Cognitive functioning, fat mass and physical activity in young adults

Funcionamiento cognitivo, masa grasa y actividad física en adultos jóvenes

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Abstract

Introduction: Evidence suggests an association between excess weight and low cognitive performance; however, findings are inconsistent due to variations in measurement approaches. Further research is needed to explore this link, considering factors such as physical activity and education level.

Objective: this study aimed to: (a) identify possible differences in cognitive performance between participants with high versus normal fat mass levels, and (b) assess the effects of fat mass levels and physical activity on executive and cognitive-motor interference performance.

Methodology: A non-experimental design was conducted, involving 61 young adult participants (M_{age}=18.9, SD=1.9) who underwent evaluations for executive functioning, cognitive-motor interference in dual tasks, body composition, and physical activity.

Results: Although differences favoring participants with high fat mass levels were found, they were not statistically significant. These results remained consistent regardless of physical activity level.

Discussion: While some studies have found an association between high adiposity and lower cognitive performance, others have not detected this relationship. Our findings align with the latter, emphasizing the need for future studies to include mediating variables to better understand this complex association.

Conclusion: this investigation supports the notion that individuals with overweight and obesity do not exhibit inferior executive and cognitive-motor interaction performance compared to individuals with normal fat mass levels.

Keywords

Bioelectrical impedance; body fat distribution; cognition; executive functions; physical activity.

Resumen

Introducción: La evidencia sugiere una asociación entre el exceso de peso y el bajo rendimiento cognitivo, aunque los hallazgos son inconsistentes debido a las variaciones en los enfoques de medición. Se necesitan más investigaciones para explorar este vínculo, teniendo en cuenta factores como la actividad física y el nivel educativo.

Objetivo: este estudio se propuso: (a) identificar posibles diferencias en el rendimiento cognitivo entre participantes con niveles de masa grasa altos frente a normales, y (b) evaluar el efecto de los niveles de masa grasa y la actividad física sobre el rendimiento ejecutivo y la interferencia cognitivo-motora.

Metodología: se realizó un estudio de diseño no experimental en el que participaron 61 adultos (M_{edad}=18.9, DE=1.9) jóvenes que desarrollaron evaluaciones de funcionamiento ejecutivo, interferencia cognitivo-motora en tareas duales, composición corporal y actividad física.

Resultados: aunque se encontraron diferencias que favorecían a aquellos con niveles de masa grasa altos, estas no fueron estadísticamente significativas. Estos resultados se mantuvieron independientemente del nivel de actividad física.

Discusión: Mientras que algunos estudios han encontrado una asociación entre alta adiposidad y menor rendimiento cognitivo, otros no han detectado esta relación. Nuestros hallazgos se alinean con estos últimos, enfatizando la necesidad de que futuros estudios incluyan variables mediadoras para comprender mejor esta compleja asociación.

Conclusión: esta investigación apoya la noción de que los individuos con sobrepeso y obesidad no muestran un rendimiento ejecutivo y de interacción físico-cognitiva inferior en comparación con los individuos con niveles de masa grasa normales.

Palabras clave

Bioimpedancia eléctrica; distribución de grasa corporal; cognición; funciones ejecutivas; actividad física.

Introduction

Overweight and obesity are conditions characterized by an abnormal or excessive accumulation of body fat, as defined by the body mass index (BMI), with the threshold being 25 kg/m^2 for overweight and 30 kg/m^2 for obesity (World Health Organization [WHO], 2024). These conditions pose risks to both physical and mental health and are associated with the development of non-communicable diseases (Gadde et al., 2018; WHO, 2021) and psychological issues (Yang et al., 2018).

The prevalence of overweight has been steadily increasing, reaching 43% of the adult population over 18 years in 2022 (WHO, 2024), a trend further exacerbated by the COVID-19 pandemic (Aguirre-Loaiza et al., 2021; Bhutani & Cooper, 2020; Cadavid-Ruiz et al., 2023). Given its escalating impact on public health and the high costs associated with medical care, overweight and obesity have become a priority issue to address (General Assembly of the United Nations, 2011).

The relationship between body composition, particularly overweight and obesity, and cognitive performance has been a subject of significant interest among researchers (Osorio-Cualdrón et al., 2021). Previous studies have suggested an association between overweight and obesity and low performance on executive functions (EF)—complex, goal-oriented cognitive processes essential to daily life (Yang et al., 2018). While most researchers agree that inhibition, cognitive flexibility, and working memory are core components of EF, some also include decision-making, verbal fluency, and planning (Yang et al., 2018).

Emerging research in Latin America aligns with global findings, indicating that primary cognitive impairments involve processes such as inhibitory control, cognitive flexibility, working memory, decision-making, and verbal fluency (Cabas et al., 2018; Silva et al., 2024; Yang et al., 2018). However, there is no consensus on which specific EF are affected, nor on the directionality of the relationship between these variables, as the evidence in the literature is inconclusive. According to a systematic review by Yang et al. (2018), there are some studies indicating that impairments in EF, particularly in inhibitory control, can cause abnormal eating behavior that may lead to overweight, while other research has found that adiposity levels cause inflammation which negatively affects brain health and cognition.

Though EF measures are commonly used to evaluate cognitive performance, other methods, such as dual-task paradigms, can offer additional insight. These paradigms assess how simultaneous cognitive and motor tasks influence each other, usually observed as a decrease in the performance of one of two tasks done simultaneously. This phenomenon is referred to as cognitive-motor interference (CMI). CMI suggests the idea that the brain's processing capacity is limited (Plummer et al., 2013) and has been proven to be useful in identifying mild cognitive impairment and the risk of suffering from dementia (Montero-Odasso et al., 2017). In consequence, the implementation of dual-tasks could add up evidence for the study of the relationship between body composition and cognitive performance.

Additionally, CMI offers a valuable approach to addressing the challenges posed by the conceptualization and methodology of studying cognition. Traditionally, motor and cognitive processes have been evaluated as separate entities, despite neuroscientific evidence supporting their close relationship. Several models such as those related to motor cognition, reflect this connection by proposing that the motor system is involved in processes traditionally regarded as higher-level cognitive functions (Jackson & Decety, 2004). CMI, therefore, enables the simultaneous evaluation of both dimensions, providing insight into their interdependence and offering a more holistic perspective on cognitive performance.

Other obstacles are worth mentioning. First, literature has highlighted concerns regarding the methods employed to measure body composition. One notable issue is the heterogeneity of these methods across different studies (Yang et al., 2018). Another significant challenge arises from the use of Body Mass Index (BMI), which is widely utilized due to its simplicity in health assessments (Gadde et al., 2018). However, BMI does not precisely account for adipose tissue distribution, nor does it discriminate between the various components constituting total body mass, such as fat mass, water, minerals, and protein content (Nuttall, 2015). This is particularly important, as being able to differentiate fat mass levels allows for a more specific analysis of its relationship with cognition, whereas BMI includes other variables of body composition that may obscure this connection. Consequently, alternative approaches that offer a more nuanced discrimination of body composition have been proposed, with bioelectrical impedance being one of them (Bove et al., 2016; Catoira et al., 2016).

Furthermore, many of the studies reviewed have overlooked the analysis of certain age groups, specifically young adults, and variables such as educational level and physical activity (PA). PA, for example, has been reported to positively influence cognitive abilities and EF such as inhibition, verbal fluency, and cognitive flexibility (Ishihara et al., 2021). Some background in our line of work has identified the effect of PA on inhibitory control (Aguirre-Loaiza et al., 2022), emotional recognition (Aguirre-Loaiza et al., 2019), and metacognitive (Herrera-Agudelo et al., 2021) processes. These improvements are thought to stem from both structural and functional changes in the brain brought about by PA. In particular, these effects have been observed in participants with obesity (Muhammad, 2024).

Considering the above, we have established two objectives that aim to address the current limitations in the literature: (a) to evaluate differences in cognitive performance (EF and CMI) between young adults with normal and high FML, and (b) to test the possible effect of PA and FML on cognitive performance. We have chosen to focus on the EF that have been shown to improve with PA. We hypothesized that there would be significant differences in executive functioning and CMI among individuals with normal FML and vigorous levels of PA, when compared to those with high FML and low PA levels.

Method

Participants

A non-experimental study was conducted with 61 young adult participants (*Mdn*$_{age}$=19.0, Interquartile range - *IQR*=2.0) who volunteered for the study. The scope of the study was to examine cognitive performance, specifically EF and CMI, in relation to FML and PA levels in young adults. Data collection for this study took place in December 2021. The final sample, determined post hoc, consisted of 16 males (*Mdn*$_{age}$=19.0, *IQR*=2.0) and 45 females (*Mdn*$_{age}$=18.0, *IQR*=2.0), all of whom were university students with a median educational level of 13 years (*IQR*=2.0). The sample size was intended to be as large as possible, and post hoc sensitivity analyses performed with G*Power 3.1 (Faul et al., 2009). Participants were recruited during a period of loosened COVID-19 pandemic restrictions, which contributed to the limited sample size.

Exclusion criteria were: (i) being minors (under 18 years old), (ii) neurological or psychiatric impairments and/or psychiatric medication usage (assessed through self-report), (iii) scoring < 21 on the Montreal Cognitive Assessment (MoCA) according to the cut-off point established for Colombian population, (iv) high scores on the Beck Depression Inventory and Barratt Impulsiveness Scale according to established cut-off points, and (v) having metallic implants that interfere with the use of the Biody Xpert ZM® device (see techniques and instruments). As a result, 14 participants were excluded from an initial sample of 75 participants.

Procedure

All participants were fully aware of the aim and extent of the study, and their participation adhered to the Declaration of Helsinki guidelines (World Medical Association, 2013). This research was approved by the Ethical Committee of the Universidad Católica de Pereira, under Resolution N°006 of November 13th of 2018. The assessment protocol was conducted in four phases within the university campus: (i) sociodemographic information, cognitive and psychological screening variables and PA questionnaire (ii) EF assessment, (iii) body composition measurements (weight, height and BIA usage) and (iv) dual tasks evaluation.

Instruments

Ad-Hoc Questionnaire

Data regarding sex, age, years of education and parents' educational level were collected through an online Google Forms® questionnaire.

Montreal Cognitive Assessment (MoCA)

This test evaluates mild cognitive impairment, assessing different cognitive domains (memory, visuospatial abilities, EF, attention, verbal fluency and orientation). It possesses satisfactory psychometric properties (Cronbach's alpha = 0.83) (Nasreddine et al., 2005). For the Colombian population the cut-off point was set at <21 (Pedraza et al., 2017).

Beck Depression Inventory (BDI-II)

It evaluates the existence of depressive symptomatology. In this study, the Spanish version was applied, which holds good internal consistency reliability for university population (α=0.89), and appropriate sensitivity and specificity indexes (>70%) (Sanz, 2013). Scoring >30 was set as an exclusion criterion.

Barratt Impulsiveness Scale (BIS-11)

It assesses impulsiveness as a personality trait. It has appropriate internal consistency reliability (α=0.83) (Stanford et al., 2009). High scores on this scale were established as an exclusion criterion, according to the Colombian psychometric properties (Aguilar et al., 2017).

Go/No Go

It assesses inhibitory control on various contexts and involves responding fast when the stimulus Go is shown and inhibiting the response when the stimulus No-Go appears (Sánchez-Kuhn et al., 2017). Forty randomized trials were presented. Accuracy rate and response time were evaluated.

Stroop

It evaluates processes such as attentional control and automatic response inhibition. In this test, participants must respond according to the color of the letters of a word, which refers to another color, while ignoring the meaning of the word. This leads to an interference effect due to the incongruence between the word's meaning and its color (Kalanthroff et al., 2013). Five blocks of twelve randomized trials each were presented. Accuracy rate and response time were evaluated.

Trail Making Test B (TMT-B)

It has been used to assess cognitive domains like processing speed, sequencing, cognitive flexibility and visuomotor skills (Bowie & Harvey, 2006). For this research, only part B of the TMT was applied (numbers and letters). Response time was evaluated through five randomized trials.

Verbal Fluency Test (VFT)

This test evaluates verbal functioning by measuring spontaneous production of words under limited conditions. It is widely used to assess executive control, lexical knowledge and retrieval capacity (Shao et al., 2014). Participants were asked to produce as many words as possible within a semantic category (i.e., animals) and beginning with a specific letter (S and F).

10m Cognitive-Motor Interference Task

The CMI refers to the simultaneous performance of cognitive and motor tasks. In this study, participants completed three tasks along a plain 10-meter surface between points A and B (see figure 1): (1) simple motor task: participants must walk from point A to B, and return, (2) dual motor-motor task: participants walk to point B where they grab a glass of water, which they hold on to their way back. (3) dual cognitive-motor task: participants walk while performing sequential subtractions of 7 beginning at 100 (i.e., 100-7, 93-7…).

Dual-task paradigms, such as walking while subtracting numbers, are commonly used to assess cognitive-motor interference (Al-Yahya et al., 2011). These tasks have been shown to reveal significant insights into how cognitive tasks affect motor performance, particularly in young adults (Buerskens et al., 2016). By comparing the performance on these tasks, it is possible to determine the CMI through the calculation of motor-motor cognitive cost (percentage change in speed between tasks 1 and 2) and motor-cognitive cost (percentage change in speed between tasks 1 and 3). Cognitive cost was computed using the following formula: ((step speed in simple task-step speed in dual task)/step speed in simple task)* 100%. Time was measured using a Stern® stopwatch (Figure 1).

Bioelectrical Impedance Analysis (BIA)

This technique assesses body composition by transmitting one or more low-intensity electrical frequencies to measure tissue resistance. It serves as an alternative to BMI by offering a more detailed analysis of body composition. The procedure is painless, non-invasive, and portable (Aldobali & Pal, 2021). In this study, we used the Biody Xpert ZM® device and Biody Manager® software to classify participants into two groups based on fat levels: high (including "to treat" and "to monitor" categories) and normal (including "close to the standard," "in the standard," and "very good") (Figure 2).

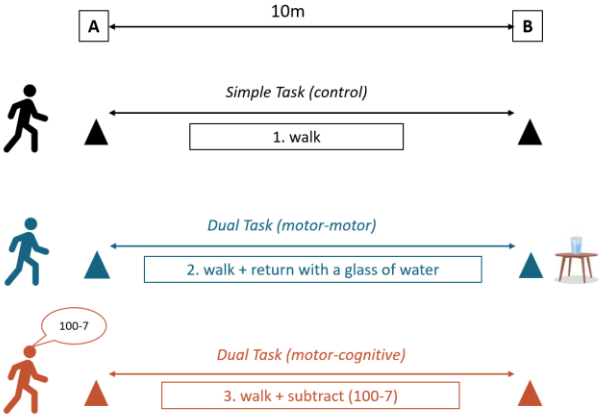
The analysis was based on fat mass indexes, which assess balance values using a ratio derived from each participant's calculated fat mass value and a reference value (adjusted by age, sex, weight, and height): Reference Value / Calculated Value. The resulting ratio ranges from 0 to 2, with 1 as the baseline. Values above 1 indicate higher fat levels, and values below 1 indicate lower levels. For example, a 20-year-old female participant (168 cm, 79.2 kg) with a reference fat mass of 20.8% and a calculated value of 34.6% would yield a fat mass index of 1.7 (34.6 / 20.8 = 1.7).

To categorize fat mass index (FMI) levels in this study, we used the median value of participants' FMI (*Mdn* = 1.20) as a cutoff: values ≤ 1.20 were classified as "normal" and values ≥ 1.21 as "high."

Body mass and height measurements

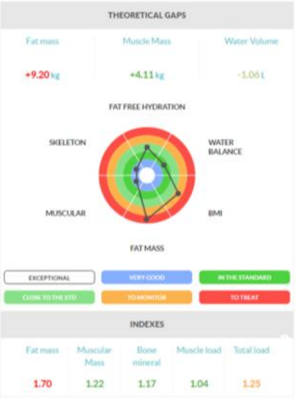
The SECA 803® scale was used to measure body mass, with a capacity of 0 to 250kg . Height was evaluated using a SECA 206® mechanical measuring tape, fixed to the wall, with a measuring range of 0-220 cms, with an accuracy of +/-5mm.

Figure 1. Illustration of the Cognitive-Motor Interference assessment through simple and dual tasks.



Source: Own elaboration

Figure 2. Fat mass analysis result example from Biody Manager® Software


THEORETICAL GAPS

Fat mass	Muscle Mass	Water Volume
+9.20 kg	+4.11 kg	-1.06 L

INDEXES

Fat mass	Muscular Mass	Bone mineral	Muscle load	Total load
1.70	1.22	1.17	1.04	1.25

Source: Own elaboration

International Physical Activity Questionnaire – Short Form (IPAQ-SF)

It evaluates PA over the last seven days through a self-report, considering duration in minutes, hours and days. Total score in METs (metabolic equivalent of task minutes per week) is registered, allowing the classification of the individual in three categories: vigorous PA (e.g. fast cycling), moderate PA (e.g. carrying light weights) or light PA (e.g. walking) (Craig et al., 2003). There is evidence of the robust psychometric properties of the IPAQ-SF (Van Poppel et al., 2010).

Data analysis

Data processing was performed using JASP® software. Three analyses were conducted: (a) data exploration and description. No missing values were identified. Extreme values and outliers were kept, frequency and percentage measures for sociodemographic characteristics were estimated, as well as measures of central tendency and dispersion. (Table 1). (b) A comparative analysis was performed using direct scores of the dependent variables related to cognitive performance (EF and CMI). Independent variables included FML (high and normal) and PA level (light, moderate and vigorous). Normality Shapiro-Wilk test) and homogeneity (Levene's test) assumptions were verified (Aguirre-Loaiza, et al., 2024). Hypothesis testing for independent samples was done through Student's t-test and Mann-Whitney U test for non-parametric distributions. The Welch's test was employed for measures that did not show equal variance. Effect size was calculated using Cohen's d and rank-biserial correlation. (c) The third analysis was a Factorial ANOVA model used to assess cognitive performance as a function of FML * PA level. Effect size was calculated using eta squared (η^2).

Results

Descriptive data is presented in Table 1. Participants with high fat mass levels (FML) showed, on average, a higher BMI than those with normal FML. Additionally, most participants with high FML were women, while the normal FML group had a more balanced sex distribution. Although these descriptive differences were notable, inferential analyses using the Mann-Whitney U test did not reveal statistically significant differences between the groups in terms of sociodemographic variables, control measures, or body composition.

Table 1. Descriptive data of sociodemographic variables, control measures and body composition of participants based on their FML.

	Fat mass level		
	High (*n*=34, 55.7%)	Normal (*n*=27, 44.3%)	All (*n*=61, 100%)
Sex			
Male$_{(n,\%)}$	2(5.9%)	14(51.8%)	16(26.2%)
Female$_{(n,\%)}$	32(94.1%)	13(48.1%)	45(73.8%)
Age$_{(M \pm SD)}$	18.8(1.5)	19.2(2.4)	18.9(1.9)
Years of education$_{(M \pm SD)}$	13.1(1.6)	12.9(1.6)	13.0(1.6)
Screening measures$_{(M \pm SD)}$			
Cognitive (MoCA)	26.8(2.1)	26.5(2.6)	26.6(2.3)
Depression (BDI-II)	10.4(7.5)	9.9(8.0)	10.2(7.7)
Impulsiveness (BIS-11)	75.0(8.9)	75.0(8.8)	75.0(8.8)
Body composition measures$_{(M \pm SD)}$			
Height	161.1(5.6)	163.1(11.1)	162.0(8.5)
Weight	63.2(10.8)	57.5(11.3)	60.7(11.3)
BMI	24.3(3.6)	21.5(2.9)	23.1(3.6)

Note: M=Mean, SD=Standard deviation

Table 2 presents the descriptive data comparing cognitive functioning between individuals with high versus normal FML. Descriptively, the normal FML group showed better cognitive performance compared to the high FML group; however, inferential tests indicated no statistically significant differences in cognitive performance between the groups.

Table 2. Comparison of the cognitive functioning between high vs normal fat mass level

	Fat mass level		Statistics		
	High(*M±SD*)	Normal(*M±SD*)	*t/MW*	*p*	*ES*
Cognitive-Motor Interference					
Motor-motor cost (%)	1.7(7.8)	-1.6(10.6)	1.416	.162	0.36
Cognitive-motor cost (%)	27.5(18.3)	21.1(15.8)	1.448	.153	0.37
Go/No Go					
Response rate (%)	99.1(1.7)	99.1(1.8)	437.5[a]	.702	-0.05[c]
Response time	1.5(0.1)	1.5(0.1)	-0.682	.498	-0.18
Stroop					
Response rate (%)	80.8(26.1)	87.9(15.9)	-1.304[b]	.198	-0.33
Response time	2.1(1.1)	2.2(1.5)	471.5[a]	.862	0.03[c]
TMT	18.2(3.9)	17.6(3.2)	0.574	.568	0.15
Verbal fluency					
Phonological (S)	10.7(3.9)	11.5(3.5)	-0.804	.425	-0.21
Phonological (F)	10.8(4.0)	11.8(3.8)	-0.911	.366	-0.23
Semantic	19.3(3.9)	19.5(4.2)	-0.195	.846	-0.05

Note: a=Mann-Whitney U (MW), b=Welch's test, c=Rank-biserial correlation, ES=Effect Size, M=Mean, SD=Standard deviation, t=Student's t-test

The 3*2 contingency analysis between PA and fat mass levels did not reveal any association, X2= 2.47(2), *p*= 0.29, (Table 3). Homogeneity regarding PA and fat mass levels is observed.

Table 3. Fat mass and physical activity levels

	Fat mass level	
Level Physical Activity	High n(%)	Normal n(%)
Low	14(22.9)	6(9.8)
Moderate	10(16.3)	11(18.3)
Vigorous	11(18.3)	11(18.3)
Total	34(55.7)	27(44.2)

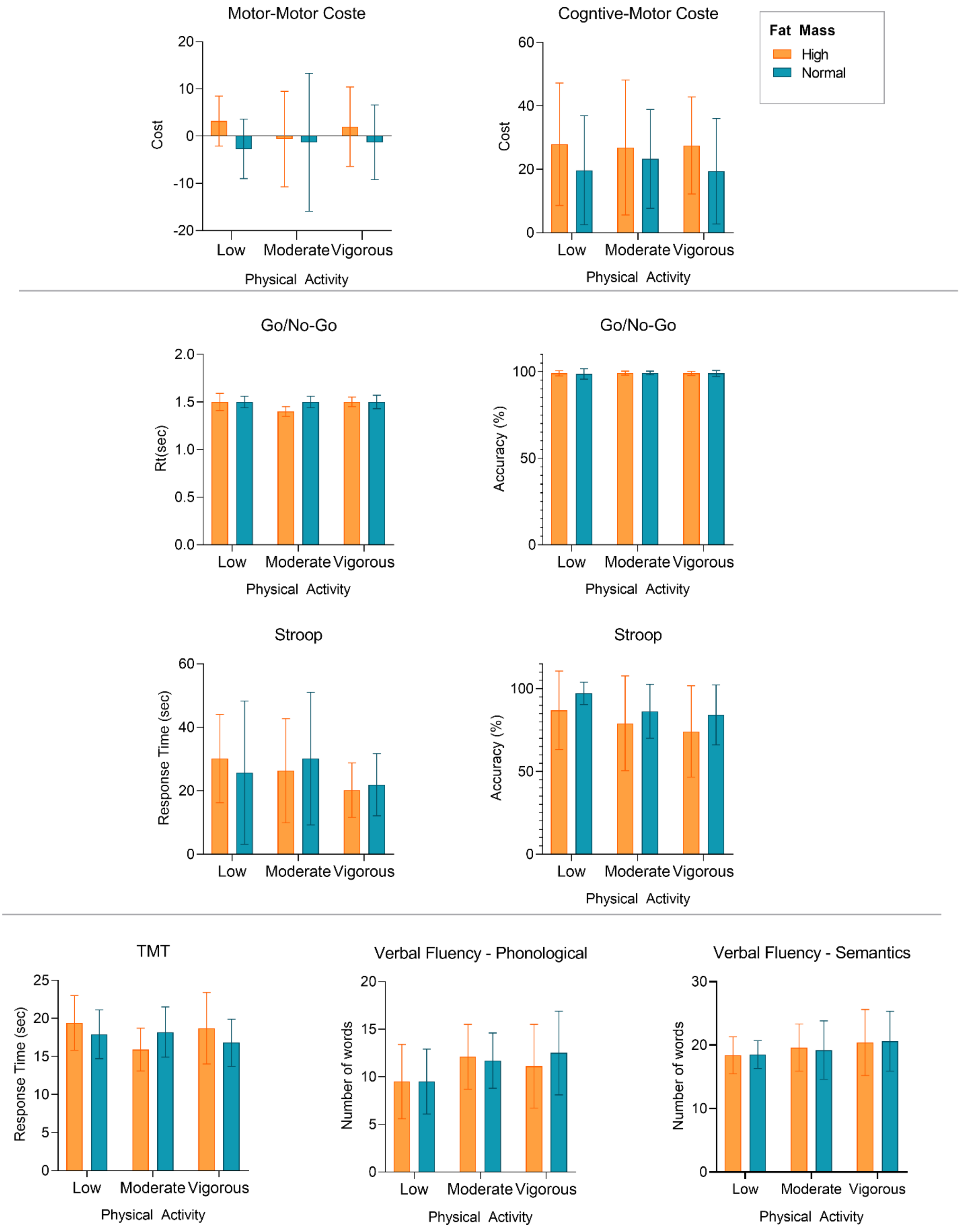
The interaction between FML*PA level was studied through factorial analysis (Table 4). Results did not show significant differences on task performance and CMI, nor on EF tasks. Main effects were not observed among any variables either (see, figure 3)

Table 4. Cognitive performance compared between Fat Mass Level and Physical Activity level

		Physical activity			Factorial análisis FML*PA level			
	FML	Light (*M±SD*) *n*=20	Moderate (*M±SD*) *n*=21	Vigorous (*M±SD*) *n*=20	*MS*	*F*	*p*	η^2
Cognitive-Motor Interference								
Motor-motor cost (%)	High	3.2(5.3)	-0.6(10.1)	2.0(8.4)	31.9	0.36	.697	0.013
	Normal	-2.7(6.3)	-1.3(14.6)	-1.3(7.9)				
Cognitive-motor cost (%)	High	27.9(19.3)	26.9(21.3)	27.5(15.3)	34.7	0.11	.896	0.004
	Normal	19.7(17.2)	23.3(15.6)	19.4(16.6)				
Go/No Go								
Response time	High	1.5(0.09)	1.4(0.05)	1.5(0.05)	0.003	0.59	.555	0.021
	Normal	1.5(0.06)	1.5(0.06)	1.5(0.07)				
Accuracy (%)	High	99.1(1.5)	99.2(1.2)	99.0(1.2)	0.23	0.87	.091	0.003
	Normal	98.7(3.0)	99.3(1.1)	99(1.7)				
Stroop	High	30.1(13.9)	26.3(16.4)	20.2(8.6)	82.9	0.33	.714	0.01
	Normal	25.7(22.6)	30.1(20.9)	21.9(9.8)				
TMT	High	19.4(3.6)	15.9(2.8)	18.7(4.7)	27.9	2.21	.119	0.072
	Normal	17.9(3.2)	18.2(3.3)	16.8(3.1)				
Verbal fluency								
Phonological (S)	High	9.5(3.9)	12.1(3.4)	11.1(4.4)	4.4	0.31	.732	0.010
	Normal	9.5(2.5)	11.7(2.9)	12.5(4.4)				
Phonological (F)	High	10.1(3.5)	11.6(4.4)	11.1(4.6)	6.4	0.42	.661	0.014
	Normal	10.2(1.8)	13.4(4.6)	10.9(3.4)				
Semantic	High	18.4(2.9)	19.6(3.7)	20.4(5.2)	0.5	0.03	.968	0.001
	Normal	18.5(2.2)	19.2(4.6)	20.6(4.7)				

Note: M=Mean, SD=Standard deviation, MS=Mean square

Figure 3. Executive functioning means comparison between high and normal FML based on PA levels.



Discussion

Our study focuses on analyzing three interconnected aspects—cognitive functioning (EF and CMI), fat mass, and PA—among young adult university students. The primary objectives were (a) to assess differences in cognitive performance (EF and CMI) between individuals with normal and high fat mass, and (b) to examine the potential impact of PA and fat mass on cognitive performance. The hypothesis posited that there would be differences in cognitive performance between fat mass categories, favoring those with lower FML and higher PA. However, our results indicate that neither fat mass nor PA significantly impacted cognitive functioning in the studied sample.

These findings align with other studies that have also failed to detect a relationship between adiposity and cognitive performance (Szcześniewska et al., 2021), highlighting the complex nature of this association. The lack of significant results may be attributed to several factors. First, it is possible that FML and PA may not directly impact cognitive functions in young adults as hypothesized, or that other variables, such as education level and impulsiveness, which were controlled for in this study, play a larger role in cognitive performance.

Additionally, while we measured PA and body composition, other confounding factors such as stress levels and sleep quality, were not accounted for. These variables are known to affect cognitive performance, and their absence may have influenced the results (Killgore & Weber, 2014; Sandi, 2013). Future studies should aim to include these factors to obtain a more comprehensive understanding of the relationship between FML, PA and cognition.

The effect of adiposity on cognitive performance remains a subject of debate, with some hypotheses suggesting that this association may vary across the lifespan. In studies involving children, it has been found that a high BMI negatively impacts EF. Among young adults, a population similar to ours, high adiposity has been associated with lower cognitive control performance (Huang et al., 2019). However, studies in older adults have concluded that a controlled ratio of lean to fat mass may act as a protective factor for cognition (Bove et al., 2016) and that higher adiposity, as measured by BMI, may be linked to better cognitive performance (Smith et al., 2014). These contradictory findings emphasize the need to consider other mediating variables such as age, sex and hormonal differences when investigating the impact of body composition on cognition.

Our results, derived from a relatively homogeneous sample and controlling for educational level and PA, might explain why no differences in cognitive performance based on FML were observed. It is also possible that the relationship between adiposity and cognitive functioning is more pronounced in populations with greater variability in body composition or cognitive tasks that impose higher demands on executive functioning. Inconsistent results across the literature likely stem from methodological differences, including the tools used to measure body composition and cognition.

The findings of this study challenge existing models that posit a direct negative impact of adiposity on cognitive performance. These results suggest that the relationship may be more complex and influenced by other mediating variables, which aligns with emerging theories of multifactorial influences on cognition (Chen & Herskovits, 2015). The findings also emphasize the need for more nuanced models and precise measures of physical activity and body composition to avoid oversimplifying the complex relationships between these factors and cognitive health.

Lastly, it is important to note that despite their significance, these findings should be interpreted with caution and not considered conclusive. We acknowledge certain limitations, such as the small sample size, which can be attributed to the challenges posed by the COVID-19 pandemic during the data collection phase. Similarly, studies evaluating the impact of the pandemic on physical and mental health are crucial for informing future research and policy implications (Aguirre-Loaiza et al., 2021). Moreover, all participants were affiliated with the same university institution and physical activity measures were based on self-reports (IPAQ), which introduces the possibility of biases related to social desirability among participants. Finally, the research design is non-experimental. We recommend that future research adopt longitudinal methodological approaches, explore physical conditioning programs (Franco & Ayala, 2023) and consider participants' sociocultural and economic backgrounds. We also propose the incorporation of fitness measures determining athletic capacity, along with the inclusion of additional anthropometric parameters (e.g., perimeters, lean mass, etc.).

Conclusions

This investigation supports the notion that individuals with overweight and obesity do not exhibit inferior executive functioning or cognitive-motor interaction performance compared to those with normal fat mass levels (FML). Additionally, we recommend that future research measure physical activity (PA) through objective physical tests rather than self-reports.

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