 years ($M=21.67$, $SD=1.99$) through random sampling technique. The participants who did not give demographic information or did not complete the questionnaires were 19 (6.33%) of the total sample. All the participants were informed in detail about the questionnaire and had consented to participate in the study. Who fulfil the inclusion criteria were given a self-report version of

the BDD questionnaire [18] which has acceptable Cronbach $\alpha=0.78$. The scale has been designed to catch the sub-clinical levels of BDD symptomology and consists of yes (1) or no (0) answers. The responses were summed up, and higher scores indicate greater BDD symptoms. To assess the body image the study has used Measure of Body Appreciation Scale (MBA) [19] consisting 10 items and 2 subscales: (1) body integrity and (2) body appearance range, ranging from 1 to 5. The scale have and grade 1 is completely agree and grade 5 is completely disagree, it achieve the satisfactory level of internal consistency Cronbach's $\alpha=0.70$. Depressive symptoms were assessed through the Centre of Epidemiologic Studies Depression Scale (CES-D; Radloff, YEAR) over the past seven days. It includes 20 statements, scored as the following rarely=0, some or little=1, occasionally=2, or most/all of the time=3. A higher score indicated a higher degree of depressive symptoms. At the end to calculated BMI, the researcher have used Stadiometer to measure height and the UC-321 precision scale was used to measure individuals' weight in kilograms (kg/m^2) [20]. The World Health Organization [21] provide that the BMI score <18.5 is considered underweight, a score between 18.5 and 24.99 is deemed normal weight, and a score ≥ 25 is deemed overweight or obese.

Statistical analysis

The study used an independent sample *t* test, univariate analysis of variance (ANOVA) were used to examine mean differences with pre-set criteria ($P \leq 0.05$). For example, comparable size if the sample breached the assumption of normality distribution, and multiple comparisons were used in Tukey's honestly significant difference (THSD) of post hoc. The IBM SPSS statistics version 21.0.0.0 for windows was used to perform the mentioned procedures and moderated mediation effect.

The study used four structural equation models (SEMs) to reduce the confounding multicollinearity effect of BMI and BI on each other, since BMI and BI are supposed to be an essential feature of BDD [22]. Therefore, first decomposed the variations explained by both mediators (BMI and BI) on depression, examined them independently. We used R-studio (Rstudio, 2009–2019) and implemented a Lavaan package with full information on Maximum-likelihood. Specific suggested criteria were used for the outstanding SEM, such as the ratio of chi-square to degrees of freedom ($\times 2/\text{df}$), the comparative fit index ($\text{CFI} \geq 0.95$), the goodness of fit index ($\text{GFI} \geq 0.95$), the root-mean-square error of approximation ($\text{RMSEA} \leq 0.06$), and Tucker–Lewis index (TLI) and AIC lowest values with non-significant *p* value ($p > 0.05$) [23].

Performed bivariate correlations to understand the pathways of conceptual models (see Fig. 1A–D). Kolmogorov–Smirnov, Shapiro–Wilk goodness-of-fit, and natural logarithms (\ln) were used to determine normality and linearity for the main variables. It allowed the variables for group comparison between predictors [24].

Results

Data preparation

We first processed the data for arranging and cleaning. We eliminated outliers and incomplete survey responses. We scored all the statements according to the scale and then summed them up in a single score at the second level. Only body image was marginally right-skewed, yet normality requirements were not violated.

Descriptive statistics

Descriptive statistics and correlation are presented in Table 1. First, relationships were examined between BDD, body image, BMI, age, and depression. The results indicated that body image (total score) was strongly associated with BDD and negatively correlated with depression. It is important to remember that BI and BDD are similar. In addition, BMI was found favorably associated with depression and gender ($r=0.145$; $r=0.120$), and age ($r=-0.188$) was negatively associated. Moreover, depression and age were not significantly correlated in the current research ($r=-0.039$), as no research has linked depression with age.

Gender differences were explored among variables. The higher mean shows a greater degree of psychopathology, while Cohen's *d* is the standardized effect (see Table 2).

The results have shown that males relative to females with marginal effect $t(279)=1.792$, $p=0.074$ (Cohen's $d=0.192$) indicating similar concern in Pakistani society. Likewise, BMI scores were found for both sexes with statistic effect $t(279)=1.805$, $p=0.072$ Cohen's $d=0.195$.

In this regard, females are at a greater risk than males on body image $t(279)=1.960$, $p=0.051$ with mild Cohen's $d=0.229$. It appears depression risks linked to both sexes on social gregariousness, numbers of friends, and social media usage. Wherever males are more prone to stressors in Pakistani society, stressor overwhelms them more than females $t(279)=-2.700$, $p=0.007$, with intermediate Cohen's $d=0.436$. Statistics show that gender and age were not significantly different $t(279)=0.415$, $p=0.678$ ($d=0.010$).

B-Appearance is very crucial for the young population. Unfortunately, the body-appearance level did not hit a significant level in the current study, although the expected equal variation was significant in the current study variables $t(253.263)=1.725$, where $p=0.086$ with the small impact of Cohen's ($d=0.186$).

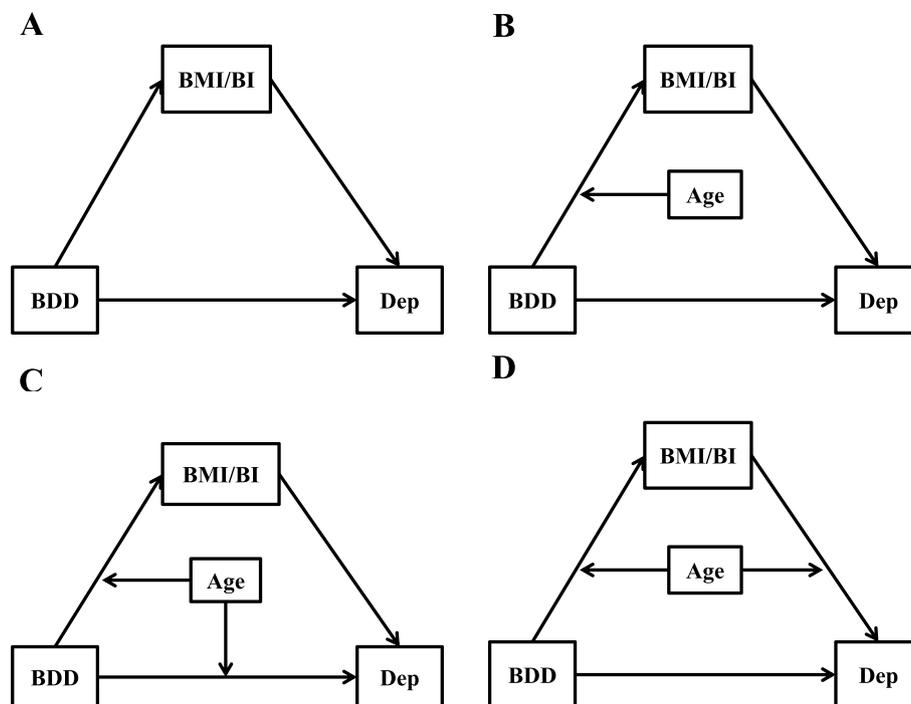


Fig. 1 **A** Model 1 mediation model. **B** Model 2 moderated mediation. **C** Model 3 moderated mediation. **D** Model 4 moderated mediation. Conceptual models link body dysmorphic disorder, body mass index, body image, and depression among Pakistani students population. This study suggested four models focused on the mediation of body mass index, body image, and the moderation effect of age

Table 1 Mean, standard deviation, and zero-order correlations between body dysmorphic disorder, body image, and demographic variables (N = 281)

	1	2	3	4	5	6	7	8	M (S.D)
BDD	(.69)								12.93(1.99)
Depr	-.123*	(.75)							46.25(2.18)
BMI	-.054	.145*	—						23.31(4.32)
BI	.226**	-.037	.034	(.71)					25.62(5.46)
B-In	.138*	-.074	.110	.813**	(.52)				12.48(3.61)
B-app	.229**	.026	-.049	.766**	.257**	(.71)			13.11(3.30)
age	-.010	-.039	-.188**	.033	-.021	.072	—		21.66(1.99)
gender	.108	-.163**	.120*	.113	.077	.109	.027	—	1.45(.49)

BDD Body dysmorphic disorder, BMI Body mass index, Depr Depression, Bi Body image. Cronbach's alpha coefficients are presented in parentheses. Significance levels

* $p < .05$

** $p < .01$

Univariate analysis of variance (ANOVA) was carried out for group mean differences, Tukey's honestly significant difference test (Tukey HSD) on the three BMI categories "underweight, normal weight, and over or obese" along with BDD, depression, BI. (B-In and B-app) age, and gender (Table 3).

The current research was expected to identify variations on BDD in BMI under, normal, and overweight somewhere the results were contradictory to

expectations. BDD values for underweight, normal weight and overweight were $F(2,279) = 0.453, p = 0.636$, while the previous research reported differences on BMI levels for BDD. On the other hand, the BI and its factors (B-In and B-app) were not significant at any level of BMI; $F(2, 279) = 0.106, p = 0.889$; $F(2, 279) = 1.441, p = 0.238$; and $F(2,279) = 1.859, p = 0.158$ respectively.

Interestingly, the statistic found that depression, age, and gender were substantially on BMI levels F

Table 2 Descriptive and inferential statistics for body dysmorphic disorder, body mass index, body image concerns, body integrity, body appearance, and age on the participant's gender ($n = 281$)

	Male (154)		Female(127)		<i>t</i>	<i>p</i>	Cohen's <i>D</i>
	<i>M</i>	<i>S.D</i>	<i>M</i>	<i>S.D</i>			
BDD	12.71	2.057	13.18	2.307	1.792	0.074	0.192
BMI	22.92	4.276	23.88	4.569	1.805	0.072	0.195
Age	21.62	1.893	21.72	2.127	0.415	0.678	0.010
BI	25.06	5.119	26.35	5.907	1.960	0.051	0.229
Depression	46.23	9.524	43.09	9.910	-2.700	0.007	0.436
B-In	12.19	3.632	12.83	3.584	1.460	0.145	0.127
B-app	12.80	3.096	13.49	3.518	1.725	0.082	0.186

BDD Body dysmorphic disorder, BMI Body mass index, BI Body image concerns. Significance levels

* $p < .05$

** $p < .01$

Table 3 Descriptive and inferential statistics for body dysmorphic disorder, body mass index, body image concerns, body integrity, body appearance, and age on the participant BMI ($n = 281$)

Variable	BMI group— <i>M</i> (<i>SD</i> .)			<i>F</i>	<i>p</i>	<i>h</i> ²
	Underweight ($n = 46$)	Normal ($n = 151$)	Overweight ($n = 84$)			
BDD	13.15 (2.33)	12.94(2.23)	12.77 (2.00)	.453	.636	0.0032
Age	22.04 (1.76)	21.82(1.93)	21.17(2.16)	3.978	.020	0.028
BI	25.91(5.23)	25.52(5.45)	25.74 (6.30)	.106	.899	0.001
Depression	40.98(10.30)	45.30 (9.25)	46.04 (10.10)	4.466	.012	0.031
BIn	11.78 (3.22)	12.46 (3.74)	12.90 (3.56)	1.441	.238	0.010
Bapp	13.93 (3.53)	13.03 (3.16)	12.80 (3.38)	1.859	.158	0.013
gender	1.48 (.505)	1.38 (.486)	1.57 (.498)	4.257	.015	0.029

Significance levels: * $p < .05$, ** $p < .01$

(2,279) = 4.466, $p = 0.012$; F (2,279) = 3.978, $p = 0.020$; F (2,279) = 4.257, $p = 0.015$ respectively. Moreover, the Levine statistical test of homogeneity of variance was not significant for one-way ANOVA.

Multiple comparisons post hoc analyses have shown significant differences on underweight and normal-weight categories Mean_{difference} = 4.326, $p = 0.023$; the underweight and overweight category Mean_{difference} = 5.057, $p = 0.013$; and the normal weight and overweight categories Mean_{difference} = 0.194, $p = 0.012$ on depression. Age was also significant for the overweight and underweight categories Mean_{difference} = 0.877, $p = 0.043$, where normal and overweight with Mean_{difference} = 0.655, $p = 0.04$.

Structural equation modeling [SEM]

SEM was completed through statistical tools; SPSS and Laveran (R-studio), and model fit parameters based on fit indices, such as the chi-square, RMSEA, and SRMR. The excellent model fit value should be zero [25] and have a cut point value of less than 0.06. The number of variances

in the covariance matrix had a cut point value greater than 0.095 for CFI and adherent to sample size. GFI is sensitive to sample size and had a cut-point value greater than 0.95, TLI > 0.90, AIC's lowest value recommended.

The mediation SEM showed three pathways, where the path from BDD to depression is negatively marginal significant ($\beta = -0.112$, $p = 0.063$), BDD-to-BI ($\beta = 0.23$, $p = 0.001$), and where the BMI predicts depression directly and positively ($\beta = 0.139$, $p = 0.018$). The total mediation effect was relevant (BMI and BI) ($\beta = -0.12$, $p = 0.049$) when considered necessary in terms of model fitting paths (Table 4).

Models

In SPSS, the authors performed eight mediation and moderated mediation models. Only four models were found to fit the data. Figure 2 is the mediation model, while Figs. 3, 4, and 5 were moderated mediation models between the BDD and depression.

Figure 2A does not fit the data, where Fig. 3A is the association between BDD and BMI-mediated depression.

Table 4 Pathways of the SEM

Predictor	Pathway	Model	
		Coefficient	P-value
BDD	Direct effect on depression	-0.114	.062
BDD	Direct effect on BI	0.224	.001
BI	Direct effect on depression	-0.016	.787
BDD	Indirect effect on Depression via BI	-0.004	.786
BDD	Total effect on depression via BI	-0.188	.480
BDD	Direct effect on BMI	-0.038	.534
BMI	Direct effect on depression	0.141	.018
BDD	Indirect effect on depression via BMI	-0.120	.207
BDD	Total effect on depression via BMI	-0.12	.049

Bold indicating significant effect(s), marginal significant = ^a

The standardized beta ($\beta = -3.57, p = 0.01$) was achieved between BDD and BMI, while age moderating the BMI and depression ($\beta = 0.307, p = 0.01$) have indirect

conditional effect on BDD with ± 1 SD. The indirect effect was negative respectively at +1, average and -1 S.D (IE = -0.1436, IE = -0.0468; IE = 0.0499) including zero at 95% CI limits, and the direct effect from BDD to depression ($\beta = -0.520, p = 0.05, CI = 0.042$ to 0.0015).

Obviously, the indirect influence between BDD and BMI was statistically significant (index = 0.048, SE = 0.027, CI = 0.009 to 0.127). We used 5000 conventional pick-a-point process bootstrapping procedures for the effective analysis with a CI of 95%, where the cumulative variance accounted for 5.98 and 3.43% for BMI and depression.

The graph (Fig. 3A(B)) depicts the simple slopes of age associated with BDD and BMI, with arbitrary levels set at the mean and ± 1 SD the mean of age. Simple slope analysis revealed that the association between BDD and BMI was significantly negative at a young age. However, the association was non-significant on average. As we progress from a younger to an older age, we may deduce that the slopes are becoming more positive.

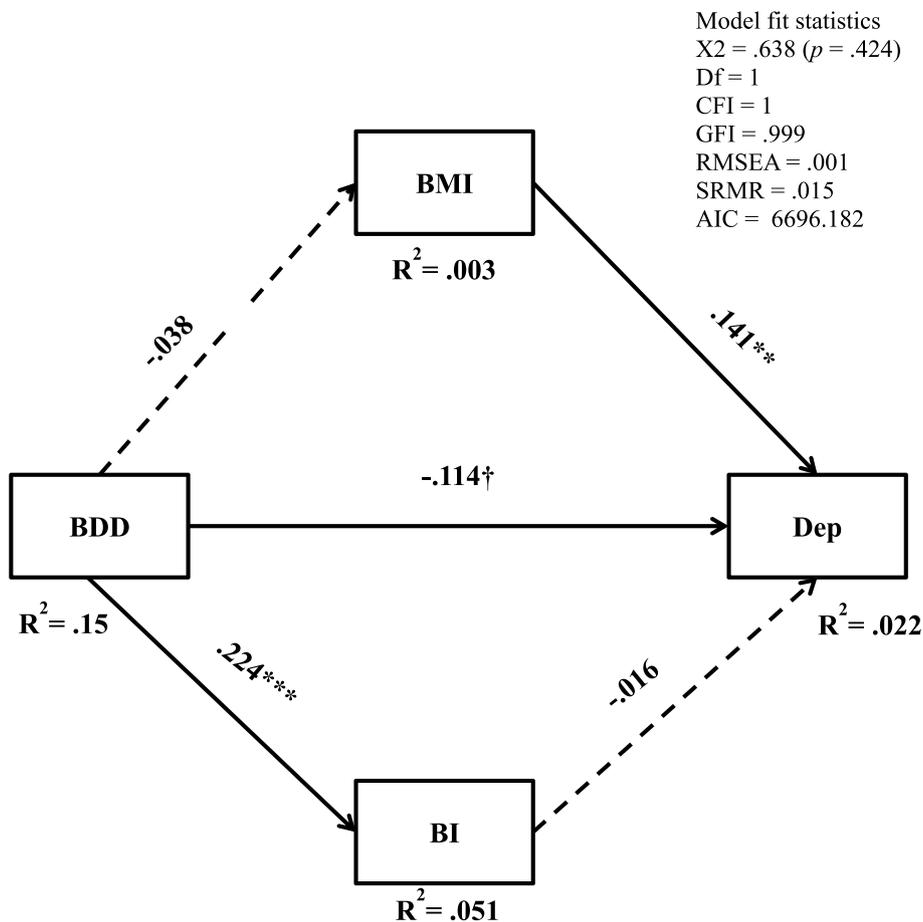


Fig. 2 The standardized coefficient (beta) for the association between BDD and depression controlling BMI and BI is in parentheses. The dashed arrow indicates non-significant effect(s), and the solid arrow indicates significant effect(s). R² represents the total variation in a dependent variable explained by the combined independent variables. The model fit statistics summary is presented. * $p < .05$, ** $p < .005$, *** $p < .001$

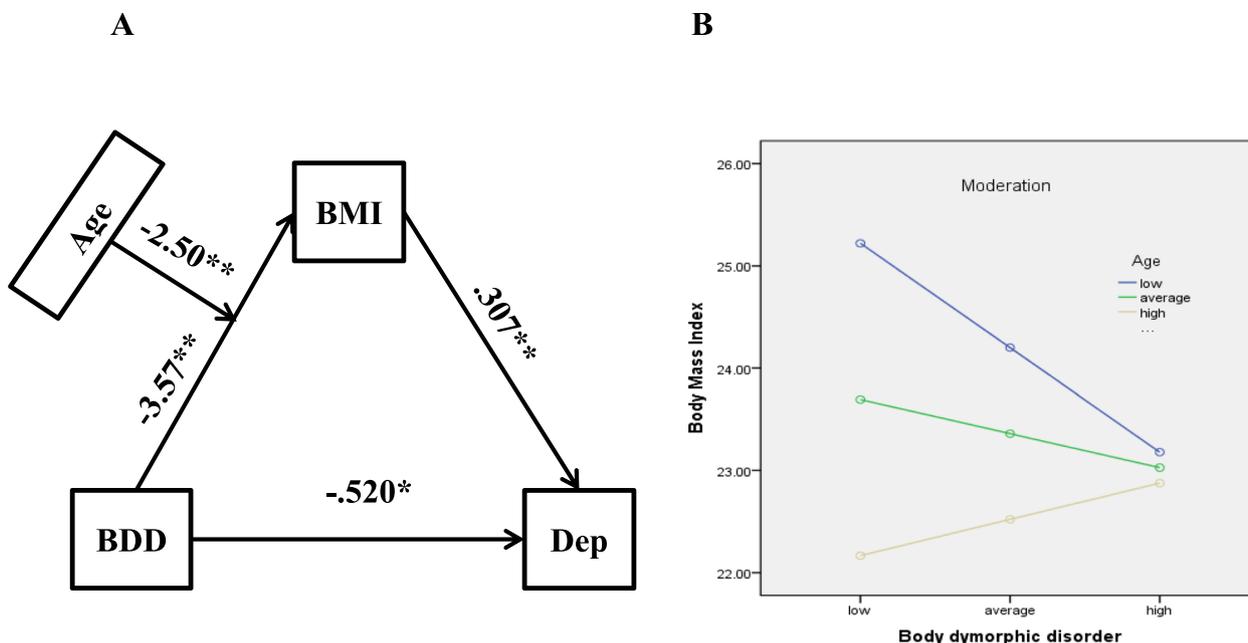


Fig. 3 **A** The proposed moderated mediation models standardized regression coefficient (beta) for the association between BDD and depression mediated by BMI and moderated by age. The standardized regression coefficient between BDD and depression, controlling for BMI, is in parenthesis, solid arrows representing significant effects, * $p < .05$, ** $p < .001$, *** $p < .001$. **B** The moderation effect of age on the relationship between BDD and BMI. Simple slopes analysis at mean, above, and below the mean level of age. Low $\beta = -.4682$, $SE = .1847$ $p < .05$, Medium $\beta = -.1527$, $SE = .1193$ $p > .05$, High $\beta = .1628$, $SE = .1615$ $p > .05$. **B** The proposed moderated mediation model standardized regression coefficient (β) for the association between BDD and depression mediated by BMI and moderated by age. The standardized beta between BDD and depression, controlling for BMI, is in parenthesis, solid arrows representing significant effects

Figure 3B (model template 7) was used to check the effects, where the body image is mediating between BDD and depression, age-moderation did not fit the data. The route of Fig. 3B from BDD to BI was not significant ($\beta = -0.254$, $p = 0.88$) and had no moderation effect of age ($\beta = -0.392$, $p = 0.704$). Neither interaction term (BDD*Age: $\beta = 0.078$, $p = 0.63$) nor the path from BI to depression ($\beta = 0.016$, $p = 0.87$), the only path was significant from BDD to depression ($\beta = -0.544$, $p = 0.048$) with CI [-1.085 - 0.004].

Assuming that moderated mediation index is not significant (index = -0.0006, $SE = 0.008$, $CI = -0.0201$ - 0.0163), the conditional indirect effect(s) of BDD on depression at all three levels of age were non-significant (at lower IE = -0.008, $SE = 0.0504$, $CI [-0.1156$ - 0.0956]; at average IE = -0.0093, $SE = 0.0542$, $CI [-0.1180$ - 0.0994]; and at higher IE = -0.0106, $SE = 0.0623$, $CI [-0.1425$ - 0.1148].

Pairwise comparison among conditional indirect effects at different levels of moderator includes zero at lower, average, and higher levels; therefore, indirect effects at pairs were not significant.

In Fig. 4 (model template 8), BI has not shown significant moderation or mediation effect. Therefore, the study did not represent that Fig. 4A model place in

this paper, in which BMI acting as mediator and age as moderator.

The path from BDD to BMI ($\beta = -3.57$, $p = 0.01$), age ($\beta = -2.46$, $p = 0.003$; $CI = -4.08$ to -0.835), interaction (BDD*age; $\beta = 0.157$, $p = 0.012$; $CI = 0.033$ to 0.281), and the path from BMI to depression reached statistical significant level ($\beta = 0.310$, $p = 0.022$; $CI = 0.044$ to 0.575). It is interesting to note that the path from BDD to depression has not shown significance ($\beta = 0.952$, $p = 0.76$; $CI = -5.25$ to 7.15), the moderating effect of age and interaction term (BDD*age; $\beta = 0.801$, $p = 0.67$, $CI = -2.90$ to 4.52 , $\beta = -0.067$, $p = 0.63$, $CI = -0.349$ to 0.214) respectively.

There was no significant conditional direct effect of BDD on depression with the moderated influence of age. At a lower level, it is only significant, with CI varying from -0.395 to -0.014. However, the mediation and the impact of moderation were both significant ($\beta = 0.048$, $SE = 0.030$ $CI = 0.005$ to -0.13).

Furthermore, we tested Fig. 5, the results showed significant path from BDD to BMI with moderation and interaction effect. The previous models has shown significant path from BDD to depression for example, Figs. 2, 3, 4, and 5. There was no substantial correlation between BMI and depression ($\beta = -2.378$, $SE = 1.486$, $p = 0.11$),

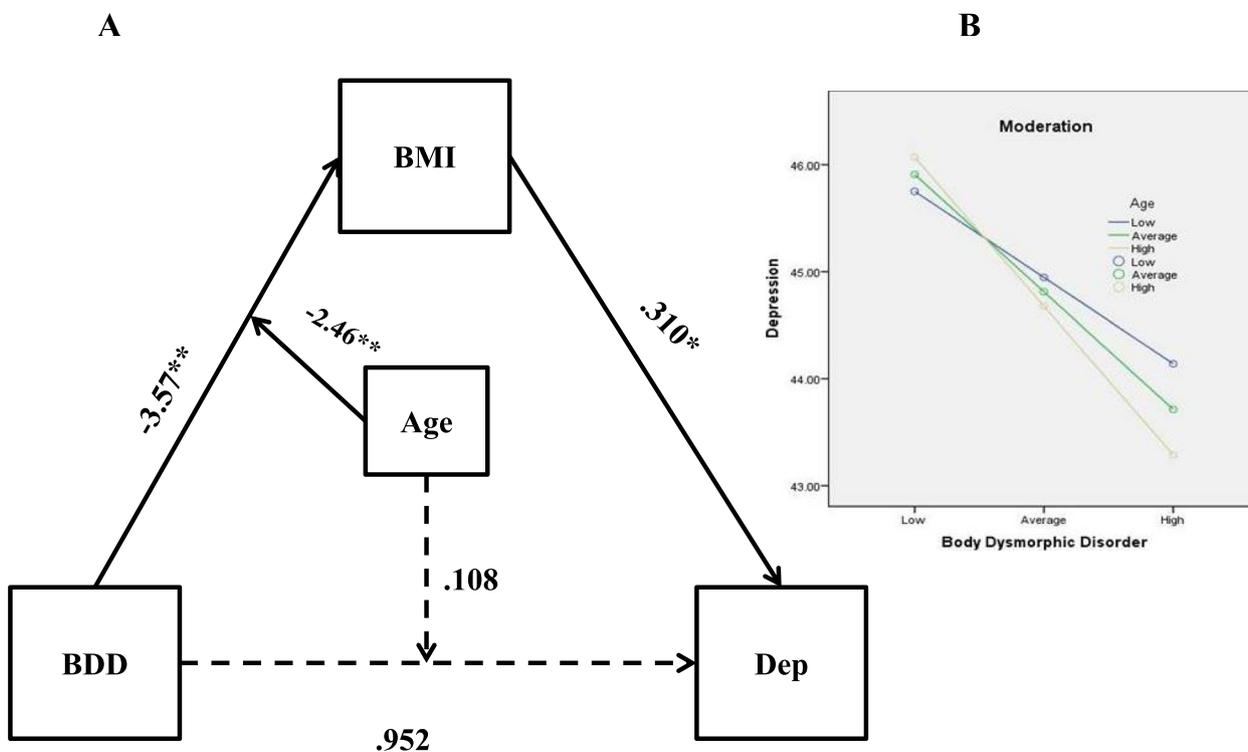


Fig. 4 **A** The proposed moderated mediation model is the association between body dysmorphic disorder and depression, mediated by BMI and moderated by age. The dashed arrows indicate non-significant effect, solid arrows indicate significant effect(s), and the numbers in the parentheses indicate effect from BDD to depression after controlling the effect of a mediator. **B** The moderation effect of age on the relationship between BDD and BMI. Simple slopes of the age

moderation effect ($\beta = -3.028$, $SE = 1.660$, $p = 0.069$) and even the overall interaction effect ($BMI \times Age$; $\beta = 0.123$, $SE = 0.068$, $p = 0.071$). However, it was positively significant at the average and higher degree of moderation ($\beta = 0.3012$, $SE = 0.1328$, $p = 0.024$, $CI = 0.0398$ to 0.5627 ; $\beta = 0.5485$, $SE = 0.1909$, $p = 0.004$, $CI = 0.1728$ to 0.9242) correspondingly (Fig. 5A(B)). The effect between BDD to depression was greater than all other models. The pairwise contrasts were at the lower bootstrapping limit of 95% of the CI ranging from -0.0118 to 0.3773 .

Discussion

The significant impact of social media and other factors have increased the prevalence of body dysmorphic disorder. It is especially true among the students who participate in the study examining the association between depressive symptomology concerning body dysmorphic feasters in the student population.

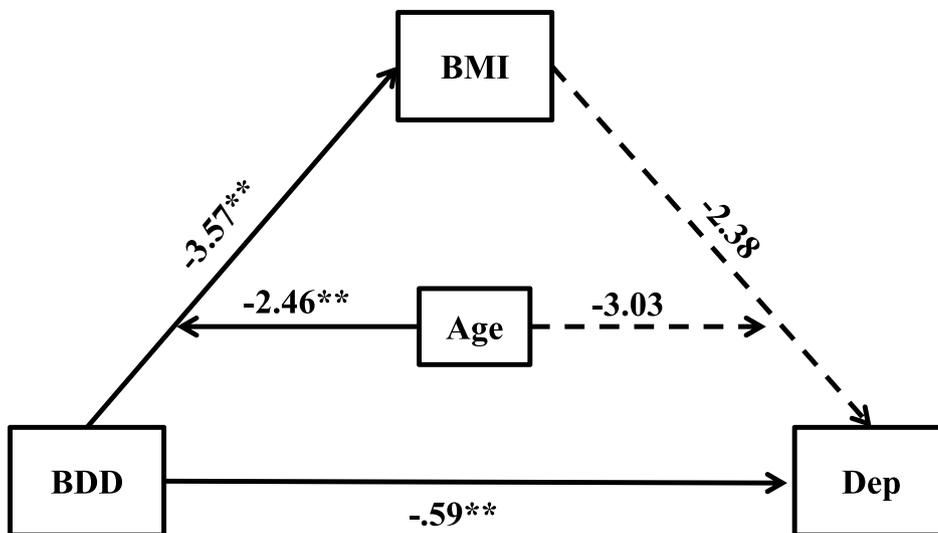
To the best of our knowledge, no study has ever been conducted to investigate the predictive role of BMI and body image and moderating role of age in relationship with BDD and depressive symptomology among Pakistani students.

The psychopathological mechanisms involved body-related concerns may moderately impact or have a severely toxic effect on the physical defect perception-related attributes. Both genders had increased risk factors, regardless of culture or religion.

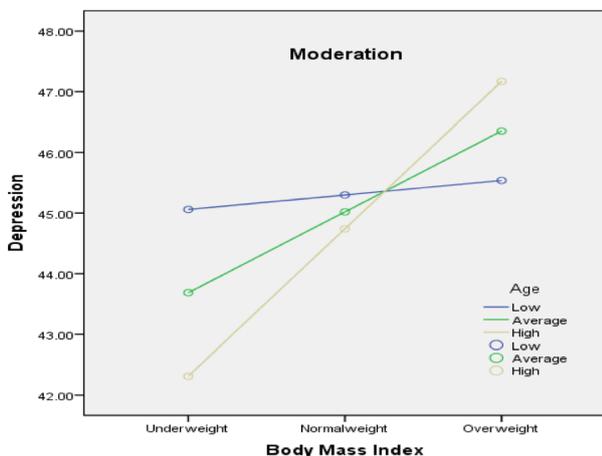
The current study examined the association and gender-based differences among BDD, depression, body image, and BMI. Results suggested statistical gender-based differences in body dissatisfaction and BMI. Based on the literature review, it could be concluded that Pakistani society is religious and male-oriented, with more responsibilities for its male citizens. It explains the higher level of depressive symptoms among male students. Similarly, females have restricted social lives often unable to participate in physical activities, or plastic surgery is considered taboo. These findings align with the previous literature, which has repeatedly confirmed a strong link between depression and BMI [26].

The consistent study stated that body dissatisfaction may work as a core disposition which increases the threat of developing depressive symptoms in adolescent females. It is due to significant levels of self-consciousness plus various internal and external factors (social constructs, personality, mindfulness, socioeconomic,

A



C



B

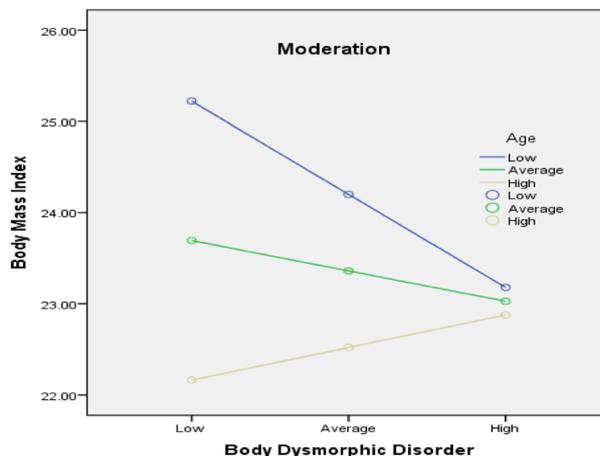


Fig. 5 **A** Proposed mechanism of the association between body dysmorphic disorder and depression mediated by BMI and moderated by age using template 58. The dashed arrows indicate non-significant effect, and solid arrows indicate significant effect(s). **B** The moderation effect of age on the relationship between Body mass index and body dysmorphic disorder. Simple slope analysis at average, above, and below the mean level of age. Low $\beta = -.4682$, $SE = .1847$, $p < .05$; Medium $\beta = -.1527$, $SE = .1193$, $p < .05$; High $\beta = .1628$, $SE = .1615$, $p < .05$. **C** The moderation effect of age on the relationship between BMI and depression. Simple slopes analysis at mean, above, and below the mean level of age. Low $\beta = .0540$, $SE = .1903$, $p < .05$; Medium $\beta = .3012$, $SE = .1328$, $p < .05$. High $\beta = .5485$, $SE = .1909$, $p < .05$

family environment, peer, social support, media, and poor self-image). These variables may function as a buffer against the detrimental effects of rumination and negative emotion. The larger the effect, the more the depression symptoms [1].

The study also revealed that over-weight individuals are at greater risk for depressive symptomology than average and low body weights (Table 3). These findings

are consistent with similar findings of [27], which stated that individuals were more concerned about body weight (BMI) and more depressed than the counter partner [11] in community samples. It suggests that overweight individuals are more vulnerable for developing depressive symptoms and mood-related problems. The current study also observed that the individual realization of their being overweight might trigger several psychological

problems, among which mood-related problems are the most prevailing psychological problems. Depression negatively affects appetite, resulting in a person slipping into unhealthy eating patterns. Similarly, weight-related un-resolved frustration and repressed feelings, which in turn may lead to depression among those who fall into the overweight or obese categories.

The researchers have found that 4 models fit the data by assessing the paths on depression and body dysmorphic disorder. Figure 2 is the mediation model with no moderation effect, while Figs. 3, 4, and 5 were mediation models with two mediators (BI and BMI) and a moderator (age) between BDD and depression.

Figure 2 does not fit the data, while Fig. 3A is BDD and BMI-mediated depression. With 95% CI, BDD indirectly influence depression via BMI was found significant.

Exploring a mediating effect of BMI, only Fig. 3B was significant in determining the connection between BDD and depression. Although, no moderation effect of age was found.

When analyzing the effect of age and BMI on BDD and depression, results revealed no significant conditional direct effect. Further, results reported the path from BDD to BMI was significant with a moderation effect and interaction, but there was no substantial correlation between BMI and depression with moderation, even the overall interaction. Correspondingly (Figs. 3A, 4A, and 5), the moderating effect between BDD to depression was significant.

Limitations and future directions

The current study focused on university students rather than a clinical sample. Small sample size may have undermined our capacity to determine a significant difference within the weight and gender categories. Still, future studies should compare larger, clinical, and non-clinical samples to maximize the chances of detecting disparities between the weight categories and gender on B-App and depression levels. Second, depressive symptoms were based on responses over the past seven days. As a result, our assessment of depressive symptoms may not represent it well. Future research should pay attention to the duration of the depressive symptoms for at least three months regarding BDD, which would help obtain more accurate results. Third, the sample only consists of undergraduates and post-graduates. It could be possible that they did not develop a healthy sense of body image yet (due to cultural restrains) or did not understand the language used in the questionnaire. Further studies should pay attention to the questionnaire language and measure additional variables, including the general population, students of varying levels, and clinical sample. It may provide additional insight into the factors that contribute

to symptoms of depression and BDD within the Pakistani population.

Implications

Despite the limitations, the findings have important implications for measuring body-related constructs. This research highlights this subject in the Pakistani Hazara's adults, but it may also limit the generalization of the results to the rest of the Pakistani population. In contrast, body image and body-related concerns may only affect some parts of the general Pakistani population more than research is needed to overcome the limitations of working with a student sample.

While the overweight category predicts depression, socio-cultural and religious elements may also be at play, maybe due to socio-cultural and religious viewpoints. The current study serves as a necessary basis for future research, which might build on it by including student samples with DSM-V diagnoses. Participants seeking dermatological treatments and those who are open and live in a major metropolis may be included in future research (less traditional).

Conclusions

This research provides a new perspective to understand the Pakistani population's awareness of the body, especially restrictions on physical activities. Therefore, females are more dissatisfied with their body image. Higher body mass index and dissatisfaction lead to negative body image and depressive symptoms, and other related disorders.

Abbreviations

χ^2/df	Chi-square to degrees of freedom
CFI	Comparative fit index
GFI	Goodness of fit index
RMSEA	Root-mean-square error of approximation
TLI	Tucker–Lewis index
ANOVA	Analysis of variance
CES-D	Centre of Epidemiologic Studies Depression Scale
MBA	Measure of body apperception
USA	The United States of America
DSM	Diagnostic and statistical manual
BDD	Body dysmorphic disorder
BMI	Body mass index
BI	Body image
CI	Confidence interval
SE	Standard error
SD	Standard deviation
M	Mean
SEM	Structural equation model

Acknowledgements

The authors would like to thank all those who assist with writing, managing, and revising.

Authors' contributions

This study has four authors who have made the following contributions: Arsalan Haider: conceptualization, wrote the first draft. Professor Zhang Wei:

data cleaning and model designing. Assistant Professor Shagufta Parveen: review the draft. Arshad Mehmood: proofreading and supervision. All authors read and approved the final manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Availability of data and materials

The supplementary material for this article can be found online. Haider, A., Harvard Dataverse, <https://doi.org/10.7910/DVN/1DDEBE>.

Declarations

Ethics approval and consent to participate

The Experimental Ethics Committee approved the Department of Psychology, Hazara University, Mansehra, experiments.

Consent for publication

Before this study, all participants gave informed written consent.

Competing interests

The authors declare that they have no competing interests.

Received: 19 November 2022 Accepted: 11 January 2023

Published online: 06 February 2023

References

1. França K, Rocchia MG, Castillo D, ALHarbi M, Tchernev G, Chokoeva A, Fioranelli M (2017) Body dysmorphic disorder: history and curiosities. *Wien Med Wochenschr* 167(Suppl 1):5–7. <https://doi.org/10.1007/s10354-017-0544-8>
2. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (5th ed.) (2013). Washington, DC: American Psychiatric Association.
3. Grant JE, Lust K, Chamberlain SR (2019) Body dysmorphic disorder and its relationship to sexuality, impulsivity, and addiction. *Psychiatry Res* 273:260–265. <https://doi.org/10.1016/j.psychres.2019.01.036>
4. De Brito MJA, Nahas FX, Cordás TA, Tavares H, Ferreira LM (2016) Body dysmorphic disorder in patients seeking abdominoplasty, rhinoplasty, and rhytidectomy. *Plast Reconstr Surg* 137(2):462–471. <https://doi.org/10.1097/01.prs.0000475753.33215.8f>
5. Hartmann AS, Thomas JJ, Greenberg JL, Matheny NL, Wilhelm S (2014) A comparison of self-esteem and perfectionism in anorexia nervosa and body dysmorphic disorder. *J Nerv Ment Dis* 202:883–888. <https://doi.org/10.1097/NMD.0000000000000215>
6. Phillips KA, Stout RL (2006) Associations in the longitudinal course of body dysmorphic disorder with major depression, obsessive-compulsive disorder, and social phobia. *J Psychiatr Res* 40(4):360–369. <https://doi.org/10.1016/j.jpsychires.2005.10.001>
7. Abbas OL, Kurkuoglu A, Aytop CD, Uysal C, Pelin C (2017) Perception of symmetry in aesthetic rhinoplasty patients: anthropometric, demographic, and psychological analysis. *Perception* 46(10):1151–1170. <https://doi.org/10.1177/0301006617714214>
8. Ribeiro RVE (2017) Prevalence of body dysmorphic disorder in plastic surgery and dermatology patients: a systematic review with meta-analysis. *Aesthetic Plast Surg* 41(4):964–970. <https://doi.org/10.1007/s00266-017-0869-0>
9. Alavi M, Kalafi Y, Dehbozorgi GR, Javadpour A (2011) Body dysmorphic disorder and other psychiatric morbidities in aesthetic rhinoplasty candidates. *J Plast Reconstr Aesthet Surg* 64(6):738–741. <https://doi.org/10.1016/j.bjps.2010.09.019>
10. Sweis IE, Spitz J, Barry DR Jr, Cohen M (2017) A review of body dysmorphic disorder in aesthetic surgery patients and the legal implications. *Aesthetic Plast Surg* 41(4):949–954. <https://doi.org/10.1007/s00266-017-0819-x>
11. Ziglias P, Menger DJ, Georgalas C (2014) The body dysmorphic disorder patient: to perform rhinoplasty or not? *Eur Arch Otorhinolaryngol* 271(9):2355–2358. <https://doi.org/10.1007/s00405-013-2792-6>
12. Valikhani A, Goodarzi MA (2017) Contingencies of self-worth and psychological distress in Iranian patients seeking cosmetic surgery: integrative self-knowledge as mediator. *Aesthetic Plast Surg* 41(4):955–963. <https://doi.org/10.1007/s00266-017-0853-8>
13. Cerea S, Bottesi G, Grisham JR, Ghisi M (2018) Body dysmorphic disorder and its associated psychological and psychopathological features in an Italian community sample. *Int J Psychiatry Clin Pract* 22(3):206–214. <https://doi.org/10.1080/13651501.2017.1393545>
14. Sands R, Tricker J, Sherman C, Armatas C, Maschette W (1997) Disordered eating patterns, body image, self-esteem, and physical activity in preadolescent school children. *Int J Eat Disord* 21(2):159–166. [https://doi.org/10.1002/\(SICI\)1098-108X\(199703\)21:2%3C159:AID-EAT6%3E3.0.CO;2-K](https://doi.org/10.1002/(SICI)1098-108X(199703)21:2%3C159:AID-EAT6%3E3.0.CO;2-K)
15. Vander Wal JS, Thelen MH (2000) Eating and body image concerns among obese and average-weight children. *Addict Behav* 25(5):775–778. [https://doi.org/10.1016/s0306-4603\(00\)00061-7](https://doi.org/10.1016/s0306-4603(00)00061-7)
16. Drenowski A, Kurth CL, Krahn DD (1995) Effects of body image on dieting, exercise, and anabolic steroid use in adolescent males. *Int J Eat Disord* 17(4):381–386. [https://doi.org/10.1002/1098-108x\(199505\)17:4%3C381::aid-eat2260170410%3e3.0.co;2-v](https://doi.org/10.1002/1098-108x(199505)17:4%3C381::aid-eat2260170410%3e3.0.co;2-v)
17. McCabe MP, Ricciardelli LA (2004) Body image dissatisfaction among males across the lifespan: a review of past literature. *J Psychosom Res* 56(6):675–685. [https://doi.org/10.1016/s0022-3999\(03\)00129-6](https://doi.org/10.1016/s0022-3999(03)00129-6)
18. Jefferys D. E., Castle D. J., (2003). Body dysmorphic disorder—a fear of imagined ugliness. *Journal of Aust Fam Physician*. (9):722–5. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/14524210>
19. Carver C. S., (2003). MBA (Measure of Body Apperception). department of psychology college of arts and sciences university of Miami. Retrieved from <http://www.psy.miami.edu/faculty/ccarver/scIMBA.html>
20. Garrow JS, Webster J (1985) Quetelet's index (W/H²) as a measure of fatness. *Int J Obes* 9:147–153
21. World Health Organisation. Obesity: preventing and managing the global epidemic - report of a WHO consultation on obesity. Geneva: WHO/NUT/NCD/98.1; 1997. http://www.who.int/nutrition/publications/obesity_executive_summary.pdf. [Cited 10 June 2020]
22. Didie ER, Kuniega-Pietrzak T, Phillips KA (2010) Body image in patients with body dysmorphic disorder: evaluations of and investment in appearance, health/illness, and fitness. *Body Image* 7(1):66–69. <https://doi.org/10.1016/j.bodyim.2009.09.007>
23. Ali A, Mattsson E (2017) Disentangling the effects of species diversity and intraspecific and interspecific tree size variation on aboveground biomass in dry zone home garden agroforestry systems. *Sci Total Environ* 598:38–48. <https://doi.org/10.1016/j.scitotenv.2017.04.131>
24. Grace JB, Anderson TM, Seabloom EW, Borer ET, Adler PB, Harpole WS, Smith MD (2016) Integrative modelling reveals mechanisms linking productivity and plant species richness. *Nature* 529(7586):390–393. <https://doi.org/10.1038/nature16524>
25. Chen F, Curran PJ, Bollen KA, Kirby J, Paxton P (2008) An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in structural equation models. *Social Methods Res* 36(4):462–494. <https://doi.org/10.1177/0049124108314720>
26. Laar RA, Shi S, Ashraf MA (2019) Participation of Pakistani female students in physical activities: religious, cultural, and socioeconomic factors. *Religions* 10(11):617
27. Khan QU, Zaffar S, Rehan AM, Rashid RR, Ashraf H, Hafeez F (2020) Relationship of major depression with body mass index and salivary cortisol. *Cureus* 12(1):e6577. <https://doi.org/10.7759/cureus.6577>

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.