


Intolerable feelings of uncertainty within the body: Associations between interoceptive awareness, intolerance of uncertainty, and body dissatisfaction

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Abstract

Background: Adolescence is a period marked by important physical and social changes, which often leads to an increase of body dissatisfaction. Recent studies have shown an association between interoception and body dissatisfaction in female adolescents. One variable that may contribute to the association between interoceptive awareness and body dissatisfaction is intolerance of uncertainty (IU). This study aims to investigate multiple facets of interoceptive awareness, IU, and their relations with body dissatisfaction in adolescent girls.

Methods: In a cross-sectional study, a convenience sample of 307 adolescent girls (mean age = 17.73; SD = 1.02) was recruited in the Netherlands in 2022. Three questionnaires were completed measuring interoceptive awareness, IU, and body dissatisfaction. A moderation analyses using a multiple hierarchical regression was used to investigate associations between variables.

Results: Correlation analyses indicated that several facets of lower interoceptive awareness (Not distracting, Not worrying and Trusting) were related to higher levels of body dissatisfaction. IU only marginally moderated the relationship between several domains of interoceptive awareness (Notice, Attention regulation and Emotional awareness) and body dissatisfaction.

Discussion: Findings suggest that experiencing bodily signals as ambiguous and uncertain may result in more complex body image issues. Within certain domains of interoceptive awareness, IU may affect the process of appraising bodily signals. Furthermore, adolescent girls who do not feel safe in their body and who find it difficult to distract their thoughts when experiencing pain or discomfort in their body may be particularly at risk for developing more complex body image disturbances and may benefit from interventions improving both interoceptive awareness and IU. Moreover, future research should focus on interoceptive awareness and IU as potential underlying mechanisms for body image issues.

KEYWORDS

adolescent girls, body dissatisfaction, interoceptive awareness, intolerance of uncertainty

1 | INTRODUCTION

Adolescence is a period marked by important physical and social changes that may predispose some individuals to a negative body image (Senín-Calderón et al., 2017). Physical appearance is highly valued and the most important predictor of adolescents' overall self-worth (Harter, 2006). Furthermore, body dissatisfaction increases in relevance from 12 to 15 years

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old (Levine & Smolak, 2002) and is considered a risk factor for the development of psychological problems such as depression and low self-esteem, and eating disorders (e.g., Andersen & Swami, 2021; Paxton et al., 2006; Stice & Shaw, 2002). Internalization of the ideal of beauty by sociocultural influence and social comparison facilitate development of a negative body image (Carey et al., 2014; Vartanian & Dey, 2013), especially for adolescent girls (Dion et al., 2015). Moreover, adolescents may be especially susceptible to experiencing anxiety in response to body dissatisfaction and sociocultural pressures about physical appearance ideals (Vannucci & Ohannessian, 2018). Additionally, adolescence represents a high-risk developmental period for the emergence and exacerbation of anxiety symptoms (Beesdo-Baum & Knappe, 2012). It is therefore important to identify determinants and underlying mechanisms contributing to the development of body dissatisfaction and its association with anxiety-related processes.

Previous studies have mainly focused on social cultural models of body dissatisfaction, including the social comparison theory (Festinger, 1954; Myers & Crowther, 2009) and the tripartite influence model (Van den Berg et al., 2002), which assume that body dissatisfaction develops in response to social and environmental (or external) factors. Interestingly, meta-analytic findings show that the relationship between social comparison and body dissatisfaction is stronger for samples whose mean age was less than 19 (Groesz et al., 2002; Myers & Crowther, 2009). For adolescent girls, the increased opportunities for social interactions with peers around appearance-related issues and the feedback and messages they receive may be associated with increased social comparison and subsequent body dissatisfaction (Cash & Fleming, 2002; McCabe & Ricciardelli, 2005). Although almost all girls are being exposed to this delicate and complex interaction between the self and the social environment during puberty, some girls seem to process the information gained by this interaction in a more negative or threatening manner (Brockmeyer et al., 2018; Schuck et al., 2018). The processing of this specific information may also stem from the awareness an individual creates of herself by making use of (interoceptive) bodily signals and may subsequently intensify the experience of emotions such as feelings of anxiety (for a review see Herbert & Pollatos, 2012). One could thus speculate that some girls might be more prone to experiencing the body in a more anxious way to begin with. Importantly, as body dissatisfaction is an established risk factor for psychological problems (e.g., eating disorders; Andersen & Swami, 2021; Paxton et al., 2006; Stice & Shaw, 2002), understanding the role of interception may provide additional insights into the transition of body dissatisfaction developing into a clinical symptom of many psychological disorders (e.g., anorexia nervosa).

According to more traditionally oriented body-image researchers, body dissatisfaction primarily relies on the processing of external, appearance-related perceptions, affects, and cognitions (Cash, 2004). However, both explanations solely focus on stimuli generated by the social and external environment (e.g., exteroceptive information) while ignoring the influence of internal experience of the body (e.g., interoceptive information). Including internal (bodily) experiences in existing theoretical models of body dissatisfaction may further improve our understanding of the underlying mechanisms (Tajadura-Jiménez & Tsakiris, 2014). This line of reasoning fits with a broader movement toward incorporating internal processes (e.g., bodily signals) into theoretical models for a multisensory body integration (Riva & Dakanalis, 2018). In this vision, multisensory integration deficits represent a failure in a functional adaptation process, which may impair the emotional and bodily experience of an individual. Interestingly, when an individual is unable to correctly (interoceptive) interpret bodily signals, this may produce a significant limitation that also affects the emotional abilities. Here, a critical role of stress and anxiety-related issues in producing multisensory body integration is also addressed (Riva & Dakanalis, 2018).

Although a small group of researchers has started focusing on the association between interoception and body dissatisfaction in female adolescents (Emanuelson et al., 2015; Todd et al., 2019), the understanding of this specific association in adolescent girls is still rather limited. Interoception is defined as the process by which the nervous system senses, interprets, and integrates signals originating from the body, providing a moment-by-moment mapping of the body's internal landscape across conscious and unconscious levels (Feinstein et al., 2018). It has been suggested that interoception may crucially contribute to the complex formation of body image, as well as to its disturbances (Badoud & Tsakiris, 2017). Additionally, as adolescence is a period of development where many psychiatric disorders (e.g., anorexia nervosa) have their onset, atypical interoception may underpin the emergence of these disorders (Murphy et al., 2017). Therefore, further disentangling the nature of the relationship between interoception and body dissatisfaction may improve our understanding of body image issues. This knowledge may be used to inform and improve the contents of preventive programs on body image in adolescent girls. Interoception consists of several facets, including interoceptive awareness, which the current study defines as the conscious level of interoception with its multiple dimensions potentially accessible to self-report¹ (e.g., using the Multidimensional Assessment of Interoceptive Awareness; MAIA-2; Mehling et al., 2018).

¹Following Todd et al. (2019), it should be noted that researchers have yet to reach a consensus about the nomenclature for different components of interoception (e.g., Garfinkel et al., 2015; Khalsa et al., 2018; Mehling, 2016; Murphy et al., 2019). In the present work, we use the term interoceptive awareness, which is consistent with the Multidimensional Assessment of Interoceptive Awareness (Mehling et al., 2012). However, other researchers have used the term interoceptive sensibility to refer to self-reported detections of interoceptive stimuli, and have used interoceptive awareness to refer to the “meta-cognitive” correspondence between behavioral and self-report measures of interoception (Garfinkel et al., 2015).

The connection between interoceptive awareness and body dissatisfaction has been explained by the self-objectification theory and the competitive cues theory. Self-objectification broadly refers to the process of adopting a view of the self that is mostly focused on one's body's appearance (Fredrickson & Roberts, 1997). Because of the limited capacity available for attentional resources, this theory postulated that women who engage in self-objectification, thus focusing strongly on their bodies, are less capable of paying attention to the processing of interoceptive information, and that this may be particularly true for adolescent girls who experience lower levels of interoceptive awareness to begin with. This theoretical mechanism is further supported by the competition of cues theory (Pennebaker & Lightner, 1980), which states that individuals who self-objectify, tend to judge external stimuli as consistently more salient than their own interoceptive cues. Indeed, a preference for exteroceptive cues has been associated with body image disturbances in both clinical and nonclinical groups (Eshkevari et al., 2012; Mussap & Salton, 2006). However, it is not clear why some individuals prefer to rely more on external cues while processing information about the body and in what way this interacts with the developmental trajectories of body dissatisfaction.

One key cognitive process that may contribute to the complex association between interoceptive awareness and body dissatisfaction is intolerance of uncertainty (IU). IU has been identified as a transdiagnostic factor underpinning anxiety (Carleton, 2012). IU refers to “an individual's dispositional incapacity to endure the adverse response triggered by the perceived absence of salient, key, or sufficient information, and sustained by the associated perception of uncertainty” (Carleton, 2016, p. 31). Individuals with high IU tend to perceive uncertainty as negative, threatening, and as something to be avoided (Carleton et al., 2007; McEvoy & Mahoney, 2012). Preliminary evidence supports the relevance of IU to body image, in both clinical and nonclinical groups (Bijsterbosch et al., 2021, 2022; Frank et al., 2012). Despite the scarcity in studies investigating the relation between IU and interoceptive awareness (Wiese, 2021), one could speculate that in adolescent girls who experience their bodily signals as ambiguous (i.e., difficult to interpret) and uncertainty (i.e., low interoceptive awareness), body image issues may be even more complex, when combined with a low tolerance of uncertainty.

Individuals with high levels of IU may intensify the threat meaning assigned to these ambiguous and uncertain interoceptive signals. Responses to IU may include gathering information on the body as much as possible or freezing up in the face of uncertainty and engage in avoidance strategies in response to the threatening stimulus (e.g., interoceptive signals). When these bodily signals are interpreted as ambiguous (e.g., not being able to detect the pace of your own heartbeat) and thus difficult to understand, this may lead to a disconnect from the body (Ainley & Tsakiris, 2013). Then, the attention automatically shifts to more accessible externally information (e.g., the way you look today) and, as such, contributes to an increased focus on the external appearance of the body. Following the objectification theory, that explains the process of adopting a view of the self that is mostly focused on their body's appearance (Fredrickson & Roberts, 1997), this could subsequently lead to higher levels of body dissatisfaction.

The aim of this study was to assess the relationships between interoceptive awareness, body dissatisfaction, and IU in adolescent girls. At the broadest level, we hypothesized that levels of interoceptive awareness would be negatively associated with body dissatisfaction (Brown et al., 2020; Emanuelsen et al., 2015; Todd et al., 2019). Investigating more specific hypotheses related to facets of interoceptive awareness, we expected that Trusting would have the strongest and most consistent predictor variable of body dissatisfaction, in line with previous findings (Brown et al., 2020; Todd et al., 2019). Furthermore, we expected that Not Distracting was also expected to be identified as a predictor variable of body dissatisfaction (Brown et al., 2017; Brown et al., 2020). Moreover, to the best of our knowledge, no study explored the interaction effect of interoceptive awareness and IU on body dissatisfaction in adolescent girls. We anticipated that IU would moderate the relation between facets of interoceptive awareness and body dissatisfaction. Specifically, we expected that the linkage of lower interoceptive awareness with more body dissatisfaction would be stronger for individuals reporting higher IU (compared with those with lower IU) (Wiese, 2021), leading to higher levels of body dissatisfaction. The hypothesized associations between facets of interoceptive awareness, IU, and body dissatisfaction are schematically depicted in Figure 1.

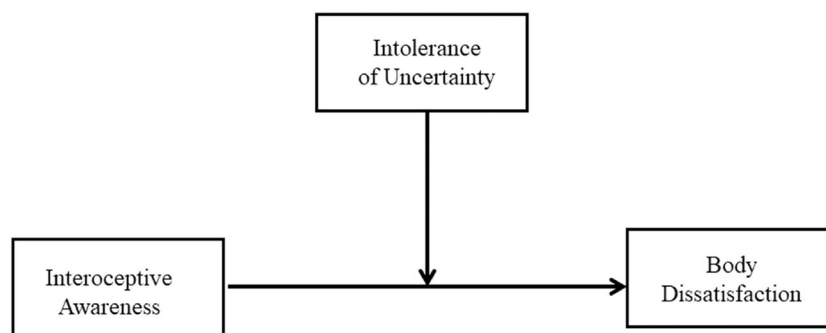


FIGURE 1 Schematic summary of the hypothesized associations between multiple facets of interoceptive awareness, intolerance of uncertainty, and body dissatisfaction.

2 | METHODS

A cross-sectional correlational research design was employed. The study was approved by the Ethics Committee of the Faculty of Social and Behavioural Sciences and is filed under the number 22-0621. The survey tool Qualtrics XM was used to develop and distribute the survey (Qualtrics XM, 2022). Participants were recruited with help from a web-based data collection company (Panelclix) and were financially compensated. To take part in the study, participants were required to sign an online informed consent form. In total 307 adolescent girls in the age group of 16 and 19 participated in this study. Participants were asked to provide demographic information, including age, and body mass index (BMI). Their mean age was 17.73 (SD = 1.02) and based on their height and weight, the BMI is 22.5 (SD = 4.20), placing the BMI-for-age at the 66th percentile for this age group. In 2023, this falls within the healthy weight BMI category according to the Centers for Disease Control and Prevention (CDC), 2023.

2.1 | Measures

2.1.1 | Body Attitude Test (BAT)

Body dissatisfaction was assessed using the Dutch version of the BAT (Probst et al., 1995, 2008). The BAT consists of 20 items (e.g., “I have a strong desire to be thinner”) that are scored on a 6-point Likert scale ranging from 0 (*Never*) to 5 (*Always*). A higher score is indicative of a stronger negative body attitude. The BAT measures four aspects of body experience: negative appreciation of body size, lack of familiarity with one’s body, general body dissatisfaction, and a rest factor. The maximum total score is 100 and the cut-off score is 36; a score above this indicates clinically significant body dissatisfaction. The BAT has been shown to be reliable and valid (Probst et al., 1995). The authors found a high internal consistency, with $\alpha = .93$. Similarly, in the current study Cronbach’s α was .94, which is considered excellent.

2.1.2 | Intolerance of Uncertainty Scale (IUS-12)

The IUS-12 (Carleton et al., 2007) measures one’s IU as expressed in several domains, including emotion, cognition, and behavior. The IUS-12 consists of 12 items, scored on a 5-point Likert scale ranging from 1 (*not at all characteristic for me*) to 5 (*entirely characteristic for me*). It has two subscales, including prospective IU, which measures cognitive distress, and inhibitory IU, which measures behavioral inhibition. An example of an item of the prospective IU subscale is “It frustrates me not having all the information I need.” An example of the inhibitory IU subscale is “When it is time to act, uncertainty paralyzes me.” Scores were calculated by summing up the respective items, with higher scores indicating higher levels of IU. A recent study by Wilson et al. (2020) suggested a cut off score of 28 as indication of clinical levels of IU. The Dutch version of the IUS-12 has good psychometric properties (Helsen et al., 2013). Carleton et al. (2007) found a high internal consistency of the IUS-12, with Cronbach’s $\alpha = .91$. In the current study, the IUS-12 has a good internal consistency ($\alpha = .84$).

2.1.3 | The Multidimensional Assessment of Interoceptive Awareness scale (MAIA-2)

The Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2) is a 37-item self-report measure that was developed to capture multidimensional aspects of interoceptive awareness (Mehling et al., 2018). It contains eight internal scales corresponding to its eight-factor structure, and items are scored from 0 (*never*) to 5 (*always*). The Noticing subscale assesses the subjective awareness of body sensations (“I notice changes in my breathing, such as it speeds up or slows down”). The Not Distracting subscale assesses the tendency to ignore or distract oneself from sensations of pain or discomfort (“I try to ignore pain”). The Not Worrying subscale assesses emotional distress or worry with sensations of pain or discomfort (“When I feel physical pain, I become upset”). The Attention Regulation subscales assesses the ability to control and maintain attention toward bodily sensations (“I can pay attention to my breath without being distracted by things happening around me”). The Emotional Awareness subscale assesses the awareness of the relation between emotional and bodily states (“I notice how my body changes when I feel happy/joyful”). The Self-Regulation subscale assesses whether a person uses attention to bodily sensations to regulate distress (“When I am caught up in my thoughts, I can calm my mind by focusing on my body/breathing”). The Body Listening subscale assesses who often a person actively attends to their bodily sensations for insight (“When I am upset, I take time to explore how my body feels”). The Trusting subscale assesses the extent to which a person experiences their body as a “safe” and “trustworthy” source of information (“I trust my body sensations”). Mean scores were computed for each subscale, and higher scores reflect greater interoceptive awareness. The MAIA-2 has shown to

have a good internal consistency, with Cronbach's α for the eight scales ranging from .64 to .83 (Mehling et al., 2018). In the present study, Cronbach's α for the eight subscales range from .63 to .85.

2.2 | Statistical analyses

All statistical analyses were performed with IBM SPSS Statistics Version 26 IBM Corp. (2019). Assumptions of the multiple regression analysis (i.e., normality, multicollinearity, and homoscedasticity) were all met. Mean scores, standard deviations, and bivariate associations between the study variables were calculated. Subsequently, a three stage multiple linear regression was conducted with body dissatisfaction as dependent variable. BMI was entered at stage one of the regression to control for weight. The eight subscales of the MAIA-2 and IU were entered at stage two. The interaction terms between the subscales of the MAIA-2 and IU were entered at stage three. All prediction variables were centered. The alpha level was set at $p < .05$. p Values between .05 and .10 were denoted as marginally significant.

3 | RESULTS

3.1 | Means, standard deviations, and bivariate associations between study variables

Table 1 presents the means scores, standard deviations, and the bivariate correlations between all study variables. In this study, the obtained means for the subscales of MAIA-2, IUS-12, and BAT were compared with other studies with nonclinical samples of adolescent girls. The average scores on the subscales of the MAIA-2 were in line with findings by Todd et al. (2019), except for Not Distracting and Not Worrying. These levels were more comparable with levels reported by Riboli et al. (2022). The mean scores on the IUS-12 and BAT were higher than reported in other studies (Dekkers et al., 2017; Probst et al., 1997). Regarding the clinical cut off scores of the questionnaires, mean levels of both the BAT and IU were above the clinical cut off (Probst et al., 1995; Wilson et al., 2020).

Furthermore, a significant positive moderate relation was found between the BAT and IU, indicating that higher levels of body dissatisfaction were associated with higher levels of IU. Regarding the subscales of the MAIA-2, the associations between the BAT and Not Distracting, Not Worrying, and Trusting were significant. Additionally, the associations between IU and Not Distracting, Not Worrying, Emotional Awareness, and Trusting were also significant. All significant relations between the BAT and the subscales of the MAIA-2 and IU and the subscales of the MAIA-2 were negatively and weakly correlated, indicating that lower levels of interoceptive awareness were related to higher levels of body dissatisfaction as well as IU. However, the association between the BAT and Trusting were negatively moderately related, indicating a stronger relation. Finally, a positive weak association between IU and Emotional Awareness was found, suggesting that lower levels of IU were associated with higher levels of Emotional Awareness (see Table 1 for a complete overview).

TABLE 1 Means, standard deviations, and bivariate correlations between all variables ($N = 307$).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Noticing										
(2) Not Distracting	-0.15**									
(3) Not Worrying	0.02	0.46								
(4) Attention Regulation	0.41**	-0.20**	0.02							
(5) Emotional Awareness	0.51**	-0.19**	-0.03	0.39**						
(6) Self-Regulation	0.35**	1.8*	-0.08	0.56**	0.41**					
(7) Body Listening	0.40**	-0.09	-0.10	0.56**	0.41**	0.45**				
(8) Trusting	0.19**	0.21**	0.21**	0.30**	0.25**	0.30**	0.33**			
(9) Intolerance Uncertainty	0.10	-0.24**	-0.28**	-0.05	0.15**	-0.03	0.40	-0.26**		
(10) Body Dissatisfaction	-0.06	-0.33**	-0.27**	-0.04	-0.01	-0.08	-0.40	-0.56**	0.45**	
<i>M</i>	3.25	2.17	2.63	2.48	2.41	2.28	2.22	2.96	37.92	58.09
<i>SD</i>	0.82	0.88	0.89	0.84	0.80	0.96	1.06	1.23	7.09	18.03

* $p < .05$; ** $p < .001$.

TABLE 2 Summary of hierarchical multiple regression analyses with body dissatisfaction as dependent variable.

Variables entered	Body Dissatisfaction						
	Step 1		Step 2		Step 3		
	B	t Value	B	t Value	B	t Value	
1	BMI	1.76	7.82***	1.27	7.43***	1.42	7.10***
2	Noticing			-0.37	1.38	-0.41	-1.52
	Not Distracting			-0.55	-3.63***	-0.56	-3.71***
	Not Worrying			-0.32	-1.81*	-0.32	-1.8*
	Attention Regulation			0.25	1.56	0.21	1.31
	Emotional Awareness			0.10	0.42	0.20	0.86
	Self-Regulation			-0.05	-0.17	-0.06	-0.21
	Body Listening			0.25	0.78	0.28	0.89
	Trusting			-2.01	-8.49***	-2.03	-8.57***
	IU			0.65	5.79***	0.65	-0.30
3	Notice × IU					-0.07	-1.81*
	Not Distracting × IU					0.01	0.29
	Not Worrying × IU					0.00	0.19
	Attention Regulation × IU					0.04	1.73*
	Emotional Awareness × IU					0.05	1.68*
	Self-Regulation × IU					-0.01	-0.17
	Body Listening × IU					0.03	0.57
	Trusting × IU					-2.03	-8.57***

Note: Unstandardized coefficients were reported. All subscales of the MAIA-2 (Noticing, Not Distracting, Not Worrying, Attention Regulation, Emotional Awareness, Self-Regulation, Body Listening, and Trusting) were entered.

Abbreviations: BMI, body mass index; IU, Intolerance of Uncertainty Scale—12.

* $p < .10$; *** $p < .001$.

3.2 | Multiple regression analysis

The hierarchical regression revealed that at stage one, BMI contributed significantly to the regression model, $F(1, 298) = 61.19$, $p < .001$ and accounted for 16.8% of the variance in body dissatisfaction. Introducing the facets of interoceptive awareness and IU explained an additional 37.5% of the variance in body dissatisfaction and the change in R^2 was significant, $F(10, 289) = 34.64$, $p < .001$. Finally, adding the interaction terms between the facets of interoceptive awareness and IU to the model explained another 1.8% of the variance in body dissatisfaction and this change was also significant, $F(18, 281) = 20.09$, $p < .001$. Together the entire model accounted for 53.6% of the variance in body dissatisfaction (see Table 2).

4 | DISCUSSION

To the best of our knowledge, this is the first study investigating the relationship between multiple facets of interoceptive awareness and body dissatisfaction and the potential moderating effect of IU in a sample of adolescent girls. At the broadest level, we hypothesized that levels of interoceptive awareness would be negatively associated with body dissatisfaction (Emanuelson et al., 2015; Todd et al., 2019). Our findings support the first hypothesis that lower levels of interoceptive awareness are associated with higher levels of body dissatisfaction in adolescent girls. As previously discussed, this may suggest that in the absence of an adequately functioning awareness of bodily signals, individuals put their focus increasingly more strongly on their bodily appearances. Subsequently, this may co-occur with higher levels of body dissatisfaction (Badoud & Tsakiris, 2017; Tajadura-Jiménez & Tsakiris, 2014; Todd et al., 2019), which may be particularly salient within the context of rapidly changing bodies during puberty.

The second and third hypotheses were more specifically formulated. When investigating facets of interoceptive awareness, we expected Trusting would be identified as the strongest and most consistent predictor variable of body dissatisfaction. In line with previous findings (Brown et al., 2020; Todd et al., 2019), we indeed found Trusting to be the strongest predictor of body dissatisfaction; adolescent girls who do not experience their body as safe seem to have stronger feelings of body dissatisfaction. Additionally and in line with previous studies (Brown et al., 2020), Not Distracting was also identified as a predictor of body dissatisfaction. Difficulties with being able to distract oneself when feeling pain or discomfort is also associated with higher levels of body dissatisfaction and may indicate that those individuals may be at risk for developing more complex body image issues. Interestingly, individuals with extreme body image disturbances (i.e., as a symptom of anorexia nervosa), often report feelings of unsafety in relation to their body and are also known for their rigidity (Talbot et al., 2015).

Findings of the present represent a small addition to the existing body of research that investigates the incorporation of internal processes into theoretical models of multisensory body integration (Riva & Dakanalis, 2018). Deficits in this area may indeed limit the emotional and bodily experience of an individual, hence resulting in higher levels of body dissatisfaction. Furthermore, findings are consistent with the framework of the self-objectification theory, which posits that interoception may crucially contribute to the complex formation of body image, as well as to its disturbances (Badoud & Tsakiris, 2017; Fredrickson & Roberts, 1997; Todd et al., 2019). Including both internally processed bodily experiences (e.g., interoceptive information) and external, appearance-related perceptions, affects, and cognitions in theoretical frameworks may be a fruitful way to further improve our understanding of the underlying mechanism of body dissatisfaction and may possibly help to clarify why some girls might be prone to experiencing the body in a more anxious way than others. However, further research is required to thoroughly investigate the underlying mechanisms (e.g., the interaction between internal and external factors) that may potentially drive body dissatisfaction.

The fourth hypothesis examined the moderating effect of IU on the association between facets of interoceptive awareness and body dissatisfaction. Only marginally significant results were found: Noticing, Attention Regulation, and Emotional Awareness were moderated by IU in the relation with body dissatisfaction, all domains of interoceptive awareness that function within the process of appraising bodily signals. The studied relationship and the (modest) moderating role of IU, suggests that experiencing bodily signals as ambiguous (i.e., difficult to interpret) and uncertain, alongside a low tolerance of uncertainty may result in more complex body image issues. Several domains of interoceptive awareness (Noticing, Attention Regulation, and Emotional Awareness) and IU may be key factors that need further investigation as potentially meaningful addition to existing theoretical frameworks of body dissatisfaction. Moreover, they may play a pivotal role in the mechanisms underpinning body dissatisfaction and potentially other components of body image disturbances, specifically in adolescent girls who are dealing with a rapidly changing body (Bijsterbosch et al., 2021; Frank et al., 2012). Additionally, the moderating role of IU may not only be enhancing the association between interoceptive awareness and body dissatisfaction. Recent findings show that IU is also involved in the association between social anxiety-related processes (exteroceptive information) and body dissatisfaction (e.g., Bijsterbosch et al., 2020).

In this study, the mean scores of IU and body dissatisfaction were higher than reported in other studies (Dekkers et al., 2017; Probst et al., 1997). Regarding the clinical cut off scores of the questionnaires, the mean levels of both IU and body dissatisfaction were above the clinical cut off (Probst et al., 1995; Wilson et al., 2020). A potential explanation for the higher scores on these questionnaires, is that the data of this study has been collected at the end of the covid-19 pandemic. Halldorsdottir et al. (2021) found that the mental health of adolescent girls decreased during the pandemic, and that they indeed showed higher levels of anxiety among other things. Furthermore, Vall-Roqué et al. (2021) suggested that the pandemic may have triggered an increase in body image issues among adolescent girls. Therefore, results may have been affected by the covid-19 pandemic and both IU and body dissatisfaction may be elevated consequently. At this stage, it is unclear whether these effects of COVID-19 are temporarily.

This study represents a small and modest step in further unraveling the relationships between multiple of facets interoceptive awareness, IU, and body dissatisfaction. Nonetheless, further research should be carried out to clarify the importance of internal factors (interoceptive awareness and IU) to body dissatisfaction and specifically how they fit with current models of body image that largely focus on external factors. Future studies may focus on investigating the interaction between external and internal factors and their potential overlap in the development of body dissatisfaction and their contribution to underlying mechanisms of body image. Examining both internal and external factors may lead to a better understanding of body dissatisfaction in adolescent girls and may be integrated in early interventions promoting the development of a healthy body image (Alleva et al., 2015). Previous studies have shown that interoceptive awareness as well as IU are malleable mechanisms and interventions for both interoceptive awareness (e.g., Mindful Awareness in Body-Oriented Therapy; Price & Hooven, 2018) and IU (Dugas et al., 2022) have demonstrated success for on the one hand increasing interoceptive awareness and on the other hand reducing IU (Boswell et al., 2013). Improving interoceptive abilities and learning how to cope with uncertainty in childhood may help to slow down or, hopefully, even prevent the development of psychopathology. Taken together, the present findings may be a steppingstone to further investigating the relationship between interoceptive awareness, IU, and body dissatisfaction.

This study contributed to a novel and potentially fruitful area in further disentangling body image issues and their underlying mechanisms. Based on the data, the tested model seems plausible. However, some limitations need to be acknowledged. Due to the cross-sectional design of the current study, the direction of causality of the associations between the studied variables could not be determined. Nevertheless, both interoceptive awareness and IU may provide a novel direction to unravel the complexity of body image disturbances and help to shed a new light on interventions aiming to improve body image issues in adolescent girls in clinical and nonclinical groups. Adding interventions that target improving both interoceptive abilities (e.g., Mindful Awareness in Body-Oriented Therapy; Price & Hooven, 2018) and IU to body image programs may be a solid step forward. Additionally, although the studied sample approaches the final stages of adolescence and have mostly grown into their adult bodies, the studied sample (16–19 years old) only represents a so-called snapshot in puberty. Longitudinal studies are required to study this specific model across the different developmental stages, preferably starting in early childhood.

Although the sample consisted of adolescent girls, a group known for their relatively high levels of body dissatisfaction (Wang et al., 2019), we did not specifically select participants on these higher levels of body dissatisfaction. Therefore, findings may not necessarily generalize to clinical groups with extreme body dissatisfaction (e.g., eating disorders and body dysmorphic disorder). Nevertheless, seeing that both interoceptive awareness and IU are transdiagnostic markers in anxiety disorders and eating disorders (Bijsterbosch et al., 2021; Boelen & Reijntjes, 2009; Khalsa et al., 2018; Sternheim et al., 2011), it is likely that the tested model is of relevance within in these disorders. Therefore, testing this study's model within a clinical group seems as an important next step as it may lead to novel ways of addressing body image issues.

Finally, it needs to be acknowledged that interoceptive awareness, using self-report measures, only partly measures interoceptive abilities. To make a thorough estimation of the functioning of all dimensions of interoception, researchers suggest not only to measure interoceptive awareness but also add instruments that measure interoceptive accuracy (the degree to which an individual can accurately perceive the state of her body) and interoceptive sensibility (an individual's confidence about her interoceptive accuracy) such as the Heart Rate Discrimination Task (Legrand et al., 2022). Investigating all dimensions of interoception in relation to all components of body image disturbances may help to understand the complex interaction between these two constructs.

5 | CONCLUSIONS

The aim of the present study was to assess the relationships between multiple facets of interoceptive awareness, body dissatisfaction, and IU in adolescent girls. In sum, the relationship found between interoceptive awareness and body dissatisfaction and the moderating role of IU in adolescent girls suggests that experiencing bodily signals as ambiguous and uncertain, alongside a low tolerance of uncertainty, may result in more complex body image issues. IU may play a role in the appraisal of these bodily signals. Moreover, this may be particularly true for those adolescent girls who do not feel safe in their body and who find it difficult to distract their thoughts when experiencing pain or discomfort.

Furthermore, the suggested imbalance between interoceptive (e.g., bodily signals) and exteroceptive (e.g., social environment) information (Eshkevari et al., 2014) should be studied more extensively as it may inform new methods of prevention and treatment of body dissatisfaction. However, future studies should focus on clarifying the exact role of internal factors in the development of body dissatisfaction. Nonetheless, the findings of the current study may help to further unravel underlying mechanisms of body image issues and to identify a potential avenue through which body dissatisfaction is developed and maintained.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data sets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

This research was approved by the Utrecht University Faculty Ethics Review Board (FETC; #22-0621). Written informed consent was obtained from the participants for publication of this case report and any accompanying images. All authors have consented in publishing the manuscript.

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