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**RESEARCH ARTICLE**

# PREVALENCE AND RISK FACTORS RELATED TO THE SEVERITY OF GASTROPARESIS SYMPTOMS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

## *(PREVALENSI DAN FAKTOR RISIKO TERKAIT TINGKAT KEPARAHAN GEJALA GASTROPARESIS PADA PASIEN DIABETES MELLITUS TIPE 2)*

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**ABSTRACT**

Type 2 diabetes mellitus is a major global health concern with increasing prevalence rates and is often accompanied by gastroparesis, a disorder that affects gastric motility and negatively impacts diabetes control. This study aimed to determine the prevalence and severity of gastroparesis symptoms among patients with type 2 diabetes mellitus in the area served by Waled Cirebon General Hospital. This cross-sectional observational study recruited 96 patients with type 2 diabetes mellitus who met the selection criteria between May and June 2025. Gastroparesis symptoms were assessed using the validated Gastroparesis Cardinal Symptom Index questionnaire . Data were collected through structured interviews and review of existing medical records. Statistical analyses included univariate descriptive statistics and bivariate analyses using Spearman's correlation test and the Chi-square test, with statistical significance set at $p < 0.05$. The severity of gastroparesis symptoms was classified as severe in 43.8% of participants, moderate in 24.0%, and mild in 32.3%. The results revealed that significant associations existed between the severity of gastroparesis symptoms and age ($r = 0.354$, $p = 0.001$), gender ($p < 0.001$), duration of diabetes ($r = 0.535$, $p = 0.001$), blood glucose control, ($r = 0.379$, $p = 0.001$), smoking ($r = 0.636$, $p = 0.001$), and body mass index. The prevalence of severe gastroparesis symptoms in this population exceeded reported global rates. All identified risk factors were signicantly associated with symptom severity, with obesity and smoking showing the strongest association. This study highlights the importance of optimal diabetes control involving several modifiable risk factors, proper screening for gastroparesis, and appropriate intervention among the high-risk population.

**Keywords**: body mass index, diabetes mellitus type 2, gastroparesis, prevalence, risk factors

*ABSTRAK*

*Diabetes mellitus tipe 2 merupakan tantangan kesehatan global yang kritis dengan prevalensi yang terus meningkat, sering disertai dengan gastroparesis, gangguan motilitas lambung yang secara signifikan mengganggu kontrol glikemik dan kualitas hidup. Studi ini bertujuan untuk menentukan prevalensi gejala gastroparesis dan menganalisis hubungan antara usia, jenis kelamin, lama menderita diabetes, status kontrol glikemik, kebiasaan merokok, indeks massa tubuh (BMI), dan tingkat keparahan gejala pada pasien diabetes mellitus tipe 2 di Rumah Sakit Umum Regional Waled Cirebon. Studi observasional potong lintang ini melibatkan 96 pasien diabetes mellitus tipe 2 yang memenuhi kriteria inklusi pada bulan Mei-Juni 2025. Gejala gastroparesis dievaluasi menggunakan kuesioner Gastroparesis Cardinal Symptom Index yang telah tervalidasi. Pengumpulan data meliputi wawancara terstruktur dan tinjauan catatan medis. Analisis statistik menggunakan statistik deskriptif univariat dan analisis bivariat dengan uji korelasi Spearman dan uji chi-square dengan ambang batas signifikansi p<0,05. Prevalensi gastroparesis sebesar 43,8% berat, 24,0% sedang, dan 32,3% ringan. Hubungan yang signifikan ditemukan antara tingkat keparahan gejala dan usia (r=0,354, p=0,001), jenis kelamin (p<0,001), durasi diabetes (r=0,535, p=0,001), kontrol glikemik (r=0,379, p=0,001), status merokok (r=0,636, p=0,001), dan BMI (r=0,682, p=0,001). Prevalensi gastroparesis yang tinggi pada populasi ini melebihi perkiraan global sebelumnya, dengan semua faktor risiko yang dianalisis menunjukkan hubungan yang signifikan dengan keparahan gejala. Obesitas dan merokok menunjukkan korelasi terkuat. Temuan ini menekankan pentingnya pengelolaan diabetes yang komprehensif yang mencakup berbagai faktor risiko yang dapat dimodifikasi, skrining rutin gastroparesis, dan intervensi terarah untuk pasien berisiko tinggi guna meningkatkan hasil pengobatan dan kualitas hidup.*

*Kata Kunci: diabetes mellitus tipe 2, faktor risiko, gastroparesis, indeks massa tubuh, prevalensi*

## INTRODUCTION

Type 2 diabetes mellitus has become a major global health concern, with the number of affected individuals expected to increase from 536.6 million in 2021 to 783.2 million by 2045.[1,2] West Java has the highest burden of patients, with 156,977 cases, while Cirebon Regency alone reports 14.055 cases annually[3,4,5] Among the complications associated with diabetes is diabetic gastroparesis, a condition affecting stomach movement that causes delayed emptying without any physical blockage. Patients with this condition often experience symptoms such as nausea, vomiting, a feeling of fullness, and bloating.[6,7] The disease mechanism is associated with damage to the vagus nerve and the interstitial cells of Cajal caused by the effects of hyperglycemia on the autonomic nervous system.[8,9] Based on available data, the prevalence of gastroparesis among people with diabetes is estimated at 9.3%, with the highest rates reported in the Asian populations, ranging from 13.8 to 29%.[8,10] Despite these alarming rates globally, a significant gap remains in the study of gastroparesis prevalence within Indonesia's diabetic

population and its asociated risk factors in the Cirebon region.

The clinical importance of diabetic-related gastroparesis extends beyond gastrointestinal discomfort, as it significantly affects blood glucose levels.[8] Various risk factors have been associated with the development of gastroparesis, including older age, gender, and a duration of diabetes of more than 10 years. Other contributing factors include poor blood glucose management, smoking, and increased body mass index.[11–16] Despite its clinical significance, gastroparesis is often underdiagnosed because of its nonspecific symptoms. The lack of adequate data on this subject from Indonesian health centers is a significant hindrance to the development of evidence-based guidelines.

This study aimed to identify the prevalence of gastroparesis symptoms and examine the association between several risk factors and symptom severity among patients with type 2 diabetes mellitus at the Waled Cirebon Regional General Hospital. By establishing these associations, this study aimed to provide critical information that may support the implementation of systematic screening programs, educational initiatives, and the creation of targeted preventive measures.

## MATERIALS AND METHODS

This observational analytic study employed a cross-sectional design and was conducted at Waled Cirebon Regional General Hospital between May and June of 2025. Ethical clearance for this study was granted by the Health Research Ethics Committee of the hospital (Approval Number: 000.9.21/144/KEPK/II/2025), in accordance with the Declaration of Helsinki and national health research ethics guidelines in Indonesia.

A consecutive sampling design was used to select 96 patients with type 2 diabetes mellitus from 116 screened volunteers. The eligibility criteria included a confirmed diagnosis of type 2 diabetes mellitus based on the Indonesian Endocrinology Association standards, age ≥18 years, the presence of gastroparesis symptoms, and provision of informed consent.[10] Patients with a history of gastrointestinal surgery, peptic ulcer disease, gastroesophageal reflux disease, or incomplete medical records were excluded.[12] The sample size was calculated using the Lemeshow formula with a 95% confidence level, a maximum proportion of variability of 0.5, and a margin of error of 10%.

The dependent variable was the severity of the gastroparesis symptoms. This was assessed using the Gastroparesis Cardinal Symptom Index (GCSI), a validated instrument that evaluates nine

cardinal symptoms using a Likert-type scale ranging from 0 to 5. Scores were categorized as mild (1-11), moderate (12-22), severe (23-33), and very severe (34-45).[17,18] The Indonesian version of the questionnaire demonstrated cceptable internal consistency, with a Cronbach's alpha of 0.738. The Independent variables were age, gender, duration of diabetes (<10 years or ≥10 years), glycemic control status, smoking status, and body mass index (BMI), classified according to the World Health Organization criteria for Asian population.[11,12] Glycemic control status was defined based on the criteria of the Indonesian Endocrinology Society, where uncontrolled status was established by a fasting plasma glucose >126 mg/dL, random plasma glucose >200 mg/dL, 2-hour postprandial plasma glucose >200 mg/dL, or Hb. Data collection techniques consisted of structured interviews using the GCSI questionnaire and a review of patients' medical records.[10]

Demographic characteristics, anthropometric measurements, and laboratory results were obtained from the medical records noted.[17] Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.0 (IBM Corp., Armonk, NY, USA). The level of statistical significance was set at 0.05. Descriptive analyses were performed to characterize the study population and estimate the prevalence of gastroparesis symptoms. Bivariate analyses included Spearman's correlation test for ordinal data and the chi-square test for nominal data.[11,12] These tests were used to assess the association between the independent variables and the gastroparesis symptom severity. These tests were conducted under the guidelines of ethical standards.

## RESULTS AND DISCUSSION

This cross-sectional study included 96 patients with type 2 diabetes mellitus from a screened pool of 116 individuals. Twenty patients were excluded due to post-surgical gastroparesis, peptic ulcer disease, gastroesophageal reflux disease, or incomplete medical records. Participant characteristics revealed a predominance of individuals aged 46-55 years (34.4%), females (61.5%), patients with a diabetes duration of less than 10 years (62.5%), uncontrolled glycemic status (55.2%), active smokers (53.1%), and those with a normal body mass index (37.5%). The age distribution indicates a concentration of middle-aged individuals, which is consistent with the typical presentation of diabetes-related complications. [19] The predominance of female participants is consistent with the epidemiology of gastroparesis, which has been reported more frequently among women and may be influenced by hormonal factors affecting

gastrointestinal motility.[13] The substantial proportion of patients with uncontrolled glycemia highlights the ongoing challenges of achieving optimal diabetes management.[10]

**Table 1** Participant characteristics by gastroparesis symptom severity (n=96)

| Characteristics | Category | Frequency | Percentage |
|---|---|---|---|
| Age (years) | 26-35 | 22 | 22.9 |
| | 36-45 | 17 | 17.7 |
| | 46-55 | 33 | 34.4 |
| | 56-65 | 19 | 19.8 |
| | >65 | 5 | 5.2 |
| Gender | Female | 59 | 61.5 |
| | Male | 37 | 38.5 |
| Diabetes duration | <10 years | 60 | 62.5 |
| | ≥10 years | 36 | 37.5 |
| Glycemic control | Controlled | 43 | 44.8 |
| | Uncontrolled | 53 | 55.2 |
| Smoking status | Active smoker | 51 | 53.1 |
| | Non-smoker | 45 | 46.9 |
| Body mass index | Underweight | 3 | 3.1 |
| | Normal | 36 | 37.5 |
| | Overweight | 26 | 27.1 |
| | Obese | 31 | 32.3 |

The prevalence of severe gastroparesis symptoms was 43.8%, while moderate and mild symptoms were observed in 24.0% and 32.3% of participants, respectively. No cases of very severe symptoms were identified. The combined moderate-to-severe prevalence (67.8%) substantially exceeded previously reported global estimates of 9.3% and Asian population rates of 13.8-29%.[8,10] This high prevalence may reflect hospital-based recruitment capturing more symptomatic individuals, a middle-aged demographic with a diabetes duration approaching or exceeding 10 years, substantial uncontrolled glycemia contributing to accelerated nerve damage, and the ability of the Gastroparesis Cardinal Symptom Index to capture symptoms more sensitively than objective gastric emptying studies.[15,17,18, 20] The absence of very severe cases may indicate that such patients seek tertiary care or have received interventions that reduce symptom burden.

**Table 2** Gastroparesis Symptom Severity Distribution (n=96)

| Symptom Severity | Frequency (n) | Percentage (%) | 95% Confidence Interval |
|---|---|---|---|
| Mild | 31 | 32.3 | 23.1-42.4 |
| Moderate | 23 | 24.0 | 15.8-33.7 |
| Severe | 42 | 43.8 | 33.7-54.2 |
| Very severe | 0 | 0 | 0-3.8 |
| Total | 96 | 100.0 | |

Spearman's correlation analysis demonstrated a significant positive association between age and gastroparesis symptom severity (r=0.354, p=0.001). Younger patients aged 26-35 years predominantly experienced mild symptoms (63.6%), whereas those aged 46-55 and 56-65 years showed the highest prevalence of severe symptoms (57.6% and 63.2%, respectively). This age-related gradient supports the cumulative damage hypothesis, wherein prolonged metabolic derangements and aging-related autonomic decline synergistically impair gastric motility through progressive myenteric plexus neuronal loss, interstitial cells of Cajal degeneration, and impaired neurotransmitter synthesis.[21] Kim reported that older patients with diabetes exhibited significantly delayed gastric emptying, which was correlated with age.[22] The unexpected finding that patients over 65 years predominantly experienced moderate symptoms may reflect survival bias or successful dietary adaptations. [23]

**Table 3** Association between age and gastroparesis symptom severity (n=96)

| Age Category | Mild n (%) | Moderate n (%) | Severe n (%) | Total n (%) | p-value | Correlation coefficient |
|---|---|---|---|---|---|---|
| 26–35 years | 14 (63.6) | 2 (9.1) | 6 (27.3) | 22 (100) | 0.001 | 0.354 |
| 36–45 years | 8 (47.1) | 5 (29.4) | 4 (23.5) | 17 (100) | | |
| 46–55 years | 6 (18.2) | 8 (24.2) | 19 (57.6) | 33 (100) | | |
| 56–65 years | 3 (15.8) | 4 (21.1) | 12 (63.2) | 19 (100) | | |
| >65 years | 0 (0.0) | 4 (80.0) | 1 (20.0) | 5 (100) | | |
| Total | 31 (32.3) | 23 (24.0) | 42 (43.8) | 96 (100) | | |

Chi-square analysis revealed a highly significant association between gender and symptom severity (p <0.001), with females demonstrating a markedly higher prevalence of severe symptoms (62.7%) than males (13.5%). This gender disparity is consistent with the international literature, which has documented a female predominance exceeding 70% in most gastroparesis cohorts.[24] Several mechanisms may contribute to this association, including the direct relaxant

effects of estrogen and progesterone on gastrointestinal smooth muscle, hormonal influences on symptom expression, and sex-related differences in autonomic nervous system function, with females exhibiting greater variability in parasympathetic tone.[23,25] Parkman and colleagues reported that female sex hormones modulate neuronal nitric oxide synthase expression, thereby impairing coordinated gastric emptying.[24] Objective gastric emptying studies have also confirmed physiological differences between sexes, suggesting that the observed association is not solely attributable to reporting bias.[26]

**Table 4** Association between gender and gastroparesis symptom severity (n=96)

| Age Category | Mild n (%) | Moderate n (%) | Severe n (%) | Total n (%) | p-value | Correlation coefficient |
|---|---|---|---|---|---|---|
| 26–35 years | 14 (63.6) | 2 (9.1) | 6 (27.3) | 22 (100) | 0.001 | 0.354 |
| 36–45 years | 8 (47.1) | 5 (29.4) | 4 (23.5) | 17 (100) | | |
| 46–55 years | 6 (18.2) | 8 (24.2) | 19 (57.6) | 33 (100) | | |
| 56–65 years | 3 (15.8) | 4 (21.1) | 12 (63.2) | 19 (100) | | |
| >65 years | 0 (0.0) | 4 (80.0) | 1 (20.0) | 5 (100) | | |
| Total | 31 (32.3) | 23 (24.0) | 42 (43.8) | 96 (100) | | |

Spearman's correlation analysis demonstrated a strong positive association between diabetes duration and symptom severity (r=0.535, p=0.001). Among patients with a disease duration of less than 10 years, most experienced mild (43.3%) or moderate (36.7%) symptoms, whereas patients with a disease duration of 10 years or more predominantly experienced severe symptoms (83.3%). These findings indicate that disease duration is a key factor in the pathophysiology of gastroparesis, where the accumulation of advanced glycation end-products, activation of the polyol pathway, and severity of the neuropathy occur over time.[15] Autonomic neuropathy has been reported to develop as the disease progresses, with severity increasing with longer disease duration, particularly after 5-10 years.[15] Progressive reductions in the myenteric plexus and the interstitial cells of Cajal have also been observed. Furthermore, Tan reported that vagal dysfunction is associated with disease duration, with longer disease duration resulting in more severe vagal dysfunction regardless of glycemic control status.[9,27,28]

**Table 5** Association between diabetes duration and gastroparesis symptom severity (n=96)

| Diabetes Duration | <10 years | ≥10 years | Total |
|---|---|---|---|
| Mild n (%) | 26 (43.3) | 5 (13.9) | 31 (32.3) |
| Moderate n (%) | 22 (36.7) | 1 (2.8) | 23 (24.0) |
| Severe n (%) | 12 (20.0) | 30 (83.3) | 42 (43.8) |
| Total n (%) | 60 (100) | 36 (100) | 96 (100) |
| p-value | 0.001 | | |
| Correlation coefficient | 0.535 | | |

Spearman's correlation analysis revealed a significant association between uncontrolled glycemia and increased symptom severity (r=0.379, p=0.001). Patients with uncontrolled diabetes predominantly experienced severe symptoms (56.6%), whereas those with controlled diabetes most commonly experienced mild symptoms (53.5%). Glycemic control represents the most clinically actionable risk factor. Mechanistically, acute hyperglycemia inhibits antral contractions and delays gastric emptying, while chronic hyperglycemia generates reactive oxygen species that damage neuronal mitochondria.[7,9,20,29] The bidirectional cycle, wherein poor control damages motility and impaired motility destabilizes glucose levels, complicates clinical management.[8] Intensive glycemic management, achieving HbA1c below 7%, has been reported to yield modest symptom improvement, though improvements tend to plateau, suggesting irreversible damage.[7]

Spearman's correlation analysis demonstrated a strong association between smoking and symptom severity (r=0.636, p=0.001), representing the highest correlation observed in this study. Active smokers overwhelmingly experienced severe symptoms (72.5%), whereas non-smokers predominantly presented with mild symptoms (57.8%). Smoking is a potent modifiable risk factor that may contribute to symptom severity through nicotine-induced vasoconstriction, reduced gastric wall blood flow, systemic oxidation, altered acetylcholine receptor expression, and reduced oxygen delivery caused by carbon monoxide exposure.[9] Wadhwa and colleagues documented that smoking cessation for a minimum of 6 months showed significant symptom improvement. The current smoking prevalence of 53.1% in the diabetic cohort underlines the potential value of smoking cessation interventions as a high-yield preventive strategy. Using Spearman’s rank correlation coefficient, the study found a strong correlation between body mass index (BMI) and gastroparesis symptom severity (r = 0.682; p = 0.001), representing the strongest correlation observed in this study. Severe

symptoms were predominantly found in obese individuals (93.5%), whereas the majority of normal-weight participants experienced mild symptoms (61.1%). The association between obesity and GERD symptom severity is thought to be mediated through several mechanisms, including insulin resistance-induced hyperinsulinism affecting the enteric nervous system, inflammation affecting the enteric nervous system, increased intra-abdominal pressure on stomach structures, and the effects of gastrointestinal hormones on the visceral adipose tissue.[9] The rates of symptom development were higher in obese diabetic individuals than in normal-weight individuals. A weight loss of 10% or more has been significantly correlated with a reduction of GERD symptoms; however, weight loss can be hindered by dietary restrictions caused by GERD symptoms.

The high incidence of this complication in the studied population (67.8% with moderate-to-severe symptoms of gastroparesis) supports the need for routine symptom screening among patients with diabetes. Identification of the associated risk factors provides important targets for educational and preventive interventions. Diabetes education programs should be modified to explicitly address gastroparesis risks and prevention methods. Furthermore, smoking cessation support must become a priority in standard diabetic care. Finally, educational initiatives regarding gastroparesis prevention should be integrated into training programs for healthcare staff, as this complication remains underappreciated despite its profound impact on patients' quality of life and treatment efficacy.

## CONCLUSION

The prevalence of gastroparesis among patients with type 2 diabetes mellitus at Waled Cirebon Regional General Hospital was high, with 43.8% classified as severe, 24.0% as moderate, and 32.3% as mild. All analyzed risk factors showed statistically significant associations with symptom severity. Obesity and smoking demonstrated the strongest correlations. These findings emphasize the necessity of comprehensive diabetes management, including routine screening for gastroparesis, modification of modifiable risk factors, and targeted interventions for high-risk patients.

Future research should employ longitudinal designs with prospective data collection and objective measures of gastric emptying. In healthcare settings, education on gastroparesis within the context of diabetes management, systematic screening for gastroparesis, and specialized nutritional education are recommended to help mitigate the burden of this serious and debilitating complication.

## CONFLICT OF INTEREST

The authors declare no conflict of interest related to the preparation and publication of this manuscript.

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## BIBLIOGRAPHY

1. Fika R, Yonrizon, Naim A, Fadhila M, Ulandari P. Evaluation of Patient Compliance with the Use of Type II Diabetes Mellitus Medication at Clinic X Padang City. Sci Midwifery [Internet]. 2022 Dec 13;10(5):4178–86. Available from: https://www.midwifery.iocspublisher.org/index.php/midwifery/article/view/1024
2. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Res Clin Pract [Internet]. 2022 Jan;183:109119. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0168822721004782
3. Cahyani AR, Abdullah A, Santi Td. Faktor - Faktor Yang Berhubungan Dengan Kejadian Diabetes Melitus Pada Usia Produktif Di Wilayah Kerja Puskesmas Kuta Alam Kota Banda Aceh Tahun 2023. J Kesehat Tambusai. 2024;5(1):1429–39.
4. Badan Pusat Statistik. Kota Bukittinggi dalam Angka 2020. Bukittinggi; 2020.
5. Dinas Kesehatan. Open Data Jabar. 2024. Jumlah Penderita Diabetes Melitus Berdasarkan Kabupaten/Kota di Jawa Barat. Available from: https://opendata.jabarprov.go.id/id/dataset/jumlah-penderita-diabetes-melitus-berdasarkan-

kabupatenkota-di-jawa-barat

6. Mukodri DML, Ginting AK, Kusumawati DD, Hanifah L, Hanifa F, Kurniyati EM, et al. Buku Ajar Asuhan Kebidanan Pada Kehamilan. Jakarta: Nuansa Fajar Cemerlang; 2024.
7. Camilleri M, Kuo B, Nguyen L, Vaughn VM, Petrey J, Greer K, et al. ACG Clinical Guideline: Gastroparesis. Am J Gastroenterol [Internet]. 2022 Aug;117(8):1197–220. Available from: https://journals.lww.com/10.14309/ajg.0000000000001874
8. Li L, Wang L, Long R, Song L, Yue R. Prevalence of gastroparesis in diabetic patients: a systematic review and meta-analysis. Sci Rep [Internet]. 2023 Aug 28;13(1):14015. Available from: https://www.nature.com/articles/s41598-023-41112-6
9. Caturano A, Cavallo M, Nilo D, Vaudo G, Russo V, Galiero R, et al. Diabetic Gastroparesis: Navigating Pathophysiology and Nutritional Interventions. Gastrointest Disord [Internet]. 2024 Feb 22;6(1):214–29. Available from: https://www.mdpi.com/2624-5647/6/1/16
10. Soelastijo SA, Suastika K, Lindarto D, Decroli E, Permana H, Sucipto KW, et al. Pedoman Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 Dewasa di Indonesia 2021 [Internet]. Jakarta; 2021. Available from: https://pbperkeni.or.id/wp-content/uploads/2021/11/22-10-21-Website-Pedoman-Pengelolaan-dan-Pencegahan-DMT2-Ebook.pdf
11. Asghar S, Asghar S, Shahid S, Sajjad H, Abdul Nasir J, Usman M. Gastroparesis-Related Symptoms in Patients With Type 2 Diabetes Mellitus: Early Detection, Risk Factors, and Prevalence. Cureus [Internet]. 2023 Mar 5; Available from: https://www.cureus.com/articles/140489-gastroparesis-related-symptoms-in-patients-with-type-2-diabetes-mellitus-early-detection-risk-factors-and-prevalence
12. Kostitska IO, Mankovsky BM, Urbanovych AM, Zhurakivska OY, Tymoschuk O V., Basiuha IO. Risk factors and early detection of gastroparesis in patients with type 2 diabetes mellitus. Regul Mech Biosyst. 2019;10(1):56–62.
13. Young CF, Moussa M, Shubrook JH. Diabetic Gastroparesis: A Review. Diabetes Spectr [Internet]. 2020 Aug 1;33(3):290–7. Available from: https://diabetesjournals.org/spectru

m/article/33/3/290/32318/Diabetic-Gastroparesis-A-Review

14. Waseem S, Moshiree B, Draganov P V. Gastroparesis: Current diagnostic challenges and management considerations. World J Gastroenterol [Internet]. 2009;15(1):25. Available from: http://www.wjgnet.com/1007-9327/full/v15/i1/25.htm
15. Bharucha AE, Kudva YC, Prichard DO. Diabetic Gastroparesis. Endocr Rev [Internet]. 2019 Oct 1;40(5):1318–52. Available from: https://academic.oup.com/edrv/article/40/5/1318/5487986
16. Pasricha PJ, Grover M, Yates KP, Abell TL, Koch KL, McCallum RW, et al. Progress in Gastroparesis - A Narrative Review of the Work of the Gastroparesis Clinical Research Consortium. Clin Gastroenterol Hepatol [Internet]. 2022 Dec;20(12):2684-2695.e3. Available from: https://linkinghub.elsevier.com/retrieve/pii/S154235652200533X
17. Chen YJ, Coyne KS, Rodriguez D, Schulz A, Huh SY, Kuo B, et al. The American Neurogastroenterology and Motility Society Gastroparesis Cardinal Symptom Index-Daily Diary: Psychometric validation and meaningful change threshold in patients with idiopathic or diabetic gastroparesi. Neurogastroenterol Motil [Internet]. 2025 Jan 11;37(1). Available from: https://onlinelibrary.wiley.com/doi/10.1111/nmo.14960
18. Cangemi DJ, Lacy BE. Gastroparesis: Myths, Misconceptions, and Management. Clin Exp Gastroenterol [Internet]. 2023 Jun;Volume 16:65–78. Available from: https://www.dovepress.com/gastroparesis-myths-misconceptions-and-management-peer-reviewed-fulltext-article-CEG
19. Hidayat R, Agianto A, Agustina R. Transportasi Pasien Stroke ke Instalasi Gawat Darurat Rumah Sakit. J Holist Nurs Sci [Internet]. 2020 Jul 23;7(2):142–56. Available from: http://journal.ummgl.ac.id/index.php/nursing/article/view/3140
20. Jung H, Choung RS, Locke GR, Schleck CD, Zinsmeister AR, Szarka LA, et al. The Incidence, Prevalence, and Outcomes of Patients With Gastroparesis in Olmsted County, Minnesota, From 1996 to 2006. Gastroenterology [Internet]. 2009 Apr;136(4):1225–33. Available from: https://linkinghub.elsevier.com/retri

eve/pii/S0016508508023056

21. Panford V, Kumah E, Kokuro C, Adoma PO, Baidoo MA, Fusheini A, et al. Treatment outcomes and associated factors among patients with multidrug-resistant tuberculosis in Ashanti Region, Ghana: a retrospective, cross-sectional study. BMJ Open [Internet]. 2022 Jul 5;12(7):e062857. Available from: https://bmjopen.bmj.com/lookup/doi/10.1136/bmjopen-2022-062857
22. Gonzalez Z, Loganathan P, Sarosiek I, McCallum RW. Gender-Related Differences in Gastroparesis. Am J Med Sci [Internet]. 2020 Nov;360(5):474–83. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0002962920301488
23. Parkman HP, Hasler WL, Fisher RS. American Gastroenterological Association technical review on the diagnosis and treatment of gastroparesis. Gastroenterology [Internet]. 2004 Nov;127(5):1592–622. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0016508504016348
24. Kshatri JS, Satpathy P, Sharma S, Bhoi T, Mishra SP, Sahoo SS. Health research in the state of Odisha, India. J Fam Med Prim Care [Internet]. 2022 Jul;11(7):3771–6. Available from: https://journals.lww.com/10.4103/jfmpc.jfmpc_2192_21
25. Xu H, Miao F rui, He Y jun, Fan Y shan. Data mining–based analysis to explore the application of an animal model of diabetic gastroparesis. Front Endocrinol (Lausanne) [Internet]. 2025 Jul 9;16. Available from: https://www.frontiersin.org/articles/10.3389/fendo.2025.1612473/full
26. Park HM, Park SY, Chung JO, Cho DH, Park CH, Kim HS, et al. Association Between Gastric Emptying Time and Incidence of Cardiovascular Diseases in Subjects With Diabetes. J Neurogastroenterol Motil [Internet]. 2019 Jul 1;25(3):387–93. Available from: http://www.jnmjournal.org/journal/view.html?doi=10.5056/jnm19037
27. Bortolotti M. Gastroparesis, a diabetic complication causing further, even serious, complications: How to prevent its worsening? World J Gastroenterol [Internet]. 2025 Jun 21;31(23). Available from: https://www.wjgnet.com/1007-9327/full/v31/i23/104932.html