iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** V **Month of publication:** May 2026

DOI: https://doi.org/10.22214/ijraset.2026.81824

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

Prevalence and Severity of Gastroesophageal Reflux Disease in Adults Using Gastroesophageal Reflux Scintigraphy

Dr. Amandeep Kaur
Guru Gobind Singh Medical College & Hospital, India

Abstract: ***Background & objectives: Gastroesophageal reflux disease (GERD) is a common gastrointestinal disorder with variable association with age, sex and body mass index (BMI). This study aimed to assess the prevalence and severity of GERD in symptomatic patients and examine its relationship with demographic and anthropometric parameters.***
Methods: In this prospective observational study, 54 symptomatic adults (24 males, 30 females; mean age 40.4±14.2years) underwent GERS using a technetium-99m sulfur colloid capsule. Reflux severity was graded scintigraphically. Patients were stratified by WHO BMI and age groups. Data were analyzed using standard statistical methods; P < 0.05 was considered significant.
Results: GERD was detected in 66.7% of participants, with a higher prevalence in females (70%) than males (62.5%). The mean age was 40.4 yr. Although the highest prevalence was observed in the 15-24year age group (87.5%), differences across age groups were not statistically significant. GERD positivity was highest among underweight individuals (88.9%), followed by normal weight (65.4%), overweight (60%) and obese (50%) categories. Grade III reflux was more frequent in underweight and overweight groups.
Interpretation & conclusions: GERD was common irrespective of age, sex or BMI. While obesity remains a known risk factor, significant reflux also occurred in underweight and non-obese individuals, indicating that BMI alone is not a reliable predictor. Larger studies using advanced diagnostic modalities are needed to clarify these associations.
Keywords: Gastroesophageal reflux disease, gastroesophageal reflux scintigraphy, body mass index, non-erosive reflux disease, Manuscript.

I. INTRODUCTION

Gastroesophageal reflux disease (GERD) is a common disorder characterized by the backward flow of stomach contents into the esophagus, resulting in symptoms such as heartburn, regurgitation, and, in severe cases, erosive esophagitis [1], [2], [3]. GERD significantly impacts quality of life and poses a considerable healthcare burden worldwide. Its prevalence varies across populations and is influenced by demographic, lifestyle, and physiological factors, including age, sex, body mass index (BMI), and anatomical abnormalities such as hiatal hernia [4], [5], [6], [7].

Obesity has long been recognized as a major risk factor for GERD, likely due to increased intra-abdominal pressure and lower esophageal sphincter dysfunction [5], [6], [8]. However, emerging evidence suggests that GERD may also occur in individuals with normal or low BMI, highlighting the multifactorial nature of disease pathogenesis[8,9]. Furthermore, sex differences have been observed, with men more prone to erosive esophagitis and women more likely to report symptomatic reflux [7], [10], [11].

Gastroesophageal reflux scintigraphy (GERS) is a non-invasive imaging modality that allows functional assessment of reflux episodes, providing complementary information to endoscopy, especially in patients with persistent or severe symptoms [3], [5], [12]. Despite its utility, data on GERS-based prevalence and reflux patterns in adult populations remain limited.

The present study aimed to determine the prevalence and severity of GERD in symptomatic adults using radioactive capsule technique of GERS and to examine associations with age, sex, and BMI. By characterizing reflux patterns across these subgroups, this study seeks to improve clinical understanding and inform patient-specific management strategies.

II. MATERIALS AND METHODS

Study Design and Setting: This prospective observational study was conducted in the Department of Nuclear Medicine at Guru Gobind Singh Medical College and Hospital from 2019 to 2023.

©IJRASET: All Rights are Reserved

Study Population: Patients presenting to the Nuclear Medicine outpatient department with signs and symptoms suggestive of gastroesophageal reflux disease (GERD) were screened for eligibility. A detailed clinical history was obtained, and demographic and clinical parameters including age, sex, reflux symptoms, alcohol consumption, and current medication use were recorded.

During the study period, 112 patients were registered for gastroesophageal reflux scintigraphy (GERS), of whom 54 met the inclusion criteria and were enrolled in the final analysis. Patients aged >15 years with reflux-related symptoms and the ability to swallow the capsule orally were included. Those aged <15 years, without reflux-related symptoms, unable to swallow the capsule, receiving acid-suppressive medications, or who had undergone an upper gastrointestinal contrast study within the preceding 2–3 days were excluded.

All participants were instructed to fast for 4-6 hrs before the procedure. Written informed consent was obtained from all participants prior to enrolment.

Gastroesophageal Reflux Scintigraphy Protocol: Gastroesophageal reflux scintigraphy was performed using a dual-head gamma camera equipped with low-energy, high-resolution collimators. Dynamic imaging was acquired in anterior and posterior projections at 10 sec intervals for 30 min using a 64×64 matrix.

Each patient ingested a gelatin capsule containing 11.1-18.5 MBq of technetium-99m sulfur colloid (^{99m}Tc-SC) with a small amount of water, followed by 300-500 mL of juice to facilitate uniform tracer distribution within the stomach, clear residual esophageal activity, and optimize gastric distension for reflux detection. Immediately after ingestion, patients were positioned supine with the thoracoabdominal region included in the field of view, and image acquisition was started.

Image Processing and Analysis: All dynamic images were reviewed frame by frame (10 second per frame) over the 30minutes acquisition period by two experienced nuclear medicine physicians. For improved visualization and detection of reflux episodes, dynamic frames were summed into 30seconds composite images.

Scintigraphic parameters were evaluated using a standardized scoring methodology and correlated with complications associated with GERD. Quantitative analysis of scintigraphic parameters was performed according to the criteria described by Soni et al [13]. Reflux severity was graded using the scintigraphic scoring system proposed by Puranik et al [14].

Clinical and Anthropometric Assessment: Participants were categorized according to World Health Organization (WHO) age groups as follows: young (15-24year), young adults (25-44year), middle aged (45-59year), and elderly (60-74year). Body mass index (BMI) was calculated as weight (kg)/height (m²) and classified according to WHO criteria as underweight (<18.5 kg/m²), normal (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (≥30 kg/m²). Statistical Analysis: Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were presented as frequencies and percentages. A P value <0.05 was considered statistically significant.

III. RESULTS

A total of 54 symptomatic patients underwent gastroesophageal reflux scintigraphy (GERS) for GERD evaluation. The cohort included 24 males (44.4%) and 30 females (55.6%), aged 15-71 yr (mean±SD: 40.44±14.2; males 38.88, females 41.7). Overall, 36 patients (66.7%) demonstrated scintigraphic evidence of GERD (males 62.5%, females 70.0%) (Table 1).

Based on WHO BMI classification, 9 patients (16.7%) were underweight, 26 (48.2%) normal weight, 15 (27.8%) overweight, and 4 (7.4%) obese. GERD positivity was highest in underweight patients (88.9%), followed by normal weight (65.4%), overweight (60.0%), and obese (50.0%) individuals; differences were not statistically significant ($p>0.05$). Grade III reflux was more frequent in underweight and overweight patients but did not reach statistical significance. Among females, 24/30 (80.0%) were GERD positive, and among males, 15/24 (62.5%) were positive (Table 2).

Age-stratified analysis showed GERD positivity of 87.5% in 15-24 yr, 60.7% in 25-44 yr, 70.0% in 45-59 yr, and 62.5% in 60-74 yr. Grade III reflux was most common in patients aged 25-59 yr. Within BMI categories, underweight patients had the highest positivity in the youngest age group, whereas normal-weight patients showed GERD across all age groups. Overweight and obese patients demonstrated variable GERD prevalence by age. No statistically significant associations were found between BMI, age, and GERD positivity ($p > 0.05$) (Table 2). Overall, GERD prevalence was 66.7%, with Grade III reflux observed predominantly in patients aged 25-59 yr, without significant differences between BMI or age groups.

IV. DISCUSSION

In this study of 54 symptomatic patients, GERS detected GERD in 66.7% of participants, with a slightly higher prevalence in females (70%) compared to males (62.5%). This finding is similar to reports from other studies worldwide, which show that women often experience reflux symptoms more frequently than men. Possible reasons include hormonal effects on the esophagus, greater sensitivity to symptoms, and a higher likelihood of women seeking medical care [15], [16].

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

The average age of the patients was 40.4 yr. Although the highest number of GERD cases was seen in the youngest age group (15-24 yr), there was no significant difference in GERD rates between age groups. Previous studies have shown mixed results, with some reporting higher GERD rates in older adults and others showing that young adults are also commonly affected. These differences may be due to variations in study populations and diagnostic methods.

Analysis by BMI showed that GERD positivity was highest in underweight patients (88.9%), followed by normal weight (65.4%), overweight (60%), and obese (50%) individuals. Although differences were not statistically significant, the unexpectedly higher prevalence in underweight patients may reflect factors beyond obesity, such as transient lower esophageal sphincter relaxation, dietary habits, or increased gastric acidity. Previous reports have often associated GERD with obesity [17], [18]; however, our findings suggest that low body weight does not preclude reflux and highlight the heterogeneity of GERD pathophysiology[19,20]. Grade III reflux was more frequently observed in underweight and overweight patients, suggesting that both extremes of BMI may influence reflux severity, even though the association did not reach statistical significance [21], [22].

When results were analyzed by sex and BMI together, females had higher GERD rates in most BMI groups. This agrees with earlier studies showing that men are more likely to have visible esophageal damage, while women more often report reflux symptoms. These differences may be related to hormonal factors, body fat distribution, and differences in how symptoms are perceived and reported [23], [24], [25].

Age-stratified analysis demonstrated the highest GERD prevalence in the youngest age group (15-24 yr, 87.5%), whereas patients aged 25-59 yr exhibited the greatest frequency of Grade III reflux. This indicates that severe reflux may be more common in middle-aged adults, potentially due to cumulative exposure to risk factors such as dietary patterns, smoking, alcohol intake, and hiatal hernia [26], [27]. Interestingly, GERD was prevalent across all age and BMI categories, emphasizing that the disease is not restricted to traditionally recognized high-risk groups.

In the present study, hiatus hernia was detected in 15.9% of patients undergoing upper gastrointestinal endoscopy, which is comparable to previously reported rates [28]. A higher proportion of affected patients were overweight (71.4%), supporting the established association between increased body mass index and the development of hiatus hernia due to raised intra-abdominal pressure [29]. A female predominance was observed, and the mean age (41.6 yr) indicates occurrence mainly in early to middle adulthood.

Overall, these findings highlight that GERD affects a broad spectrum of patients irrespective of age, sex, or BMI, and that severe reflux correlates more closely with mucosal injury rather than body habitus alone. The high prevalence of NERD underscores the importance of functional assessment in symptomatic patients. Limitations of this study include the relatively small sample size and cross-sectional design, which may limit the ability to detect statistically significant associations between BMI, age, and GERD severity. Future studies with larger cohorts and combined diagnostic modalities may provide further insights into the complex interactions between demographic factors, reflux severity, and esophageal mucosal changes.

In conclusion, GERD was common across different ages, sexes, and BMI groups in this study. While obesity is a known risk factor, this study shows that underweight and non-obese individuals can also have significant reflux. This suggests that BMI alone cannot reliably predict GERD. The presence of severe reflux in non-obese patients highlights the role of other factors such as anatomy, diet, and lifestyle. Larger studies using advanced tests such as pH monitoring and esophageal manometry are needed to better understand how age, sex, BMI, and reflux severity are related.

1) Financial support & sponsorship: None.
2) Conflicts of Interest: None.
3) Use of Artificial Intelligence (AI)-Assisted Technology for manuscript preparation: There was no use of AI-assisted technology for assisting in the writing of the manuscript and no images were manipulated using AI.

REFERENCES

[1] Shaqran, T. M., Ismaeel, M. M., Alnuaman, A. A., Al Ahmad, F. A., Albalawi, G. A., Almubarak, J. N., AlHarbi, R. S., Alaqidi, R. S., AlAli, Y. A., Alfawaz, K. S., & Daghriri, A. A. (2023). Epidemiology, Causes, and Management of Gastro-esophageal Reflux Disease: A Systematic Review. Cureus, 15(10), e47420. https://doi.org/10.7759/cureus.47420

[2] El-Serag, H. B., Sweet, S., Winchester, C. C., & Dent, J. (2014). Update on the epidemiology of gastro-oesophageal reflux disease: a systematic review. Gut, 63(6), 871–880. https://doi.org/10.1136/gutjnl-2012-304269

[3] Asakura, Y., Imai, Y., Ota, S., Fujiwara, K., & Miyamae, T. (2005). Usefulness of gastroesophageal reflux scintigraphy using the knee-chest position for the diagnosis of gastroesophageal reflux disease. Annals of nuclear medicine, 19(4), 291–296. https://doi.org/10.1007/BF02984621

[4] Burton, L., Khoma, O., Mackey, D. W., Pearson, M., & Falk, G. L. (2022). Reflux scintigraphy in gastro-esophageal reflux disease: a comparison study with 24-hour pH-impedance monitoring by Shim et al. Scandinavian journal of gastroenterology, 57(9), 1147. https://doi.org/10.1080/00365521.2022.2055973

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

[5] Isaacs, P. E., Martins, J. C., Edwards, S., Fagg, N. L., Maisey, M. N., & Sladen, G. E. (1990). Assessment of gastro-esophageal reflux disease: comparison of reflux scintigraphy with endoscopy biopsy and esophageal pH monitoring. Hepato-gastroenterology, 37(2), 198–200.
[6] Vakil, N., van Zanten, S. V., Kahrilas, P., Dent, J., Jones, R., & Global Consensus Group (2006). The Montreal definition and classification of gastroesophageal reflux disease: a global evidence-based consensus. The American journal of gastroenterology, 101(8), 1900–1943. https://doi.org/10.1111/j.1572-0241.2006.00630.x
[7] Sadafi, S., Azizi, A., Pasdar, Y., Shakiba, E., & Darbandi, M. (2024). Risk factors for gastroesophageal reflux disease: a population-based study. BMC gastroenterology, 24(1), 64. https://doi.org/10.1186/s12876-024-03143-9
[8] Corley, D. A., & Kubo, A. (2006). Body mass index and gastroesophageal reflux disease: a systematic review and meta-analysis. The American journal of gastroenterology, 101(11), 2619–2628. https://doi.org/10.1111/j.1572-0241.2006.00849.x
[9] Hom, C., & Vaezi, M. F. (2013). Extraesophageal manifestations of gastroesophageal reflux disease. Gastroenterology clinics of North America, 42(1), 71–91. https://doi.org/10.1016/j.gtc.2012.11.004
[10] el-Serag, H. B., & Sonnenberg, A. (1998). Opposing time trends of peptic ulcer and reflux disease. Gut, 43(3), 327–333. https://doi.org/10.1136/gut.43.3.327
[11] Jacobson, B. C., Somers, S. C., Fuchs, C. S., Kelly, C. P., & Camargo, C. A., Jr (2006). Body-mass index and symptoms of gastroesophageal reflux in women. The New England journal of medicine, 354(22), 2340–2348. https://doi.org/10.1056/NEJMoa054391
[12] Jansson, C., Nordenstedt, H., Johansson, S., Wallander, M. A., Johnsen, R., Hveem, K., & Lagergren, J. (2007). Relation between gastroesophageal reflux symptoms and socioeconomic factors: a population-based study (the HUNT Study). Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association, 5(9), 1029–1034. https://doi.org/10.1016/j.cgh.2007.04.009
[13] Soni, P. S., Sarojini, C., & Krishna, B. A. (1990). Gastroesophageal reflux scintigraphy with radioactive capsules--a new technique for detection and quantitation of reflux. European journal of nuclear medicine, 16(4-6), 345–348. https://doi.org/10.1007/BF00842790
[14] Puranik, A. D., Nair, G., Aggarwal, R., Bandyopadhyay, A., Shinto, A., & Zade, A. (2013). Scintigraphic scoring system for grading severity of gastro-esophageal reflux on 99mTc sulfur colloid gastro-esophageal reflux scintigraphy: A prospective study of 39 cases with pre and post treatment assessment. Indian journal of nuclear medicine : IJNM : the official journal of the Society of Nuclear Medicine, India, 28(2), 79–84. https://doi.org/10.4103/0972-3919.118240
[15] Nilsson, M., Johnsen, R., Ye, W., Hveem, K., & Lagergren, J. (2003). Obesity and estrogen as risk factors for gastroesophageal reflux symptoms. JAMA, 290(1), 66–72. https://doi.org/10.1001/jama.290.1.66
[16] Kim, Y. S., Kim, N., & Kim, G. H. (2016). Sex and Gender Differences in Gastroesophageal Reflux Disease. Journal of neurogastroenterology and motility, 22(4), 575–588. https://doi.org/10.5056/jnm16138
[17] Chang, P., & Friedenberg, F. (2014). Obesity and GERD. Gastroenterology clinics of North America, 43(1), 161–173. https://doi.org/10.1016/j.gtc.2013.11.009
[18] Siboni, S., Bonavina, L., Rogers, B. D., Egan, C., Savarino, E., Gyawali, C. P., & DeMeester, T. R. (2022). Effect of Increased Intra-abdominal Pressure on the Esophagogastric Junction: A Systematic Review. Journal of clinical gastroenterology, 56(10), 821–830. https://doi.org/10.1097/MCG.0000000000001756
[19] Hiramoto, B., Redd, W. D., Muftah, M., Jonnadula, S., Okwara, N. C., Jenkins, A., Cricco-Lizza, E., Lee, D. J. H., Cai, J. X., & Chan, W. W. (2024). Higher obesity class is associated with more severe esophageal symptoms and reflux burden but not altered motor function or contractile reserve. Neurogastroenterology and motility, 36(1), e14691. https://doi.org/10.1111/nmo.14691
[20] Znamirowski, P., Nawacki, Ł., & Głuszek, S. (2025). Relationship between BMI and upper gastrointestinal pathologies. Medicine, 104(38), e44564. https://doi.org/10.1097/MD.0000000000044564
[21] Singh, M., Lee, J., Gupta, N., Gaddam, S., Smith, B. K., Wani, S. B., Sullivan, D. K., Rastogi, A., Bansal, A., Donnelly, J. E., & Sharma, P. (2013). Weight loss can lead to resolution of gastroesophageal reflux disease symptoms: a prospective intervention trial. Obesity (Silver Spring, Md.), 21(2), 284–290. https://doi.org/10.1002/oby.20279
[22] Bucan, J.I., Braut, T., Kršek, A., Sotošek, V., & Batičić, L. (2025). Updates in Gastroesophageal Reflux Disease Management: From Proton Pump Inhibitors to Dietary and Lifestyle Modifications. Gastrointestinal Disorders.
[23] Khan, A., Kim, A., Sanossian, C., & Francois, F. (2016). Impact of obesity treatment on gastroesophageal reflux disease. World journal of gastroenterology, 22(4), 1627–1638. https://doi.org/10.3748/wjg.v22.i4.1627
[24] Bhatia, S. J., Makharia, G. K., Abraham, P., Bhat, N., Kumar, A., Reddy, D. N., Ghoshal, U. C., Ahuja, V., Rao, G. V., Devadas, K., Dutta, A. K., Jain, A., Kedia, S., Dama, R., Kalapala, R., Alvares, J. F., Dadhich, S., Dixit, V. K., Goenka, M. K., Goswami, B. D., … Wadhwa, R. T. (2019). Indian consensus on gastroesophageal reflux disease in adults: A position statement of the Indian Society of Gastroenterology. Indian journal of gastroenterology : official journal of the Indian Society of Gastroenterology, 38(5), 411–440. https://doi.org/10.1007/s12664-019-00979-y
[25] Scheese D, Chehab M, Puig CA. Sex Differences in Gastroesophageal Reflux Disease (GERD). Foregut: The Journal of the American Foregut Society. 2023;3(2):192-198.
[26] Yamasaki, T., Hemond, C., Eisa, M., Ganocy, S., & Fass, R. (2018). The Changing Epidemiology of Gastroesophageal Reflux Disease: Are Patients Getting Younger?. Journal of neurogastroenterology and motility, 24(4), 559–569. https://doi.org/10.5056/jnm18140
[27] Wang, Z., Lin, S., Liu, H., Zhou, J., Tang, E., Xi, Z., Zheng, J., & Yang, W. (2025). Association of healthy lifestyle behaviors with incident gastroesophageal reflux disease in a large population-based prospective cohort. Preventive medicine reports, 60, 103276. https://doi.org/10.1016/j.pmedr.2025.103276
[28] Cram, M. (2011). Hiatus hernia and gastro-oesophageal reflux disease. Medicine. https://doi.org/10.1016/J.MPMED.2010.12.005
[29] Hampel, H., Abraham, N. S., & El-Serag, H. B. (2005). Meta-analysis: obesity and the risk for gastroesophageal reflux disease and its complications. Annals of internal medicine, 143(3), 199–211. https://doi.org/10.7326/0003-4819-143-3-200508020-00006

Table 1. Demographic Characteristics and Scintigraphic GERD Findings in Symptomatic Patients (n=54)

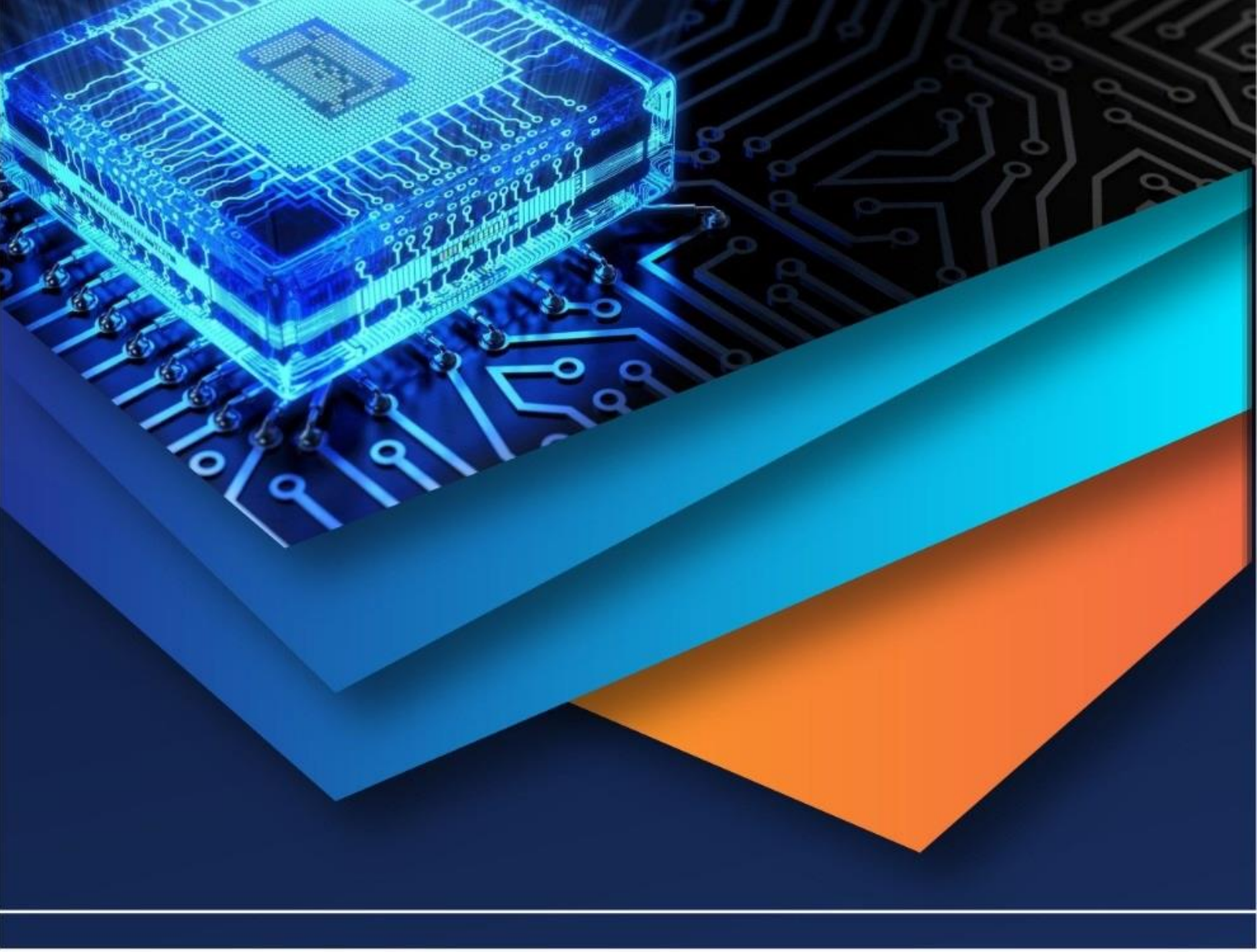
Characteristic	Total	Male	Female
Patients	54 pts	24 (44.4%)	30 (55.6%)
Age (mean age; age range)	40.4 yrs;	38.9 yrs;	41.4 yrs;

Scintigraphic GERD	36 (66.7%)	15 (62.5%)	21 (70%)

Table 2: Distribution of GERD positivity according to BMI and Grade III reflux according to age group (n = 54)

Weight Criteria	Age Group				
	15-24 yrs	25-44 yrs	45-59 yrs	60-74 yrs	Total
	Total/GER +ve n/N (%)	Total/GER +ve n/N (%)	Total/GER +ve n/N (%)	Total/GER +ve n/N (%)	Total/GER +ve n/N (%)
Under weight	4/4 (100)	3/4 (75)	1/1 (100)	-	8/9 (88.9)
Normal weight	3/4 (75)	9/13 (62.2)	3/5 (60)	2/4 (50)	17/26 (65.4)
Over weight	-	5/10 (50)	1/2 (50)	3/3 (100)	9/15 (60)
Obese	-	2/1 (50)	2/2 (100)	-/1	2/4 (50)
Total	7/8 (87.5)	17/28 (60.7)	7/10 (70)	5/8 (62.5)	36/54 (66.7)

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)