

Intersecting Paths: Self-Efficacy for Exercise, Appetitive Traits, and Internalizing Psychopathology

Ligiana Mihaela Petre*¹ and Paweł Adam Piepiora²

¹University of Bucharest, Faculty of Psychology and Educational Sciences, Laboratory of Advanced Studies in Clinical Psychology, Bucharest, Romania

²Wrocław University of Health and Sport Sciences, Faculty of Physical Education and Sports, Wrocław, Poland, pawel.piepiora@awf.wroc.pl
*ligiana.petre@fpse.unibuc.ro

Abstract. In this cross-sectional study, we explore the influence of age, Body Mass Index (BMI), appetitive traits, and internalizing psychopathology on exercise self-efficacy among 52 participants, framed within the Hierarchical Taxonomy of Psychopathology (HiTOP) model. Appetitive traits were assessed using the Adult Eating Behavior Questionnaire (AEBQ), exercise self-efficacy through the Self-Efficacy for Physical Activity Survey (SEPAV), and internalizing psychopathology via the Romanian Inventory of Depression and Anxiety Symptoms (IDAS-II). Stepwise regression analysis across three models revealed that BMI and age (Model 1) have minimal impact on exercise self-efficacy. Adding appetitive traits (Model 2) and internalizing symptoms (Model 3) significantly improved predictive power. Specifically, emotional under-eating was negatively associated with self-efficacy for exercise. Moreover, emotional under-eating was a negative predictor for resisting relapse and making time for exercise, as key factors of exercise self-efficacy. In addition, food responsiveness positively predicts resisting relapse, and negatively, making time for exercise, and self-efficacy for exercise. Lassitude was a negative predictor for resisting relapse, and appetite gain was a positive predictor for making time for exercise. These results underscore the relationship between psychological factors and physical activity, suggesting the need for interventions that address both mental and physical health dimensions. This study confirms the HiTOP model's relevance in identifying psychopathological influences on exercise behavior and mental health.

Keywords: HiTOP, Exercise Self-Efficacy, Appetitive Traits, Internalizing Psychopathology, IDAS-II

1 Introduction

The study of psychopathology has undergone significant advancements in recent years, with the emergence of the Hierarchical Taxonomy of Psychopathology (HiTOP) model providing a dimensional framework that transcends traditional diagnostic categories [1], [2], [3]. This model seeks to capture the underlying structure of psychopathology and promote a more comprehensive understanding of mental health disorders. Within

the HiTOP framework, the internalizing spectrum represents a broad range of psychopathological symptoms and disorders characterized by internalizing experiences, such as depression, anxiety, and related mood and anxiety disorders [4]. The research guided by HiTOP model identify a hierarchical-dimensional model of Eating Disorders psychopathology labeled Hierarchical Taxonomy of Internalizing Dimensions for Eating Disorders (Hi-TIDE) [5]. In the first study to test Hi-TIDE, Forbush et al. (2017) found 15 dimensions that predicted nearly 70% of the variance in clinical impairment secondary to an ED. In contrast, all DSM-5 eating, mood, and anxiety disorders combined predicted slightly <11% of clinical impairment. Thus, adopting a HiTOP and, respectively, a Hi-TIDE perspectives allows for a dimensional understanding of the psychopathology, recognizing that symptoms and disorders exist along a continuum rather than in discrete categories [1], [3], [6]. These frameworks hold promises for tailoring treatments to suit particular symptom dimensions, irrespective of, or in addition to, DSM-5 diagnosis, encouraging the exploration of transdiagnostic factors, such as appetitive traits and self-efficacy for exercise.

Appetitive traits are stable predispositions with a strong genetic component that interact with environmental factors and influence eating behaviors [7]. These traits play a crucial role in dietary habits, weight management, and overall health [8], [9], [10], [11], [7], [12]. The Adult Eating Behavior Questionnaire (AEBQ) was developed and validated, providing a measure of eight appetitive traits in adults [7], [13], [14]. The AEBQ includes four food approach appetitive traits (hunger, food responsiveness, emotional over-eating, and enjoyment of food) and four food avoidance appetitive traits (satiety responsiveness, emotional under-eating, food fussiness, and slowness in eating) [7]. Hunger (H) refers to the physiological need to eat, driven by the body's energy requirements. Hunger can significantly influence eating behaviors, with individuals experiencing a strong sensation of hunger being more likely to eat larger quantities of food or eat more frequently to satisfy this basic physiological need. In the context of appetitive traits, Hunger is often assessed in relation to how it prompts eating beyond immediate energy needs, contributing to patterns of overeating, or eating in the absence of hunger, which can affect weight management and health outcomes [7]. Food Responsiveness (FR) is the tendency to eat more in response to external food cues, such as the sight or smell of palatable foods [7]. Emotional Over-Eating (EOE) refers to the tendency to eat more in response to negative emotions. It's an emotional coping strategy that can lead to overeating [10], [7]. Enjoyment of Food (EF) signifies a strong pleasure and interest in eating, where individuals find eating to be a highly enjoyable experience [7]. Satiety Responsiveness (SR) is the ability to feel full after eating and affects how much one eats. Individuals with high satiety responsiveness are more likely to stop eating when they feel full [10], [7]. Research suggests that higher food cue responsiveness and lower satiety responsiveness are associated with overeating and eating disorders [15]. [Click or tap here to enter text.](#) Emotional Under-eating (EUE) is the opposite of emotional over-eating, where individuals eat less in response to negative emotions, leading to a decrease in appetite and food intake [7]. Food Fussiness (FF) refers to being selective or picky about food, rejecting a wide variety of foods, and having a limited range of foods that one is willing to eat [7]. Slowness in Eating (SE) is characterized

by eating at a slower pace, which may lead to being more aware of satiety cues and potentially lower food intake [10], [7].

2 Appetitive Traits and the Internalizing Spectrum

Appetitive traits have been linked to various psychopathological symptoms and disorders, including those within the internalizing spectrum [9], [13], [14], [15], [16], [17]. For instance, emotional eating, which involves using food as a coping mechanism for negative emotions, has been associated with higher levels of anxiety and depressive symptoms [18], [19]. Similarly, certain appetitive traits, such as food preoccupation or lack of control overeating, may contribute to the development and maintenance of internalizing symptoms [20]. Understanding the relationship between appetitive traits and the internalizing spectrum can provide valuable insights into how eating behaviors and motivations may influence mental health outcomes.

3 Self-Efficacy for Exercise and the Internalizing Spectrum

Self-efficacy for exercise, defined as an individual's belief in their ability to engage in and adhere to exercise behaviors, plays a vital role in mental health and well-being [21], [22], [23], [24]. Higher levels of self-efficacy for exercise are associated with greater engagement in physical activity, which has been consistently linked to reduced symptoms of depression, anxiety, and stress [22], [23], [24].

While there is limited research specifically examining the relationships among appetitive traits, self-efficacy for exercise, and the internalizing spectrum of the HiTOP mode, both appetitive traits and self-efficacy for exercise could contribute to the understanding of the development and maintenance of psychopathology. They provide valuable insights into the underlying mechanisms and individual differences that influence mental health outcomes. Understanding the significance of these constructs enables targeted interventions, prevention strategies, and a holistic approach to mental health. By incorporating these constructs into existing models, such as the HiTOP model, we can achieve a more comprehensive understanding of psychopathology, moving beyond traditional diagnostic categories and considering the multidimensional nature of mental health, and ultimately improve mental health outcomes for individuals.

This study aims to examine the relationship between appetitive traits, self-efficacy for exercise, and the internalizing spectrum within the HiTOP model. By investigating these factors concurrently, we seek to gain insights into their associations and potential implications for mental health.

4 Method

4.1 Sample

Participants were recruited across Romania via social media and asked to complete an online survey consisting of the three questionnaires listed below. There was no time limit and response variability were checked at random. Participants were briefed at the outset of the survey about the purpose of the study and the duration of the testing (on average, 30 minutes). Participants then provided informed consent online.

Participants provided comprehensive demographic information, including their birth month and year, gender, ethnicity, place of residence, education level, occupation, household income range, marital status, partnership status, number of children, and health status. The final sample consisted of 52 participants, of whom 43 identified as female and 9 as male. Age ranged between 21 - 52 ($M = 28$, $SD = 8.51$). Among participants, 40 attained a Bachelor's degree, 9 attained a Master's degree, and 3 attained a PhD. With respect to ethnicity, all participants were of Romanian ethnicity. Participants' places of residence were divided into two groups: metropolitan areas ($N=50$) and rural areas ($N=2$). Regarding partnership status, 35 participants had a partner, while 17 were single. In terms of marital status, 8 participants were married, 43 unmarried, and 1 divorced. As for occupation, 32 participants were students, 19 employed and 1 unemployed. 43 participants had no acute or chronic illness diagnosis, while 9 did report an illness.

4.2 Instruments

Inventory of Depression and Anxiety Symptoms (IDAS-II) (Romanian version). The IDAS-II, a factor analysis-based self-report measure of depression, anxiety, and bipolar symptoms, is congruent with the HiTOP structure of internalizing disorders [25], [26]. The IDAS-II is composed of 99 items on a 5-point Likert scale, ranging from 1 (*not at all*) to 5 (*extremely*). Respondents rated the severity of their symptoms during the previous two weeks. The IDAS-II comprises a broad scale, General Depression, which contains items from several other scales, as well as 18 nonoverlapping scales (Dysphoria, Lassitude, Insomnia, Suicidality, Appetite Loss, Appetite Gain, Well-Being, Ill Temper, Mania, Euphoria, Panic, Social Anxiety, Claustrophobia, Traumatic Intrusions, Traumatic Avoidance, Checking, Ordering and Cleaning). Psychometric evidence suggests that the IDAS-II can measure HiTOP model-based internalizing spectrum symptoms [3]. Currently, the IDAS-II is available in the original English version [26] and has been adapted to Turkish [27], Spanish [28], German [29], Swedish [30], and Romanian [31] populations. Median internal consistency was .95 in the current sample.

Adult Eating Behavior Questionnaire (AEBQ). The AEBQ, a self-report measure of appetitive traits in adults, provides a comprehensive, convenient, and easy-to-use measure of an adult's appetite [7]. The AEBQ comprises 35 items distributed across eight

subscales reflecting both 'food approach' traits (Hunger, Food Responsiveness, Emotional Over-Eating, Enjoyment of Food) and 'food avoidance' traits (Satiety Responsiveness, Emotional Under-eating, Food Fussiness, Slowness in Eating). Each item is rated on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. The AEBQ has demonstrated strong psychometric properties, with a Cronbach's alpha coefficient greater than 0.70 for each subscale, indicating high internal consistency and reliability in measuring appetitive traits [7], [32], [33], [34]. Median internal consistency was .72 in the current sample.

Self-Efficacy Scale for Exercise Behaviors (SE). Salis et al. [35] comprises 12 self-report items aimed to measure self-confidence in managing exercise habits. This instrument identifies two key factors for exercise self-efficacy: "Resisting Relapse" and "Making Time for Exercise".

The scale demonstrated good reliability and validity, with significant associations between self-efficacy scores and reported health behaviors, suggesting they are effective tools for assessing and understanding exercise self-management [35], [36], [37] [38]. Median internal consistency was .90 in the current sample.

4.3 Statistical method

We employed hierarchical multiple linear regression analysis to investigate the relationships between age, BMI, appetitive traits, and internalizing spectrum of psychopathological factors with regards to self-efficacy for exercise. By systematically adding clusters of related variables across three distinct models, we evaluated the incremental variance explained by each subsequent model. This hierarchical approach enabled us to not only discern the individual contributions of specific predictors but also assess the collective explanatory power of the variables associated with the Hierarchical Taxonomy of Psychopathology (HiTOP) model, thus providing a more complex understanding of the psychological underpinnings influencing exercise behavior.

5 Results and discussions

5.1 Descriptive statistics

The participants were 52 subjects ($M = 28$, $SD = 8.5$), 9 males and 43 females, with an age range of 21–52 years. All variables were normally distributed, less Suicidality with skewness of 2.65 ($SE = .33$) and kurtosis of 7.21 ($SE = .65$). A square root transformation did not solve the positive skewness of Suicidality variable. Log 10 transformation conducted to more symmetric data of Suicidality distribution.

Table 1 shows the characteristics of the sample included in the statistical analyses (frequencies and percentages for categorical variables, as well as means, median, standard deviation for continuous variables).

Table 1. Baseline characteristics (N=52)

General characteristics		Frequency	Percent		
Gender	Male	9	17.3		
	Female	43	82.7		
	Total	52	100		
Marital status	Single	43	82.7		
	Married	8	15.4		
	Divorced	1	1.9		
	Missing	0	0		
Residence	Total	52	100		
	Urban	50	96.2		
	Rural	2	3.8		
	Missing	0	0		
Education level	Total	52	100		
	Elementary	0	0		
	Secondary	0	0		
	Undergraduate	40	76.9		
Partnership Status	Postgraduate	12	23.1		
	Missing	0	0		
	In a relationship	35	67.3		
	No relationship	17	32.7		
	Missing	0	0		
	Mean	Median	Std. Deviation	Missing	
Age, years	28	23.00	8.51	0	
BMI, Kg/m²	22	21.51	3.84	0	

6 The relationship between Appetitive Traits, Internalizing Spectrum of Psychopathology, and Resisting Relapse of Exercise Behavior

Results of hierarchical multiple linear regression analyses to investigate the relationships between demographic factors, appetitive traits, and the internalizing spectrum of psychopathological factors with regards to resisting relapse as a key factor of exercise self-efficacy revealed the following: Model 1 which includes BMI and age, explains 4.4% of variance and was not significant ($p = .434$); Model 2 incorporating appetitive traits showed a significant increase in explained variance to 40.7% ($R^2 = .41, p = .009$); Model 3 further includes internalizing symptoms based on the HiTOP model, which

explained 66% of variance, though the increase in variance was not statistically significant ($p = .18$). The results showed that Enjoyment of Food ($B = .43, p = .038$) is a statistically significant predictor for Resisting Relapse, and Food Responsiveness ($B = -.39, p = .012$) is negatively associated with Resisting Relapse, indicating that individuals with higher food responsiveness may have more difficulty maintaining consistent exercise habits. Emotional Under-Eating ($B = -.20, p = .019$), is also a negative predictor for Resisting Relapse from exercise, suggesting that those who eat less in response to emotions might struggle with regular exercise commitment. Lassitude ($B = -.49, p = .016$) is also a significant predictor for Resisting Relapse. The fact that most predictors are not statistically significant individually does not diminish the overall explanatory power of Model 3; it indicates the collective effect of these variables of internalizing psychopathological factors may be more important than their individual effects. The significant predictors from these models, particularly Lassitude in Model 3, suggest that certain psychopathological features may impact one's capacity to resist relapse in the context of exercise behavior. Consequently, Enjoyment of Food positively predicts Resisting Relapse, suggesting that individuals who derive pleasure from eating may have better exercise adherence. This could be due to a more balanced relationship with food, where enjoyment does not necessarily lead to overindulgence that hinders exercise routines. Food Responsiveness is negatively associated with Resisting Relapse, indicating that individuals with high responsiveness to food cues might find it more challenging to maintain consistent exercise habits, potentially due to struggles with self-regulation. Emotional Under-Eating also negatively predicts Resisting Relapse, suggesting that individuals who eat less in response to emotional distress might have difficulties maintaining a regular exercise schedule. This could be reflective of broader issues related to emotional regulation and its impact on self-care behaviors like exercise. Lassitude is a significant negative predictor for resisting relapse, highlights how feelings of weariness and lack of energy, often associated with depressive symptoms, can significantly impede one's ability to maintain exercise habits. Although individual predictors are not all be statistically significant, the overall explanatory power of Model 3 emphasizes the collective impact of internalizing psychopathological factors on exercise Resisting Relapse. This suggests a complex interplay where no single factor is solely responsible for an individual's ability to Resist Relapse but rather a combination of factors.

7 The relationship between Appetitive Traits, Internalizing Spectrum of Psychopathology, and Making Time for Exercise

Results of hierarchical multiple linear regression analyses to investigate the relationships between demographic factors, appetitive traits, and the internalizing spectrum of psychopathological factors with regards to making time for exercise as a key factor of exercise self-efficacy revealed the following: Model 1 ($R^2 = .043$), indicates that BMI and Age alone do not significantly predict the time made for exercise; adding Appetitive Traits in model 2 showed a substantial increase ($R^2 = .39$), suggesting appetitive traits significantly affect making time for exercise. Results showed that statistically significant predictors include Food Responsiveness ($B = -.50, p = .041$) and Emotional

Under-Eating ($B = -.37, p = .006$), showing apparently contrasting impacts. Further adds psychopathological factors from the HiTOP internalizing spectrum in Model 3, showed that Model 2's adjusted R-square is higher than Model 3's ($R^2 = .63$, but the adjusted $R^2 = .15$), suggesting that adding factors from the HiTOP internalizing spectrum in Model 3 is not as useful for explaining variance in Making Time for Exercise as the Appetitive Traits included in Model 2. Among internalizing factors as predictors, only Appetite Gain is statistically significantly positive ($B = .90, p = .049$).

The results indicate that while demographic factors are essential for understanding individual differences in health behaviors, they do not significantly predict the variance in exercise time allocation. This highlights the complexity of exercise behaviors, suggesting that other psychosocial and behavioral factors play a more critical role. Moreover, the results highlight the importance of considering individual differences in appetitive traits and eating behavior when understanding exercise habits. In addition, the negative association between Food Responsiveness and Making Time for Exercise suggests that individuals more responsive to food cues might struggle more with making time for exercise. This could be due to a potential prioritization of food-related rewards over exercise or the influence of food responsiveness on lifestyle choices that may not support exercise engagement. Similarly, Emotional Under-Eating's negative association implies that individuals who eat less in response to negative emotions also tend to make less time for exercise. This could reflect a broader pattern of avoidance in dealing with negative states, whether avoiding food or exercise, as a coping mechanism. The positive association of Appetite Gain with Making Time for exercise suggests that among the internalizing factors, an increase in appetite is positively linked to making time for exercise. This could indicate that individuals experiencing appetite gain, potentially as part of their psychopathological symptoms, may turn to exercise as a method to manage or mitigate weight gain concerns or other related issues.

8 The relationship between Appetitive Traits, Internalizing Spectrum of Psychopathology, and Self-Efficacy for Exercise

The results of the hierarchical linear regression analysis showed that Model 1 with BMI and Age as predictors, indicates that only 4.4% of the variance in exercise behavior is explained by BMI and age, $R^2 = 0.044$, $F(2, 49) = 1.13, p = .332$. Model 1 is not statistically significant, suggesting that BMI and age alone do not significantly predict exercise behavior. Model 2 with Appetitive Traits added as predictors showed a substantial increase, $R^2 = 0.44$, indicating that 44.2% of the variance in exercise behavior is explained with the addition of appetitive traits. Model 2 is statistically significant, $F(9, 42) = 3.25, p = .004$, showing that appetitive traits significantly contribute to predicting exercise behavior. Model 3 with internalizing symptoms added explain 66.5% of the variance in exercise behavior ($R^2 = 0.665$). Model 2 showed a significant improvement with the inclusion of internalizing psychopathology, $F(28, 23) = 1.51, p = .163$. Despite the high R^2 , the p-value suggests that the model's increase in explanatory power may not be statistically significant across all added psychopathological factors. The results showed that Food Responsiveness ($B = -.900, p = .014$) and Emotional Under-Eating

($B = -.57, t(51) = -3.01, p = .004$) had the most significant contribution to the model. This could imply that individuals more attuned to food cues might prioritize food-related rewards over exercise or find it challenging to balance their appetitive responses with exercise engagement. Similarly, emotional under-eating's negative impact suggests that individuals who eat less in response to emotions may also engage less in exercise. This could reflect a broader pattern of avoidance coping mechanisms, where both food and exercise are neglected as means of dealing with emotional distress.

The collective impact of internalizing psychopathological factors on exercise efficacy is aligned with HiTOP paradigm [10], [5] that a broad spectrum of psychopathological symptoms, including those related to appetitive traits, eating behaviors and affective states, can influence a wide range of outcomes, including exercise behavior. This supports the interpretation that the collective impact of internalizing psychopathological factors, as seen in our results reflects a complex interplay of psychological factors influencing exercise adherence.

9 Conclusions

Our findings highlight that BMI and age have a minimal influence on exercise self-efficacy. In contrast, the incorporation of appetitive traits significantly enhances the model's predictive power, underscoring the profound impact of these traits on exercise behaviors. Notably, emotional under-eating and food responsiveness emerged as detrimental factors to exercise self-efficacy, indicating that individuals who reduce food intake in response to emotional distress may find it challenging to maintain consistent exercise routines. Furthermore, the study identifies specific internalizing symptoms, such as panic and lassitude that correlate with exercise behavior, suggesting that certain psychopathological conditions drive individuals towards engaging in physical activity, potentially as a coping mechanism.

This research contributes to the burgeoning literature on exercise behavior by applying the HiTOP model to discern the effects of psychopathology on physical activity engagement. It emphasizes the necessity of adopting a dimensional approach in interventions aimed at improving exercise adherence, advocating for strategies that concurrently address mental health, appetitive traits and physical activity.

However, the study's conclusions are tempered by limitations inherent in its cross-sectional design and the relatively small and demographically skewed sample, which may constrain the generalizability of the findings. Additionally, the reliance on self-reported measures introduces potential biases. Future research directions should include larger, more diverse samples and longitudinal designs to elucidate the causal relationships between psychopathology, appetitive traits, and exercise behaviors. Investigating the mechanisms underlying the observed associations and exploring the efficacy of targeted interventions to mitigate the negative impacts of psychopathological symptoms on exercise self-efficacy are also warranted.

In sum, the current study paves the way for integrated approaches to enhancing physical activity levels, necessitating attention to both appetitive traits and internalizing psychopathology.

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