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The Effect of Physical Activity Level on Intuitive Eating and Mindful Eating*

Muttalip Gökhan DİNÇER[1], Neşe TOKTAŞ[2†], Başak BAYHAN[2], Cemile BALCI[3]

[1] Department of Sports, Culture and Art, Antalya Bilim University, Antalya.
[2] Faculty of Sports Sciences, Akdeniz University, Antalya.
[3] Institute of Medical Science, Akdeniz University, Antalya.

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Abstract

Physical activity (PA) can provide self-control in regulating individuals' nutritional behaviors and physically active individuals tend to adopt healthier dietary habits compared to less physically active ones. There is a growing interest in the concept of mindful eating (ME) and intuitive eating (IE) in modulating healthy dietary habits. The significance of PA on IE and ME as well as the relationship between them is not clear in the literature. Thus, this study evaluated the effects of PA level on IE and ME. Using convenience sampling, a total of 423 participants, with n = 205 healthy females (M =26.00, SD =7.33 years; M =21.96, SD =3.40 kg/m^{-2}) and n= 218 healthy males (M =25.95, SD =6.32 years; M =24.56, SD =3.41 kg/m^{-2}), participated in this study. Participants completed the International Physical Activity Questionnaire-Short Form, Intuitive Eating Scale-2, Mindful Eating Questionnaire, and Eating Attitudes Test. Student's t-test or Mann–Whitney U test for two-group comparisons, as well as Kruskal–Wallis H test or one-way ANOVA for three-group comparisons, were conducted for statistical analyses, and a multiple linear regression analysis was used. However, IE and ME total scores were not significantly different among inactive, minimally active, and sufficiently active participants in both genders. According to multiple linear regression analysis, the effect of the total PA score on IE and ME was not found to be significant. The relationship between PA, IE, and ME is not visible. Thus, further studies are needed to develop effective intervention strategies in both general and clinical populations.
Keywords: Physical activity, Intuitive eating, Mindful eating

Fiziksel Aktivite Düzeyinin Sezgisel Yeme ve Yeme Farkındalığı Üzerine Etkisi

Öz

Fiziksel aktivite bireylerin beslenme davranışlarını düzenlemede özdenetim sağlayabilir. Fiziksel olarak aktif bireyler, daha az aktif olanlara göre sağlıklı beslenme alışkanlıklarını benimseme eğilimindedir. Sağlıklı beslenme alışkanlıklarını düzenlemede yeme farkındalığı ve sezgisel yeme kavramlarına olan ilgi artmaktadır. Fiziksel aktivitenin sezgisel yeme ve yeme farkındalığı üzerindeki rolü ve aralarındaki ilişki literatürde net olarak belirtilmemiştir. Bu çalışmanın amacı, fiziksel aktivite düzeyinin sezgisel yeme ve yeme farkındalığı üzerindeki etkilerini değerlendirmektir. Çalışmaya kolayda örnekleme yöntemi ile toplam 423 sağlıklı kadın (n=205) (*Ort.* =26.00, *S* =7.33 yıl; *Ort.* =21.96, *S* =3.40 kg/m^2) ve erkek (n=218) (*Ort.* =25.95, *S* =6.32 yıl; *Ort.* =24.56, *S* =3.41 kg/m^2) katılmıştır. Bireylere Uluslararası fiziksel aktivite anketi-kısa form, sezgisel yeme ölçeği-2, yeme farkındalığı ölçeği ve yeme tutum testi-kısa form uygulanmıştır. İki grup karşılaştırmalarında Student t-testi veya Mann Whitney U testi, üç grup karşılaştırmalarında Kruskal Wallis H testi veya tek yönlü ANOVA yapılmıştır. Ayrıca çoklu doğrusal regresyon analizi uygulanmıştır. Her iki cinsiyette de aktif olmayan, minimal aktif ve aktif bireyler arasında sezgisel yeme ve yeme farkındalığı toplam puanlarında anlamlı bir farklılık bulunmamıştır. Çoklu doğrusal regresyon analizine göre toplam fiziksel aktivite puanının sezgisel yeme ve yeme farkındalığı üzerindeki etkisi anlamlı değildir. Hem genel hem de klinik popülasyonda etkili müdahale stratejileri geliştirmek için daha fazla çalışmaya ihtiyaç vardır.
Anahtar kelimeler: Fiziksel aktivite, Sezgisel yeme, Yeme farkındalığı

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† **Corresponding Author:** Assistant Professor Neşe Toktaş, **E-mail:** nesetoktas@akdeniz.edu.tr

INTRODUCTION

Physical activity (PA) is one of the strongest lifestyle behaviors for promoting health and well-being (Nielson, 2009; Tylka & Homan, 2015). Thus, physically active individuals have lower rates/risk of cardiovascular disease, obesity, some types of cancer, type II diabetes, metabolic syndrome, better glycemic control, muscle and bone strength, as well as stronger respiratory capacities and immune systems compared to physically inactive individuals (Bardone-Cone et al., 2016; Fuezeki et al., 2017; Gauthier et al., 2020; Posadzki et al., 2020; Tylka & Homan, 2015). Likewise, many emergency health problems are linked to a lack of PA and poor nutrition (Gast et al., 2015). A limited number of studies observed the interaction between PA and nutrition (Joseph et al., 2011). However, PA can provide self-control in regulating individuals' Nutritional Behaviors (NBs) (Blakely et al., 2004), and physically active individuals tend to adopt healthier dietary habits compared to less physically active ones (Andrade et al., 2010; Gauthier et al., 2020). Hence, various mechanisms have been asserted for the relationship between PA and NBs (Carraça et al., 2019). The first is motivational and cognitive processes (Fleig et al., 2015; Mata et al., 2011), the increase in exercise-related self-managed motivation (Mata et al., 2011) and self-efficacy (Carraça et al., 2019) positively changes NBs. Therefore, it is assumed that regular PA and healthy food consumption share a common neurocognitive basis (Joseph et al., 2011). PA can be a gateway behavior for improved nutritional regulation, which can help individuals self-regulate their nutrition more healthily (Carraça et al., 2019). The second is the effect of PA on hunger and satiety. Some findings indicate that regular exercise affects different appetite hormones, food choices (Andrade et al., 2010; Gauthier et al., 2020), and appetite hormones, which directly determine hunger, potential food consumption, and the quantity of food consumed (Gauthier et al., 2020; King et al., 2011; Martins et al., 2008). These findings are assumed to achieve the abovementioned by changing the hedonic response to food stimuli and increasing the sensitivity of the satiety signaling system; physically active individuals have more advanced hunger-satiety mechanisms and better control their appetite (Joseph et al., 2011). Another possible mechanism has been attributed to the psychological aspect of PA. Regular exercise provides psychological benefits such as reduced anxiety and depression, increased self-confidence, better quality sleep, and higher quality of life (Tylka & Homan, 2015). These steps are stated to help improve the psychological state, decrease anxiety and stress, and resist the urge to overeat (Joseph et al., 2011). Therefore, PA can be helpful for an individual to control the urge to eat food while experiencing negative emotions (Andrade et al., 2010; Bardone-Cone et al., 2016; Moy et al., 2013).

There is also a growing interest in the concept of mindful eating (ME) and intuitive eating (IE) in modulating healthy dietary habits. Although there is no universal definition of ME (Warren et al., 2017). one can say that people are aware of the moment they are in while eating, paying close attention to the effects of foods on emotions, and non-judgmentally note the physical and emotional sensations in response to food (Moor et al., 2013; Schaefer & Magnuson, 2014; Warren et al., 2017). ME helps in paying attention to the hunger and satiety signals produced by the body to eat (Fuentes Artiles et al., 2019). Thus, it allows individuals to make conscious decisions about what to eat and when and how to consume it without following overly restrictive diets by promoting a non-judgmental attitude toward food (King et al., 2021). Furthermore, if individuals pay attention to their food experience and consumption, awareness of how food makes the individual feel can increase; thus, the individual will make healthier

food choices (Grider et al., 2020). However, ME mainly focuses on paying close attention to the eating process, not the type of food eaten (Moor et al., 2013). Consequently, there is increasing awareness of satiety, hunger, energy levels, emotions, and environmental cues in ME (Martin et al., 2013).

IE, similar to ME, helps individuals consume food when they are physiologically hungry. It also focuses on individuals' consumption of any food they desire. However, eating due to social, environmental, and emotional stimuli is avoided in IE. The stimuli that are mainly followed are the body's hunger and satiety signals (Camilleri et al., 2017; Gast et al., 2015; Horwath et al., 2019; Moy et al., 2013; Nielson, 2009). IE rejects the dieting mentality (Gast et al., 2015; Grider et al., 2020) and adopts the principle of respecting the body (Schaefer & Magnuson, 2014). It allows individuals to regulate food consumption in a healthy way and determine when to start and stop eating the foods they want. Therefore, they start their food intake when they are hungry and stop eating when they feel full (Gast et al., 2012; Moy et al., 2013). The role of PA in IE and ME, and the link between them is unclear. The purpose of this study was to evaluate the effect of PA level on IE and ME in adults aged between 18–45 years.

MATERIAL AND METHODS

Research Model

In this study, relational survey models, from quantitative research methods, were applied.

Participants

Using convenience sampling, 423 participants (205 females and 218 males) aged 18–45 years (this age range was preferred because of the increasing chronic diseases and drug use and the decreasing PA and IE with age progression) living in Antalya (Turkey) were recruited for participation. Questionnaires were administered to personnel and students from the universities where researchers work and asked to give the questionnaires to their families and friends. Inclusion criteria were being physiologically and psychologically healthy based on their self-report and not taking any medications and nutritional support. The exclusion criteria included elite athletes and postmenopausal, pregnant, and/or lactating women, being on a diet, and any medical condition that would affect appetite and eating status or the PA level. The participants' characteristics are provided in Table 1.

Table 1. Descriptive characteristics of participants

	Female (n=205)		**Male (n=218)**		**Total (n=423)**	
	Min.-Max.	**X̄±SD**	**Min.-Max.**	**X̄±SD**	**Min.-Max.**	**X̄±SD**
Age (year)	18.00-43.9	26.00±7.33	18.20-44.70	25.95±6.32	18.00-44.70	25.97±6.82
Height (cm)	150.00-191.00	165.53±6.29	152.00-193.00	177.92±6.94	150.00-193.00	171.92±9.08
Weight (kg)	42.00-97.00	60.21 ±10.08	50.00-120.00	77.95±13.07	42.00-120.00	69.35±14.69
BMI (kg/m^{-2})	16.10-34.80	21.96±3.40	18.30-35.10	24.56±3.41	16.10-35.10	23.30±3.65

X̄: Mean, SD: Standard Deviation

Instruments

International Physical Activity Questionnaire - Short Form (IPAQ): The IPAQ developed by Craig et al. (2003) and performed Turkish adaptation and validity by Sağlam et al. (2010) were used in this study. In the questionnaire, daily and weekly frequencies of moderate and vigorous activities and walking were evaluated within the last seven days to determine the PA level of participants. Scoring is made by considering the minute, day, and metabolic equivalents (MET) value and the PA level of the participants is determined. The sitting time is scored separately. The PA level is categorized according to the score obtained.
Inactive: <600 MET-min/week
Minimally active: 600–3000 MET-min/week
Sufficiently active: >3000 MET-min/week

Intuitive Eating Scale (IES-2): The IES was developed by Tylka (2006) to evaluate three key features to compare regular and irregular eating behavior. Tylka and Kroon Van Diest (2013) reviewed and identified a fourth feature. Baş et al., (2017) adapted it to Turkish adaptation and developed the IES-2 version. Consequently, the Turkish version was used in this study. The test-retest reliability of the IES-2 was 0.88 for the IES-2 total score. The scale consists of twenty-three five-point Likert-type questions and four subscales. The higher the total score or subscale scores of the scale, the higher the IE scores. These subscales are listed as follows: unconditional permission to eat, eating for physical rather than emotional reasons, reliance on hunger and satiety cues, and body-food-choice congruence. The test-retest reliability of the IES-2 was 0.80 for the unconditional permission to eat subscale score, 0.87 for eating for physical rather than emotional reasons subscale score, 0.84 for reliance on hunger and satiety cues subscale score, 0.90 for bodyfood choice congruence subscale score.

Mindful Eating Questionnaire (MEQ): The MEQ developed by Framson et al., (2009) consists of 30 questions and seven subscales. Köse et al. (2016), who adapted this five-point Likert-type scale to Turkish adaptation, rearranged some items and made additions. Its edited version was used in the study with a Cronbach's alpha of 0.73. The higher the total score on the scale, the higher the ME. These subscales are listed as follows: disinhibition, emotional eating, control of eating, focusing, eating discipline, awareness, and interference.

Eating Attitudes Test (EAT-26): EAT-40 developed by Garner and Garfinkel (1979) is used for screening and determining eating pathology. Savaşır and Erol (1989) adapted EAT-40 to Turkish and conducted a validity and reliability study. EAT-26, the short version of EAT-40, was used in this study. The internal consistency coefficient of the scale was found to be 0.70. In EAT-26, a six-point Likert-type scale consisting of 26 items, the risk of eating attitude disorder increases as the score increases. Participants with a total score of 20 and above were seen as having this disorder and were excluded from the study.

Ethical Approval

This study was approved by the Akdeniz University Clinical Research Ethics Committee (No: 70904504/498 and dated 10/02/2019). Written consent was obtained, and the study was conducted following the Declaration of Helsinki.

Statistical Analysis

The Kolmogorov–Smirnov and Levene test was conducted to verify the normality and homogeneity of variances of the variables. Data were analyzed using Student's t-test or Mann–Whitney U test for two-group comparisons, and Kruskal–Wallis H test or one-way ANOVA for three-group comparisons, depending on the compliance with the normality assumption. Post hoc analysis of pairwise comparisons in the analysis of variance was evaluated with the least significant difference test, and the groups that differed are shown with letters. When a significant difference between groups was observed in the Kruskal–Wallis H test, the post hoc test was conducted by Mann–Whitney U test with Bonferroni correction to account for the inflation of type-I error due to multiple comparisons. Hence, to determine the effect of the IPAQ total scores of the participants on IES and MEQ total scores, multiple linear regression analysis was conducted.

FINDINGS

The IE total and subscale scores of the participants, according to PA level, are presented in Table 2.

No difference was found between the groups in terms of the IE total and subscale scores according to the PA level in females ($p>0.05$). Similarly, no significant difference was found between the groups' IE total scores and the subscales of unconditional permission to eat, eating for physical rather than emotional reasons, and reliance on hunger and satiety cues according to the PA level in males ($p > 0.05$). However, there was a significant difference between the groups for the body-food-choice congruence, one of the subscales of IE ($p < 0.05$). According to the subanalyses conducted to determine at what measurements the difference originated, there was a difference between inactive and minimally active males as well as between inactive and active males ($p < 0.05$). The body-food-choice congruence score of inactive males (3.53 ± 0.90) was lower compared to minimally active (3.86 ± 0.86) and active males (4.01 ± 0.80). There was no difference between minimally active and active males ($p > 0.05$).

For all participants, no significant difference was found between the groups in terms of the IE total scores and the subscales of unconditional permission to eat, eating for physical rather than emotional reasons, and reliance on hunger and satiety cues according to the PA level ($p > 0.05$). There was a significant difference between the groups for the body-food-choice congruence, one of the subscales of IE ($p<0.05$). According to the subanalyses conducted to find out at what measurements the difference originated, a difference between inactive and active participants ($p<0.05$) was observed. The body-food-choice congruence score of inactive participants (3.55 ± 0.89) was lower compared to active participants (3.99 ± 0.84) ($p<0.05$). There was no difference between minimally active and active participants and between inactive and minimally active participants ($p>0.05$).

When the IE total scores and subscale scores in inactive, minimally active, and active participants were compared by gender, no difference was observed between inactive females and inactive males, and active females and active males ($p>0.05$). While there was no difference in terms of the subscale scores between minimally active females and minimally

active males ($p > 0.05$), there was a difference in the IE total score ($p<0.05$). The IE total score of minimally active males (3.67 ± 0.52) was higher compared to minimally active females (3.44 ± 0.63) ($p < 0.05$).

Table 2. Difference in the IE total scores, subscale scores, and gender variable according to the participants' level of PA

		Inactive X̄±SD	**Minimally active X̄±SD**	**Sufficiently active X̄±SD**	
IE total scores	Female	3,50±0.61	3.44±0.63	3.66±0.63	F=1.622 p=0.200
	Male	3.49±0.45	3.67±0.52	3.64±0.56	F=2.332 p=0.100
		t=0.084 p=0.933	t= -2.603 **p=0.01***	t=0.141 p=0.888	
	Total	3.50±0.54	3.55±0.59	3.65±0.58	F=1.985 p=0.139
Subscales					
Unconditional permission to eat	Female	3.43±0.80	3.34±0.86	3.36±0.62	F=0.219 p=0.803
	Male	3.33±0.78	3.46±0.79	3.36±0.80	F=0.568 p=0.567
		t=0.753 p=0.453	t= -0.906 p=0.366	t=0.002 p=0.998	
	Total	3.38±0.79	3.40±0.83	3.38±0.73	F=0.070 p=0.932
Eating for physical rather than emotional reasons	Female	3.49±0.99	3.44±1.05	3.61±1.12	F=0.360 p=0.698
	Male	3.58±0.74	3.72±0.82	3.71±0.84	F=0.698 p=0.499
		t= -0.571 p=0.569	t= -2.014 p=0.05	t= -0.504 p=0.616	
	Total	3.53±0.87	3.57±0.96	3.67±0.95	F=0.667 p=0.514
Reliance on hunger and satiety cues	Female	3.56±1.00	3.46±0.96	3.87±0.96	χ^2=5.957; df=2 p=0.051
	Male	3.54±0.87	3.71±0.94	3.65±0.81	χ^2=2.282; df=2 p=0.320
		Z= -0.558 p=0.577	Z= -1.978 p=0.05	Z= -1.542 p=0.123	
	Total	3.55±0.94	3.58±0.95	3.61±0.93	F=1.271 p=0.282
Body-food choice congruence	Female	3.57±0.89	3.64±0.94	3.96±0.90	χ^2=3.898; df=2 p=0.142
	Male	3.53±0.90[a]	3.86±0.86[b]	4.01±0.80[c]	χ^2=11.217; df=2 **p=0.004****; [a-b.c]
		t=0.292 p=0.770	Z= -1.752 p=0.08	t= -0.312 p=0.756	
	Total	3.55±0.89[a]	3.74±0.91[b]	3.99±0.84[c]	χ^2=13.567; df=2 **p=0.001****; [a-c]

X̄: Mean, SD: Standard deviation, χ^2: Kruskal-Wallis H statistic value, F: ANOVA test statistic value, t: Independent samples T test (t-table value), Z: Mann-Whitney U test statistic value, * p<0.05; ** p<0.01
[a-b.c]: statistically significant difference to a with b. a with c (statistical significance value $\alpha = 0.017$ with post-hoc Bonferroni correction)
[a-c]: statistically significant difference to a with c (statistical significance value $\alpha = 0.017$ with post-hoc Bonferroni correction)

The ME total and subscale scores according to the participants' PA levels are presented in Table 3.

No difference was found between the groups' ME total and subscale scores according to the PA level in females ($p>0.05$). Furthermore, no significant difference was observed between the groups' ME total scores and the subscales of disinhibition, emotional eating, focusing, eating discipline, awareness, and interference according to the PA level in males ($p>0.05$). However, there was a significant difference between the groups for eating control, one of the subscales

of ME ($p<0.05$). According to the subanalyses conducted to determine at what measurements the difference originated, there was a difference between minimally active and active males ($p < 0.05$). The eating control subscale score of minimally active males (3.22 ± 0.62) was higher than active males (2.98 ± 0.57).

There was no difference between inactive, minimally active, and active participants' ME total and subscale scores ($p>0.05$).

When the ME total scores and subscale scores in inactive, minimally active, and active participants were compared by gender, there was no significant difference between the groups for the ME total score and the subscales of disinhibition, focusing, eating discipline, awareness, and interference between inactive females and inactive males ($p>0.05$), but there was a significant difference between the groups for emotional eating and eating control, which are the subscales of ME ($p<0.01$). The emotional eating subscale score of inactive males (3.59 ± 0.90) was higher compared with inactive females (3.10 ± 1.17) ($p < 0.01$). The eating control subscale score of inactive females (3.47 ± 0.68) was higher compared to inactive males (3.17 ± 0.53) ($p<0.01$).

There was no significant difference between the minimally active females and minimally active males, and active females and active males for the ME total score and the subscales of disinhibition, emotional eating, eating control, focusing, eating discipline, and interference ($p > 0.05$). However, there was a significant difference between minimally active females and minimally active males for awareness, one of the subscales of ME ($p<0.01$). The awareness subscale score of minimally active females (3.03 ± 0.57) was higher than the score of minimally active males (2.82 ± 0.53) ($p<0.01$). Similarly, there was a significant difference between active females and active males for emotional eating and eating control, which are the subscales of ME ($p < 0.05$). The emotional eating subscale score of active males (3.62 ± 0.90) was higher than the score of active females (3.22 ± 1.07) ($p<0.05$). The eating control subscale score of active females (3.42 ± 0.59) was higher than the score of active males (2.98 ± 0.57) ($p<0.01$).

Table 3. Difference in the ME total score. subscale scores and gender variable according to the participants' level of PA

		Inactive X̄±SD	**Minimally active X̄±SD**	**Sufficiently active X̄±SD**	
ME total score	Female	3.16±0.48	3.23±0.42	3.17±0.48	F=0.624 p=0.537
	Male	3.18±0.33	3.19±0.41	3.13±0.38	F=0.405 p=0.667
		t= -0.359, p=0.720	t= 0.738, p=0.461	t=0.445, p=0.657	
	Total	3.17±0.41	3.21±0.41	3.15±0.42	F=0.840 p=0.432
Subscales					
Disinhibition	Female	3.12±0.89	3.24±0.79	3.18±0.90	F=0.385 p=0.681
	Male	3.25±0.75	3.17±0.88	2.99±0.85	χ^2=2.688 df=2 p=0.261
		Z= -0.857, p=0.392	t= 0.570, p=0.569	t=1.056, p=0.294	
	Total	3.18±0.82	3.20±0.84	3.07±0.87	χ^2=1.297 df=2 p=0.523
Emotional eating	Female	3.10±1.17	3.33±1.10	3.22±1.07	F=0.857 p=0.426
	Male	3.59±0.90	3.60±0.96	3.62±0.90	χ^2=0.105 df=2 p=0.949
		t= -2.687, **p=0.008****	Z= -1.669, p=0.095	Z= -2.059, **p=0.040***	
	Total	3.35±1.07	3.46±1.04	3.47±0.98	χ^2=0.827 df=2 p=0.661
Control of eating	Female	3.47±0.68	3.33±0.66	3.42±0.59	χ^2=2.180; sd=2 p=0.336
	Male	3.17±0.53 [a]	3.22±0.62[b]	2.98±0.57[c]	χ^2=7.342; df=2 **p=0.025*;** [b-c]
		Z= -3.214, **p=0.001****	Z= -1.059, p=0.290	t= 3.712, **p=0.000****	
	Total	3.32±0.63	3.28±0.65	3.15±0.61	χ^2=5.313 df=2 p=0.070
Focusing	Female	3.24±0.40	3.21±0.44	3.08±0.56	F=1.703 p=0.185
	Male	3.20±0.41	3.12±0.42	3.18±0.45	F=0.618 p=0.540
		t=0.649, p=0.517	t= 0.544, p=0.194	t= -0.989, p=0.325	
	Total	3.22±0.40	3.17±0.43	3.14±0.50	F=1.055 p=0.349
Eating discipline	Female	2.96±0.76	3.09±0.83	3.11±0.82	F=0.667 p=0.514
	Male	2.95±0.83	2.96±0.84	2.92±0.68	F=0.050 p=0.951
		t=0.027, p=0.978	t= 1.105, p=0.270	t= 1.206, p=0.232	
	Total	2.96±0.79	3.03±0.84	2.99±0.74	F=0.323 p=0.724

Table 3 (Continue). Difference in the ME total score. subscale scores and gender variable according to the participants' level of PA

		Inactive X̄±SD	**Minimally active X̄±SD**	**Sufficiently active X̄±SD**	
Awareness	Female	2.94±0.59	3.03±0.57	3.02±0.58	χ^2=1.729 df=2 p=0.421
	Male	2.83±0.55	2.82±0.53	2.86±0.60	χ^2=0.412 df=2 p=0.814
		Z= -0.765, p=0.444	Z= -3.016 ,**p=0.003****	t= 1.281, p=0.203	
	Total	2.89±0.57	2.93±0.56	2.92±0.59	F=0.275 p=0.760
Interference	Female	3.46±1.04	3.60±0.74	3.28±1.13	χ^2=2.191 df=2 p=0.334
	Male	3.30±0.95	3.64±0.82	3.55±0.78	χ^2=4.471 df=2 p=0.107
		Z= -1.140 p=0.254	Z= -0.372 p=0.710	Z= -1.304 p=0.192	
	Total	3.38±0.99	3.62±0.77	3.45±0.93	χ^2=3.182 df=2 p=0.204

X̄: Mean, SD: Standard deviation, χ^2: Kruskal-Wallis H statistic value, F: ANOVA test statistic value, t: Independent samples T test (t-table value), Z: Mann-Whitney U test statistic value
* p<0.05; ** p<0.01; [b-c]: Statistically significant difference to b with c (statistical significance value α = 0.017 with post-hoc Bonferroni correction)

Multiple linear regression analysis was conducted to determine the effect of the total PA score on IE and ME in the participants (Table 4). In the univariate analysis (Model 1), while it was observed that the increasing total PA score positively affected IE (β = 0.113; p = 0.020), it was not found to be linked with ME (p = 0.835). In Model 2, the total PA score's effect on IE and ME was evaluated by adjusting it according to age, gender, and body mass index (BMI). As a result of the analysis, it was identified that the total PA score and IE were positively related but not statistically significant (β = 0.090; p = 0.061). Model 3 was adjusted according to occupation, income level, smoking, and alcohol use in addition to age, gender, and BMI, and a positive but not significant relationship between the total PA score and IE (β=0.089; p=0.066) was observed. In both Models 2 and 3, the effect of the total PA score on ME was not found to be significant.

Table 4. The effect of the participants' total PA scores on IE and ME

	Model 1			**Model 2**			**Model 3**		
Dependent variables	**β**	**t**	**p**	**β**	**t**	**p**	**β**	**t**	**p**
IE	0.113	2.338	**0.020***	0.090	1.878	0.061	0.089	1.844	0.066
ME	-0.010	-0.209	0.835	0.006	0.116	0.908	0.014	0.283	0.777

IE: Intuitive eating; ME: Mindful eating
Linear regression
Model 1: Crude model; Model 2: Adjusted for age, gender, and BMI; Model 3: Adjusted for age, gender, BMI, occupation, education, income, smoking and alcohol.

Multiple linear regression analysis was conducted to determine the effect of sitting time on IE and ME in the participants (Table 5). In Models 1 and 2, the effect of sitting time on IE and ME was not found to be significant.

Table 5. The effect of the participants' sitting time on IE and ME

	Model 1			Model 2			Model 3		
Dependent variables	**β**	**t**	**p**	**β**	**t**	**p**	**β**	**t**	**p**
IE	-0.045	-0.917	0.360	-0.010	-0.200	0.842	-0.008	-0.173	0.863
ME	-0.093	-1.912	0.057	-0.083	-1.721	0.086	-0.081	-1.668	0.096

IE: Intuitive eating; ME: Mindful eating
Linear regression
Model 1: Crude model; Model 2: Adjusted for age, gender, and BMI.; Model 3: Adjusted for age, gender, BMI, occupation, education, income, smoking and alcohol

DISCUSSION

This study was evaluated to determine if the PA level in adults affected IE and ME. No difference was found between the groups in terms of the IE total score among inactive, minimally active, and sufficiently active individuals in both females and males. According to multiple linear regression analysis conducted to determine the effect of the total PA score on IE, there was a positive but not significant relationship between the total PA score and IE. Furthermore, the effect of sitting time on IE was not found to be significant.

The link between IE and health behaviors such as PA is not clear (Van & Drinkwater, 2014). In the literature concerning IE and PA, there are studies on the motivation for PA and studies conducted on the effects of IE interventions on PA and in clinical populations such as obesity or eating disorders. The relationship between dieting by restricting calorie intake, exercising (cardiorespiratory activities), and IE was evaluated in a study involving boys (n = 669) and girls (n = 708). It was found that exercising, regardless of gender and diet, was associated with feeling less permission to eat what is desired and eating to satisfy physical hunger rather than coping with emotional distress. Unlike our study, a positive link was found between exercise and IE. Interestingly, those who exercised ate more restrictively as per this study. Nevertheless, food consumption was not evaluated in this study, thus, it is unknown whether this restrictive eating is associated with healthy foods (Moy et al., 2013). IE has been proposed as an eating style that promotes a positive relationship with the body, food, and PA. It is crucial to be physically active for health and pleasure purposes rather than weight loss and energy consumption (Bruce & Ricciardelli, 2016). In the relationship between body image, markers linked with eating, and exercise, the participant's desire to participate in PA is also essential rather than the frequency and amount of exercise. The goal of intrinsic PA, such as health, socialization, better psychological state, and pleasure, was found to be positively associated with IE (Tylka & Homan, 2015). In a study conducted on 200 undergraduate female students, it was demonstrated that females with internal motivation for eating also had the internal motivation to participate in regular PA. Their reason for participating in PA is pleasure, and PA is a part of the self-concept of women who are internally motivated to eat (Gast et al., 2015). A total of 108 male students participated in the study investigating college men in the continuity of motivation based on IE state and whether PA and IE motivation were associated. According to this study, IE can be an essential factor in the first few stages of motivation for PA; however, it is not essential at further stages (Gast et al., 2012). In a study conducted to evaluate PA motivation between restrictive eaters and intuitive eaters among female students, it was observed that intuitive eaters had higher intrinsic motivation to participate in PA. However, this finding does not mean that intuitive eaters are better at maintaining PA than non-intuitive

eaters (Nielson, 2009). In other words, IE was linked with more motivation to participate in PA when focused on feelings of pleasure and less motivation when focused on feelings of guilt, appearance, or pressure (Bruce & Ricciardelli, 2016). In a review conducted by Van & Drinkwater (2014), it was observed that there could not be a strong relationship between IE and PA unless the IE intervention program is specially focused on PA. A total of 1,435 active women of 40–50 years participated in the study investigating differences in IE and motivation for eating between women who did activities for losing weight and those who did activities without the aim of losing weight. Women who mainly did physical activities for losing weight were found to be associated with less IE style (Carraça et al., 2019).

While there was no difference among females with different PA levels for the IE subscales, there was a difference only for the subscale of body-food-choice congruence in males. The body-food-choice congruence score of inactive males was lower compared with minimally active and active males. There was no difference between minimally active and active males; they preferred foods suitable for their physiological needs, which helped their bodies to be healthier and support their physical performance. In a study involving 5,238 participants (51% males) of 20–100 years, the relationship between IE, BMI, diet quality, and PA was evaluated, and a small significant positive relationship was observed between body-food-choice congruence and PA in both females and males, as well as between eating for physical rather than emotional reasons and PA in females only (Horwath et al., 2019). This result could be due to the difference in the age group and the number of participants.

In our study, the weekly frequency and daily duration of moderate and vigorous activities and walking within the last seven days were evaluated. We focused on the frequency and duration of the activity rather than the reason for participation in PA, motivational factors, and the type of activity. There is a need for additional studies on the long-term effects of PA on IE and its progression. No difference was found between the groups in terms of the ME total score among inactive, minimally active, and sufficiently active participants in both females and males. Furthermore, the effect of the total PA score on ME and the effect of sitting time on ME was insignificant according to Models 1, 2, and 3.

Ninety participants between 18–58 years of age, with a mean age of 25.86 ± 9.67 years, participated in a study investigating the relationship between BMI, PA level, and ME among university students. Similar to our study, the PA level was not linked with ME scores (Moor et al., 2013). According to the findings obtained by Framson et al. (2009), who developed and tested the MEQ, participants who did more exercises were not more mindful eaters. However, according to the findings of Moor et al. (2013), physically active participants were less aware of foods and were more emotional eaters. In our study, a significant difference was found for the eating control subscale only in males. This subscale score of minimally active males was higher than that of active males. We cannot yet explain the reason for this finding. We attributed this to chance. A total of 159 women who did exercises participated in the study in which the role of mindfulness and body awareness in the relationship between exercise and eating behavior was evaluated; among the women who did different types of exercises like yoga or cardio-based exercises, a positive correlation was found between the time spent on yoga and ME in women who only did yoga because yoga includes mindfulness and supports body awareness (Martin et al., 2013). In another study, the relationship between ME, BMI, binge eating, anxiety, and the negative effect was evaluated in 216 participants consisting of students

who regularly exercised, university athletes, participants who did yoga, and obese participants. As a result of this study, it was indicated that obese participants ate less mindfully compared to participants who did yoga and sports at the professional or recreational level. Furthermore, ME was negatively associated with anxiety and negative affect. In our study, conditions such as the type of PA, anxiety, and negative effects were not evaluated.

However, this study has some limitations. All data were measured as self-report. Only weekly frequency and daily duration were evaluated for the PA level. PA can be measured more objectively (e.g., by accelerometer), and the type of activity, the purpose of doing the activity, and the motivational factors can be evaluated. Eating behavior is a complex behavior shaped by emotional, social, physiological, and environmental-cultural factors. Participants with eating disorders were not included in this study. However, conditions such as depression, anxiety, and negative effects were not measured; there may be an unknown physiological disease that affects eating behavior. Furthermore, the study is cross-sectional and could limit the results.

CONCLUSION

The PA level did not affect IE and ME. Studies on PA, IE, and ME are promising for healthy living behavior, positive effects on some diseases, and weight management. The relationship between PA, IE, and ME is not straightforward. Thus, there is a need for additional studies for effective intervention strategies in both the general and clinical populations.

Conflict of Interest: The authors of the article do not have any personal or financial conflicts of interest within the scope of the study.

Authors' Contribution: Study design: NT, MGD; Data collection: MGD, BB; Statistical analysis: NT, CB; Manuscript Preparation: NT, CB, MGD, BB.

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