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Aortomesenteric Angle and Distance in Relation to Body Mass Index: A Descriptive Cross-Sectional Study Using Computed Tomography

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ABSTRACT

Introduction: Superior mesenteric artery syndrome (SMAS) is a rare cause of upper gastrointestinal obstruction resulting from compression of the third part of the duodenum between the abdominal aorta and the superior mesenteric artery (SMA). Reduction in aortomesenteric angle (AMA) and aortomesenteric distance (AMD), often related to decreased body mass index (BMI), and predisposes individuals to this condition. This study aimed to assess the relationship between BMI, AMA, and AMD using contrast-enhanced computed tomography (CT) imaging in the Nepalese population.

Methods: A descriptive cross-sectional study was conducted involving 324 patients undergoing abdominal contrast-enhanced CT scans at Patan Academy of Health Sciences, Nepal. AMA and AMD were measured on sagittal and axial reconstructions, respectively. Participants were categorized based on BMI according to the WHO classification. Correlations among BMI, AMA, and AMD were analyzed using Pearson's correlation coefficient.

Results: Among 324 patients (220 males, 104 females; mean age 46.2 ± 14.7 years), the average BMI was 26.9 ± 4.5 kg/m². The mean AMA and AMD were 56.3° ± 16.4° and 15.4 ± 5.2 mm, respectively. BMI showed a significant positive correlation with AMA ($r = 0.19$, $p < 0.01$) and AMD ($r = 0.15$, $p = 0.02$). A strong correlation was noted between AMA and AMD ($r = 0.64$, $p < 0.001$).

Conclusions: We can infer that BMI significantly influences aortomesenteric angle and aortomesenteric distance. The findings can assist in the CT-based evaluation of SMAS and provide reference data tailored for the South Asian population.

Keywords: *Duodenum; Intestinal Obstruction; Superior Mesenteric Artery Syndrome*

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INTRODUCTION

Superior mesenteric artery syndrome (SMAS), also known as Wilkie's syndrome, is a rare and potentially debilitating cause of proximal intestinal obstruction. It is characterized by the compression of the third part of the duodenum between the SMA anteriorly and the aorta posteriorly, usually secondary to loss of mesenteric fat that cushions these structures.[1,2,3]

The normal anatomical configuration provides an AMA of approximately 25° to 60° and an AMD ranging between 10 and 28 mm. When these parameters decrease-commonly below 22° for AMA and 8 mm for AMD-clinical symptoms such as nausea, vomiting, early satiety, and postprandial abdominal pain may ensue.[4,5,6,7,8]

Several factors, including rapid weight loss (from eating disorders, malignancy, trauma, surgery, or chronic illness), congenital anomalies, or anatomical variations, have been implicated in the etiology of SMAS. BMI, as an indirect measure of body fat, is hypothesized to influence the spatial relationship between the SMA and the aorta.[9,10]

While numerous studies have described SMAS primarily in Western populations, there is a paucity of data focusing on South Asian populations, where body composition may differ significantly. Therefore, this study aims to evaluate the relationship between BMI, AMA, and AMD in the Nepalese population utilizing contrast-enhanced CT imaging.[11,12]

METHODS

A descriptive cross-sectional study was conducted at the Department of Radiology and Imaging, Patan Academy of Health Sciences. A total of 324 patients were included through simple random sampling. Patients aged ≥18 years, undergoing contrast-enhanced CT abdomen with no known history of SMAS or major abdominal surgery, were included. Patients with previous abdominal surgeries, known SMAS, or altered anatomy were excluded.

BMI was calculated from recorded weight and height. Patients were categorized into four WHO BMI categories. AMA was measured on sagittal multiplanar reconstructions, and AMD on axial images at the duodenum crossing. All CT images were obtained using standardized imaging protocols. Data were analyzed using Pearson's correlation and descriptive statistics.

RESULTS

Of the 324 patients, 220 were male (68%) and 104 female (32%), with a mean age of 46.2 ± 14.7 years. The average BMI was 26.9 ± 4.5 kg/m². The mean aortomesenteric angle (AMA) was 56.3 ± 16.4°, and the mean aortomesenteric distance (AMD) was 15.4 ± 5.2 mm. The correlation between BMI and AMA was significant and positive ($r = 0.19$, $p < 0.01$), as was the correlation between BMI and AMD ($r = 0.15$, $p = 0.02$). A strong correlation was observed between AMA and AMD ($r = 0.64$, $p < 0.001$). (Table 1, 2 & 3)

These results were consistent across gender and BMI categories. The values suggest that lower BMI is associated with reduced AMA and AMD, which may predispose individuals to SMAS.

Demographic and BMI Distribution

Out of 324 participants:

Males: 220 (68%)

Females: 104 (32%)

Mean age: 46.2 ± 14.7 years

Mean BMI: 26.9 ± 4.5 kg/m²

Aortomesenteric Parameters

Mean AMA: 56.3° ± 16.4°

Mean AMD: 15.4 ± 5.2 mm

Table 1: BMI-Based Stratification

BMI Category	Mean AMA (°)	Mean AMD (mm)
Underweight	45.8 ± 10.1	10.2 ± 2.4
Normal weight	53.1 ± 14.2	13.7 ± 3.6
Overweight	59.5 ± 14.8	16.3 ± 4.1
Obese	64.3 ± 16.0	19.3 ± 4.5

A statistically significant trend was observed: as BMI increased, both AMA and AMD increased.

Correlation Analysis

BMI vs. AMA: r = 0.19, $p < 0.01$
BMI vs. AMD: r = 0.15, $p = 0.02$
AMA vs. AMD: r = 0.64, $p < 0.001$

There was no significant sex-based difference in the relationship between BMI and the anatomical parameters.

Table 2: Number of patients and mean age (±SD) among different BMI categories

BMI Category	Sex	N (total)	Mean Age (years) ± SD	Age Range (years)
Underweight (<18.5)	Male	12	44.2 ± 13.5	20–67
Underweight (<18.5)	Female	8	42.7 ± 12.3	22–65
Normal (18.5–24.9)	Male	85	47.8 ± 15.6	18–74
Normal (18.5–24.9)	Female	32	46.2 ± 14.9	19–73
Overweight (25–29.9)	Male	78	49.3 ± 14.1	20–75
Overweight (25–29.9)	Female	40	47.6 ± 13.7	21–71
Obese (≥30)	Male	45	50.1 ± 12.9	30–70
Obese (≥30)	Female	24	49.0 ± 13.1	29–69

Table 3: Mean values (±SD) of aortomesenteric angle (AMA) and distance (AMD) by BMI category and gender

BMI Category	Sex	Mean AMA (°) ± SD	Mean AMD (mm) ± SD	Sample Size (n)
Underweight	Male	48.5 ± 10.6	11.2 ± 2.7	12
Underweight	Female	42.3 ± 9.4	9.1 ± 2.2	8
Normal	Male	55.6 ± 14.5	14.2 ± 3.8	85
Normal	Female	50.4 ± 13.9	12.8 ± 3.3	32
Overweight	Male	60.8 ± 15.0	16.5 ± 4.0	78
Overweight	Female	58.2 ± 14.7	15.4 ± 3.7	40
Obese	Male	65.3 ± 16.1	19.8 ± 4.6	45
Obese	Female	63.1 ± 15.2	18.7 ± 4.4	24

DISCUSSION

The current study corroborates previous findings that BMI significantly influences aortomesenteric anatomical parameters. In individuals with lower BMI, reduced retroperitoneal fat results in a narrower AMA and a shorter AMD, both of which predispose to duodenal compression and SMAS development.[13,14]

These findings align with the observations by Ozkurt et al. and Desai et al., who noted that normal BMI individuals had higher AMA and AMD compared to underweight individuals. Similar trends have been seen across multiple populations, though baseline values may differ slightly due to ethnic and body composition differences.[6,7,15]

The strong correlation between AMA and AMD supports the anatomical interplay between these two measurements. Our study's values slightly differ from Western normative data, reinforcing the importance of generating population-specific references.[12]

Contrast-enhanced CT remains the imaging modality of choice for diagnosing SMAS, offering detailed anatomical visualization. In clinical practice, recognizing reduced AMA and AMD in underweight patients should prompt consideration of SMAS, particularly when evaluating nonspecific gastrointestinal symptoms.[5,8,11]

CONCLUSION

This study confirms a positive association between BMI and aortomesenteric anatomical parameters. Lower BMI is linked with reduced AMA and AMD, suggesting a higher susceptibility to SMAS. The normative values can enhance the diagnostic accuracy of CT imaging for SMAS and highlight the importance of considering patient BMI during evaluation. Awareness of these correlations is vital for early diagnosis and management of SMAS, especially in populations vulnerable to weight loss or malnutrition.

CONFLICT OF INTEREST

None

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REFERENCES

1. Merrett ND, Wilson RB, Cosman P, Biankin AV. Superior mesenteric artery syndrome: diagnosis and treatment strategies. *J Gastrointest Surg* 2009;13(2):287-92. https://doi.org/10.1007/s11605-008-0695-4

2. Roy A, Gisel JJ, Roy V, Bouras EP. Superior mesenteric artery (Wilkie's) syndrome as a result of cardiac cachexia. *J Gen Intern Med* 2005;20(10):C3-4. https://doi.org/10.1111/j.1525-1497.2005.0201.x

3. Matheus CD, Waisberg J, Zewer MH, Godoy AC. Syndrome of duodenal compression by the superior mesenteric artery following restorative proctocolectomy: a case report and review of literature. *Sao Paulo Med J*;123(3):151-3. https://doi.org/10.1590/S1516-31802005000300013

4. Applegate GR, Cohen AJ. Dynamic CT in superior mesenteric artery syndrome. *J Comput Assist Tomogr* 1988;12(6):976-80.https://doi.org/10.1097/00004728-198811000-00013

5. Ahmed AR, Taylor I. Superior mesenteric artery syndrome. *Postgrad Med J* 1997 ;73(866):776-8.https://doi.org/10.1136/pgmj.73.866.776

6. Ozkurt H, Cenker MM, Bas N, Erturk SM, Basak M. Measurement of the distance and angle between the aorta and SMA: normal values in different BMI categories. *Surg Radiol Anat* 2007;29(7):595-9. https://doi.org/10.1007/s00276-007-0238-9

7. Bhagirath Desai A, Sandeep Shah D, Jagat Bhatt C, Umesh Vaishnav K, Salvi B. Measurement of the distance and angle between the aorta and superior mesenteric artery on CT scan: values in Indian population in different BMI categories. *Indian J Surg* 2015;77(Suppl 2):614-7. https://doi.org/10.1007/s12262-013-0941-1

8. Adhikari D, Paudyal S, Paudel B, Paudel D, Acharya I. Angulation and distance of superior mesenteric artery according to body mass index on patients based on computed tomography scan study at Chitwan Medical College. *J Chitwan Med Coll* 2019;9(3):74-8. Available from; https://nepjol.info/index.php/JCMC/article/view/25787 [Accessed 1st June 2025]

9. Welsch T, Büchler MW, Kienle P. Recalling superior mesenteric artery syndrome. *Dig Surg* 2007;24(3):149-56. https://doi.org/10.1159/000102097

10. Biank V, Werlin S. Superior mesenteric artery syndrome in children: a 20-year experience. J *Pediatr Gastroenterol Nutr* 2006;42(5):522-5. https://doi.org/10.1097/01.mpg.0000221888.36501.f2

11. Lee TH, Lee JS, Jo Y et al. Superior mesenteric artery syndrome: where do we stand today?. *J Gastrointest Surg* 2012;16(12):2203-11.

https://doi.org/10.1007/s11605-012-2049-5

12. Gwee KA. Superior mesenteric artery syndrome: an uncommon but important cause of abdominal pain. *Singapore Med J* 2010;51(2):180-2.

13. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, *NJ: Lawrence Erlbaum Associates* 1988.

14. Shiu JR, Chao HC, Luo CC et al. Clinical and nutritional outcomes in children with SMAS. *Pediatr Neonatol* 2012;53(4):230-235. https://doi.org/10.1097/mpg.0b013e3181c7bdda

15. Ünal B, Aktas A, Kemal G, Bilgili Y, Güliter S, Daphan Ç, Aydinuraz K. Superior mesenteric artery syndrome: CT and ultrasonography findings. *Diagn Interv Radiol* 2005;11(2):90-5. Available from; https://www.researchgate.net/profile/Aykut-Aktas/publication/7785939_Superior_mesenteric_artery_syndrome_CT_and_ultrasonography_findings/links/5450a2710cf24e8f7374d279/Superior-mesenteric-artery-syndrome-CT-and-ultrasonography-findings.pdf [Accessed 6th June 2025]