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The Relationship between Visceral Adiposity and Cognitive Function: A Cross-sectional Study

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KEYWORDS

A Body Shape Index, cognitive function, lifestyle assessment, FANTASTIC questionnaire, central obesity, Indian adults

ABSTRACT:

Background: Central (visceral) obesity and unhealthy lifestyle behaviours are increasingly recognised as modifiable risk factors for early cognitive decline, yet the role of refined anthropometric markers such as A Body Shape Index (ABSI) in predicting domain-specific cognitive impairment in Indian adults remains poorly understood.

Objective: To determine the utility of ABSI score in predicting cognitive impairment.

Methods: This single-centre, hospital-based analytical cross-sectional study included 100 adults (18–67 years) recruited by convenience sampling, after obtaining IHEC approval and written informed consent. Anthropometry (including ABSI), FANTASTIC lifestyle scores and cognitive domains (reasoning, memory, attention, coordination, perception) were assessed using standardised procedures, and data were analysed in SPSS v27 with $p<0.05$ considered statistically significant.

Results: Among 100 adults, 60.0% were aged ≤30 years, 40.0% >30 years, and 53.0% were male; most resided in the city (71.0%). The mean ABSI z-score was −0.44 ± 1.80 and mean FANTASTIC lifestyle score was 59.92 ± 6.67, with 71.0% classified as having a good lifestyle and only 8.0% a very good lifestyle. Mean cognitive scores ranged from 306.67 ± 143.36 (coordination) to 325.15 ± 141.52 (reasoning). ABSI showed weak, largely non-significant correlations with most domains, but had a significant negative association with perception ($r = −0.274$, $p = 0.006$). Lifestyle scores correlated only trivially with cognition. ABSI did not differ by age but was higher in females than males (0.105 vs −0.926; $p = 0.004$); females also had better memory scores ($p = 0.026$).

Conclusion: A Body Shape Index showed only a modest, domain-specific association with cognition and lifestyle scores were not related to cognitive performance, suggesting that in this relatively young adult cohort ABSI and lifestyle measures alone had limited utility for identifying early cognitive impairment.

Introduction

Cognitive impairment and dementia are growing global public health challenges, with an estimated 55–57 million people currently affected worldwide, and numbers projected to more than double by 2050, particularly in low- and middle-income countries.(1-3) Even before clinical dementia develops, subtle deficits in memory, attention and executive function can impair daily functioning and productivity in adults of working age, underscoring the need to understand modifiable risk factors that act earlier in the life course.(4, 5) Obesity—especially central or visceral adiposity—has emerged as an important contributor to cognitive decline through mechanisms involving insulin resistance, vascular damage, systemic inflammation and neuroinflammation.(4, 6, 7) Recent epidemiological and Mendelian randomisation data in Asian populations suggest that even relatively small increments in visceral fat have measurable cognitive consequences; each 0.27 kg increase in abdominal fat has been linked to a reduction in cognitive performance equivalent to about 0.7 years of additional cognitive ageing.(6, 8)

Traditional indices such as body mass index (BMI) capture overall adiposity but do not adequately reflect body fat distribution, which appears more relevant for cardiometabolic and brain outcomes.(9, 10) A Body Shape Index (ABSI) was proposed by Krakauer and colleagues as a waist-based metric that adjusts waist

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circumference for height and weight, thereby quantifying abdominal body shape independently of BMI.(11) Higher ABSI values have consistently been associated with increased all-cause and cause-specific mortality, and in large cohorts ABSI stratifies mortality risk more effectively than several alternative central obesity indices.(9, 10, 12) Emerging evidence now links ABSI to neurocognitive outcomes; studies in older adults from the United States and China have found that elevated ABSI or related body-shape indices are associated with poorer global cognition, higher odds of cognitive impairment, and increased risk of incident dementia, independent of BMI and other vascular risk factors.(13-16) However, most of this literature focuses on late-life populations in high-income settings, and data from younger or middle-aged adults in South Asia remain scarce.

Lifestyle behaviours represent another key, modifiable determinant of both adiposity and cognitive health. Composite ‘healthy lifestyle’ indices that integrate diet quality, physical activity, smoking, alcohol use and other habits have been repeatedly associated with better cognitive performance, slower memory decline and lower risk of mild cognitive impairment and dementia.(17, 18) The FANTASTIC Lifestyle Questionnaire is a brief, multidimensional tool originally developed for primary care and health-promotion settings to assess lifestyle across domains such as family and friends, physical activity, nutrition, tobacco and alcohol, sleep, personality, insight, and career.(19) Nonetheless, relatively few studies have examined how quantified lifestyle scores relate simultaneously to anthropometric indices like ABSI and to detailed cognitive domain profiles within the same adult cohort.(20) Against this background, the objective of the present study was to determine the utility of ABSI score in predicting cognitive impairment.

Materials and Methods

This was a single centre, hospital-based, analytical cross-sectional study conducted in the Department of Physiology, Chettinad Hospital and Research Institute, Kelambakkam, Tamil Nadu, India over a period of one year between December 2024 and November 2025. The study was approved by the Institutional Human Ethics Committee (IHEC) with reference number IHEC-I/3276/24 dated 11/12/2024. The participants were given the Participant Information Sheet (PIS) in their native language, and its contents were verbally explained to ensure their understanding and satisfaction. Enrolment into the study proceeded upon receipt of informed written consent. The study included 100 voluntary participants, 18 to 67 years of age, of both gender (using nonprobability sampling technique – convenience sampling). However, those with history of metabolic diseases, mental disorders, autoimmune diseases, recent surgeries or hospitalizations, acute or chronic illnesses, medication use, neurological deficits, or musculoskeletal disorders were excluded.

Data were collected using a structured proforma created in Google Forms. After obtaining written informed consent, each eligible participant was interviewed to record sociodemographic details and relevant medical history. Anthropometric data—age, sex, height, weight and waist circumference—were then measured using standard techniques in a dedicated examination room. Height was measured to the nearest 0.1 cm with a stadiometer, and weight to the nearest 0.1 kg using a calibrated digital weighing scale, with participants wearing light clothing and no footwear. Waist circumference was recorded to the nearest 0.1 cm using a non-stretchable measuring tape placed horizontally at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest at the end of normal expiration. Body mass index (BMI) was computed as weight (kg)/height (m^2). The A Body Shape Index (ABSI) score was calculated for each participant using the formula ABSI = waist circumference/($BMI^{2/3} \times height^{1/2}$).(11) ABSI z-scores were subsequently derived by subtracting the age- and sex-specific reference mean ABSI and dividing by the corresponding standard deviation for the relevant age and gender group. Lifestyle behaviours were assessed using the validated FANTASTIC lifestyle questionnaire, and a total FANTASTIC lifestyle score was computed for each participant.(21) Cognitive function was assessed on the same visit using the CogniFit® app-based cognitive assessment program, downloaded from the official app store onto a tablet device and administered in a quiet setting. The battery provided standardized scores for multiple domains, including reasoning, memory, attention, coordination and perception, automatically adjusted for age and sex. A global composite score was generated, and participants whose composite score fell

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more than one standard deviation below the normative mean were classified as having cognitive impairment.

Statistical analysis: Statistical analysis was performed using IBM SPSS Statistics for Windows, version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The distribution of continuous variables was examined using descriptive plots and normality tests before applying parametric procedures. Independent-samples t-tests were used to compare mean ABSI z-scores and cognitive domain scores across sociodemographic subgroups. The association between ABSI z-scores, FANTASTIC lifestyle scores and individual cognitive domain scores was assessed using Pearson's correlation coefficients. All tests were two-tailed, and a p value <0.05 was considered statistically significant.

Results

In this study of 100 participants, 60.0% were aged ≤30 years and 40.0% were >30 years. Males constituted a slight majority (53.0%) compared to females (47.0%). Most participants resided in the city (71.0%), while 26.0% were from villages and 3.0% from towns. The mean ABSI z-score was −0.44 with a standard deviation of 1.80, and the mean FANTASTIC lifestyle score was 59.92 ± 6.67. Cognitive function scores (mean ± SD) were 325.15 ± 141.52 for reasoning, 317.83 ± 138.54 for memory, 324.62 ± 136.25 for attention, 306.67 ± 143.36 for coordination, and 313.42 ± 172.74 for perception. The distribution of FANTASTIC lifestyle score grading showed that the majority of participants had a good lifestyle score (71.0%). A smaller proportion (21.0%) fell into the fair lifestyle category. Only 8.0% of participants achieved a very good lifestyle score.

The correlation analysis showed that ABSI z-scores had weak, predominantly negative correlations with cognitive domains. The coefficients for reasoning (r = −0.148, p = 0.143), attention (r = −0.194, p = 0.054) and coordination (r = −0.053, p = 0.598) were negative but did not reach statistical significance, while the correlation with memory was weakly positive and non-significant (r = 0.091, p = 0.366). In contrast, ABSI z-scores demonstrated a statistically significant negative correlation with perception (r = −0.274, p = 0.006), indicating that higher ABSI values were associated with poorer perceptual performance. FANTASTIC lifestyle scores showed very weak correlations with all cognitive domains (r ranging from −0.036 to 0.066), and none of these associations were statistically significant (all p > 0.05).

The comparison of ABSI z-scores across sociodemographic groups showed that mean ABSI z-score did not differ significantly by age, with values of −0.279 ± 1.89 in participants aged ≤30 years and −0.685 ± 1.65 in those aged >30 years (mean difference −0.406, p = 0.272). However, females had a significantly higher ABSI z-score (0.105 ± 1.92) than males (−0.926 ± 1.55), with a mean difference of 1.031 (p = 0.004). Cognitive domain scores did not differ significantly by age for reasoning, memory, attention, coordination or perception (all p > 0.05). By gender, females demonstrated a significantly higher mean memory score than males (350.66 ± 111.05 vs. 288.72 ± 154.24; mean difference 61.943, p = 0.026), while differences in other domains, including a borderline higher coordination score in females (p = 0.052), were not statistically significant.

Discussion

The present study provided an opportunity to explore how an anthropometric marker of central body shape, lifestyle behaviours and basic sociodemographic factors related to multiple cognitive domains in an adult Indian sample. The age structure, with 60% of participants aged ≤30 years and 40% >30 years, suggested a relatively young to mid-life cohort, in contrast to much of the literature on obesity and cognition that primarily focuses on older adults at higher baseline risk for cognitive decline.(22, 23) The slight male predominance and high proportion of urban residents (71% city-dwellers) were consistent with Sengupta et al. (2025) and Sruthi et al. (2023), where urbanisation and sedentary occupations contribute to rising central adiposity and cardiometabolic risk.(24, 25)

The mean ABSI z-score of −0.44 (SD 1.80) indicated that, on average, participants had a waist-to-body-size profile somewhat below the reference risk level derived from the original ABSI population norms, where a z-score of 0 corresponds to average mortality risk.(11) ABSI was originally proposed as a waist-based metric that, by adjusting for BMI and height, better captures abdominal adiposity and its association with all-cause mortality and cardiometabolic outcomes than BMI

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alone.(12) Subsequent work has shown that higher ABSI is associated with multiple adverse outcomes, including hypertension, metabolic syndrome and subclinical atherosclerosis, underscoring its utility as a compact indicator of central obesity–related risk.(9, 26) Within this context, the modestly negative mean ABSI in our sample suggested that a large fraction of participants were not yet at the highest levels of central adiposity typically implicated in cognitive impairment, which may partly explain the generally weak correlations with cognitive performance.

The finding of a statistically significant negative correlation between ABSI z-score and the perception domain ($r = -0.274$, $p = 0.006$) but only non-significant, small correlations with reasoning, memory, attention and coordination aligns with emerging but still heterogeneous evidence linking central obesity to specific aspects of cognition. Hou et al. (2019), Li et al. (2022) and Tang et al. (2021) have reported that waist-based markers of abdominal adiposity, including waist circumference and related indices, are associated with poorer global cognition and increased risk of cognitive impairment and dementia in middle-aged and older adults.(22, 23, 27) More recently, studies that examined ABSI specifically have also documented inverse associations between higher ABSI and composite cognitive scores in older populations, strengthening the case that central body shape may be related to cognitive outcomes independent of BMI.(13, 14) The selective association with perceptual performance in our cohort may reflect that perceptual tasks in the CogniFit battery are more sensitive to subtle processing speed and visuospatial integration deficits, domains that are often affected early in vascular and metabolic pathways of brain injury linked to central obesity.(22, 28)

At the same time, the small effect sizes and predominantly non-significant correlations for other domains suggested that ABSI alone captured only a limited fraction of the variance in cognitive performance in this age range. This is consistent with recent work indicating that obesity markers show stronger and more consistent relationships with cognition in older age and in the presence of comorbid conditions such as diabetes, where cumulative vascular and inflammatory insults have had more time to manifest.(7, 15) It also echoes findings that alternative waist-adjusted indices, such as the weight-adjusted-waist index, may show stronger associations with cognitive impairment than ABSI in some datasets, highlighting that anthropometric predictors of cognitive risk remain an evolving field.(29)

The lifestyle profile of participants, as assessed using the FANTASTIC questionnaire, was largely favourable, with a mean score of approximately 60 and 71% of individuals classified as having a ‘good’ lifestyle. This pattern is comparable to Batista et al. (2022) and Murillo-Llorente et al. (2022) where the FANTASTIC instrument has demonstrated acceptable validity and reliability in capturing multidimensional health-related behaviours, including physical activity, nutrition, tobacco and alcohol use, and stress management.(21, 30) The weak and non-significant correlations between FANTASTIC lifestyle scores and all cognitive domains in our study (r values close to zero) may therefore be driven less by a true absence of relationship between lifestyle and cognition and more by the restricted variability in lifestyle scores, with relatively few participants at the extremes of very poor or excellent lifestyle where cognitive differences might be more pronounced. Moreover, many lifestyle effects on cognition operate cumulatively over decades, and cross-sectional snapshots in predominantly young adults may underestimate long-term associations that only become clinically evident in later life.(31)

The gender pattern observed for ABSI z-scores, with females exhibiting significantly higher values than males, was notable. This suggested greater central adiposity in women relative to their sex-specific reference distribution, despite the cohort’s relatively young age. Chaudhary & Sharma (2023) and Gupta et al. (2023) have documented a higher prevalence of abdominal obesity in women compared with men, a pattern attributed to sociocultural factors, hormonal influences and differential physical activity levels, particularly in urban settings.(32, 33) Similar sex-linked differences in obesity patterns, including central fat accumulation and associated metabolic risk, have been described globally, reinforcing the need to consider sex-specific risk profiles when interpreting indices such as ABSI.(34) Our findings therefore aligned with broader evidence that women, especially in South Asian contexts, carry a disproportionate burden of central adiposity and its potential downstream health consequences even in early and mid-adulthood.

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In contrast to these anthropometric differences, cognitive domain scores were largely comparable across age groups, which is in keeping with expectations in a sample spanning young and middle adulthood rather than older age, where age-related declines become more prominent.(22) The one robust cognitive difference by gender was the significantly higher mean memory score in females compared with males, with a borderline trend towards higher coordination scores as well. This pattern resonates with a substantial body of neuropsychological literature demonstrating a female advantage in several aspects of verbal learning and memory, and in some studies of episodic memory more broadly, across both healthy individuals and those with mild cognitive impairment.(35, 36) Proposed explanations include both biological factors (such as sex hormone effects on hippocampal structure and function) and sociocultural influences (including educational and occupational experiences that differentially shape cognitive reserve in men and women).(37)

Taken together, the present results suggested that in a relatively young, predominantly urban adult sample with generally ‘good’ lifestyle scores, ABSI captured modest variation in central adiposity that showed a specific inverse association with the perception domain of cognition and clear sex differences, whereas global lifestyle scoring did not emerge as a salient correlate of cognitive performance. These patterns reinforce the view that central body shape and sex-specific adiposity profiles may be more proximally related to certain cognitive processes than aggregated lifestyle indices in early and mid-adulthood, and they underscore the importance of integrating refined anthropometric markers such as ABSI into future research on metabolic–cognitive links in Indian populations.

The present study had several limitations. First, it was a single-centre, hospital-based, analytical cross-sectional study with a relatively small sample size of 100 participants, which limited statistical power and precluded robust subgroup analyses, particularly by age band and residence. The use of non-probability convenience sampling and a predominantly urban sample reduced generalisability to the wider community. The cross-sectional design did not allow causal inferences regarding the directionality of associations between ABSI, lifestyle factors and cognitive performance, nor did it capture cumulative or longitudinal effects of adiposity and lifestyle on cognition. Lifestyle behaviours were assessed using a self-reported questionnaire (FANTASTIC), which was susceptible to recall and social desirability bias, and there was no objective corroboration of physical activity, diet or sleep patterns. Cognitive function was evaluated using a single app-based battery rather than a comprehensive neuropsychological test panel, and no clinical diagnoses of mild cognitive impairment or other neurocognitive disorders were established. Residual confounding was also likely, as important variables such as educational attainment, socioeconomic status, depressive symptoms, detailed cardiometabolic profile and sleep disorders were not measured or adjusted for in the analyses.

Conclusion

In conclusion, this single-centre cross-sectional study demonstrated that ABSI and FANTASTIC lifestyle scores showed only limited associations with cognitive performance in a relatively young, predominantly urban adult cohort. While ABSI z-scores were significantly higher in females than males and exhibited a modest but significant negative correlation with the perception domain, they did not relate meaningfully to other cognitive domains. Lifestyle scores were generally in the ‘good’ range and were not significantly associated with any cognitive domain, suggesting that within this relatively healthy sample, lifestyle variation was insufficient to translate into measurable cognitive differences. Females showed better memory performance than males, consistent with known sex-related patterns in cognition. Overall, the findings suggest that ABSI may capture early central adiposity-related vulnerability in specific cognitive processes, particularly perception, and highlight the need for larger, longitudinal studies to clarify the temporal and causal relationships between body shape, lifestyle and cognition.

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Table 1: Descriptive analysis of sociodemographic characteristics, ABSI scores, lifestyle scores and cognitive function scores

Variables		**Frequency (N=100)** **n**	**Percentage** **%**
Age (years)	≤30	60	60.0
	>30	40	40.0
Gender	Female	47	47.0
	Male	53	53.0
Residence	City	71	71.0
	Village	26	26.0
	Town	3	3.0
ABSI z-score, Mean (SD)		-0.44 (1.80)	
Lifestyle scores, Mean (SD)		59.92 (6.67)	
Cognitive function, Mean (SD)	Reasoning	325.15 (141.52)	
	Memory	317.83 (138.54)	
	Attention	324.62 (136.25)	
	Coordination	306.67 (143.36)	
	Perception	313.42 (172.74)	
SD, Standard deviation; ABSI, A Body Shape Index			

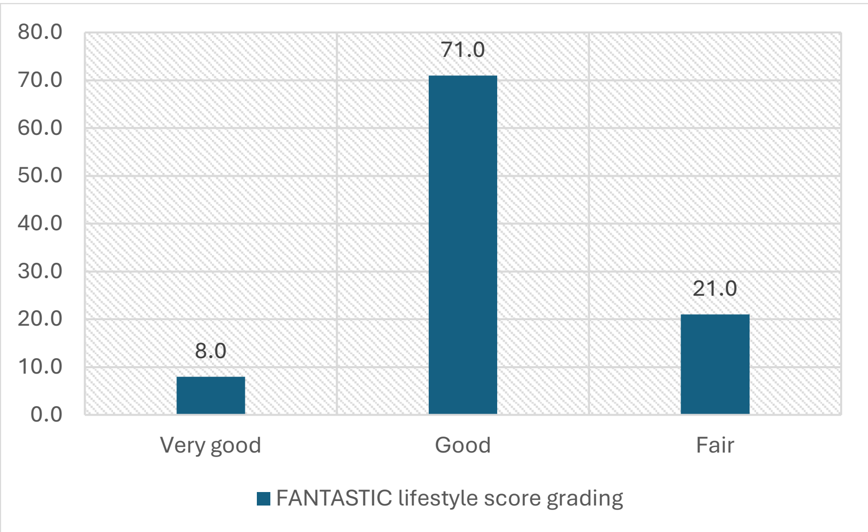

Figure 1: FANTASTIC lifestyle score grading

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Table 2: Correlation between ABSI z-score, FANTASTIC lifestyle scores and cognitive domain scores

Cognitive Domains		Reasoning	Memory	Attention	Coordination	Perception
ABSI z-score	r	-0.148	0.091	-0.194	-0.053	-0.274
	p value	0.143	0.366	0.054	0.598	0.006*
FANTASTIC lifestyle scores	r	-0.036	- 0.011	-0.016	0.066	-0.014
	p value	0.723	0.912	0.871	0.516	0.887
*Statistically significant at p<0.05						

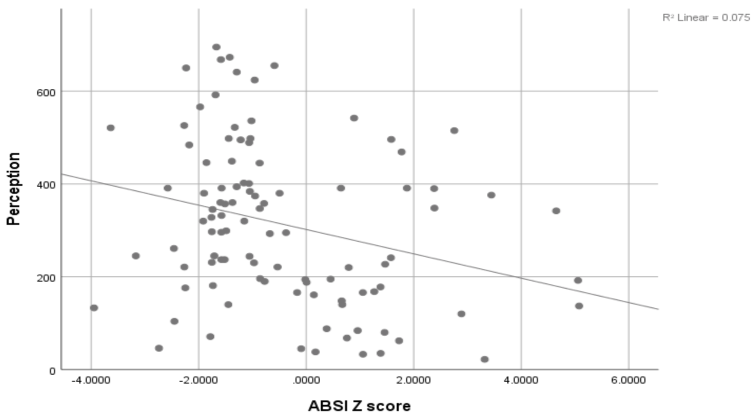

Figure 2: Correlation between ABSI z-score and cognitive domain scores

Table 3: Comparison between sociodemographic characteristics and ABSI z-score

Variables		Mean ± SD	Mean difference	p value
Age (years)	≤30	-0.279 ± 1.89	-0.406	0.272
	>30	-0.685 ± 1.65		
Gender	Female	0.105 ± 1.92	1.031	0.004*
	Male	-0.926 ± 1.55		
*Statistically significant at p<0.05				

Table 4: Comparison between sociodemographic characteristics and cognitive domain scores

Variables	Mean ± SD	Mean difference	p value
Reasoning			
Age >30 years	305.08 ± 151.51	- 33.458	0.249
Age ≤30 years	338.53 ± 134.08		
Female	334.81 ± 144.24	18.224	0.523

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Male	316.58 ± 139.88		
Memory			
Age >30 years	321.35 ± 141.99	5.867	0.837
Age ≤30 years	315.48 ± 137.34		
Female	350.66 ± 111.05	61.943	0.026*
Male	288.72 ± 154.24		
Attention			
Age >30 years	322.10 ± 153.33	- 4.200	0.881
Age ≤30 years	326.30 ± 124.91		
Female	331.74 ± 144.66	13.443	0.627
Male	318.30 ± 129.41		
Coordination			
Age >30 years	291.85 ± 159.86	- 24.683	0.402
Age ≤30 years	316.53 ± 131.71		
Female	336.13 ± 149.12	55.599	0.052
Male	280.53 ± 134.08		
Perception			
Age >30 years	318.05 ± 178.98	7.716	0.828
Age ≤30 years	310.33 ± 169.92		
Female	306.51 ± 166.56	-13.037	0.708
Male	319.55 ± 179.41		