Knowledge and Awareness of Metabolic dysfunction-associated steatotic liver disease among Patients with Type 2 Diabetes Mellitus in the Eastern Provinces: A Cross-Sectional Study

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Abstract

Background: The development of metabolic dysfunction-associated steatotic liver disease (MASLD) is closely linked to obesity, insulin resistance, dyslipidemia, and type 2 diabetes mellitus. Many people who have type 2 diabetes are at risk for liver steatosis and progressive (negligence) fibrosity, but many patients do not know about their condition or even know they may be at high risk. Why is this? Objective: To evaluate the level of familiarity with MASLD among individuals with type 2 diabetes mellitus in the Eastern Provinces and to investigate the demographic characteristics, knowledge, and awareness associated with this condition. Methods: The analysis was cross-sectional.' p. They collected 500 full survey records. Among the questions were sociodemographic characteristics, diabetes-related anthropometric measures, chronic conditions, 23 knowledge questions, and 15 awareness statements. The total knowledge score ranged from 0 to 23, which was calculated by adding the correct answers. A five-point Likert scale was used to rate the awareness statements and provide a summary of the scores as attainable. The use of descriptive statistics, Cronbach's alpha, Pearson chi square tests, independent samples t tests (anti-admix bias), one-way analysis of variance, Tukey comparisons, Spearman correlation, Binary logistic regression. and multiple linear regression were all employed. A p 0.05 was the threshold for statistical significance. Results: There was an average total knowledge of 11.85 4.29 out of 23 and an awareness score of 3.11 д, 0.52 t in 5. The awareness scale was considered to be of good internal consistency (Cronbach's alpha = 0.813) and the knowledge measure (alpha/KR 20 = 0.750). MASLD or NAFLD was present in 241 individuals (48.2%). The category of body mass index was significantly linked to MASLD status (2 = 52.201, df = 4, test result 0,001; Cramer's variable V is 0.233). The mean weight group's prevalence increased from 22.0% to 87.1% in those with obesity class III, according to the study. In the unadjusted analysis, MASLD was found to have fewer significant correlations with dyslipidemia (2 = 4.866, P value 0.099). Knowledge and awareness scores were most strongly correlated with education level.? A significant correlation existed between total knowledge and awareness, with Pearson's = 0.766 and the p - 0.001 test indicating positive or negative. The body mass index was the only significant independent predictor of MASLD status in the adjusted logistic model (adjusted odds ratio = 1.146 per unit, 95% confidence interval: 1.101 to 1.193). The multiple linear regression model found that knowledge was the most significant predictor of awareness (B = 0.080, p 0.001). Conclusion: Knowledge of MASLD was moderate, while awareness was mostly low or moderate. Better understanding was consistently associated with higher education, and the most evident clinical factor linked to MASLD status was body mass index. There was considerable interest in obtaining further information, but only a few participants reported that neurologist had spoken to them about their individual risk of MASLD. [N]. By incorporating clear liver health education and structured metabolic risk assessment, early detection and patient involvement in diabetes may be enhanced. [A].

Keywords: metabolic dysfunction-associated steatotic liver disease; type 2 diabetes mellitus; knowledge; awareness; obesity; body mass index; health literacy; diabetes care; Eastern Provinces; Saudi Arabia

1. INTRODUCTION

Modern clinical practice has made steatotic liver disease, which is associated with metabolic dysfunction, one of the most critical chronic diseases of this type. MASLD is now known to refer to "steatotic liver disease" when cardiometabolic risk factors (i.e. The term replaces the traditional nonalcoholic fatty liver disease and emphasizes metabolic processes that drive this condition. [2]. Several NAFLD labels were preserved in the questionnaire and analytical dataset used for this study. In this manuscript, the main term is MASLD (for clarity) and NAFLD when directly referring to the source variables or older literature.

Clinical features of MASLD differ from one another. Some patients develop liver fat without significant inflammation or fibrosis, while others experience metabolic dysfunction-linked complications such as steatohepatitis (MS), severe inflammatory conditions like Fibrosomia, cirrhosis/FS, liver failure, or ultimately hepatocellular carcinoma. The fibrosis stage is crucial because it is strongly associated with liver consequences and long-term mortality. The liver is not the only organ affected by MASLD. Common causes of death include cardiovascular disease, kidney disease (hypertensive), obesity, hypertension and dyslipidemia – these are all forms of type 2 diabetes.

Type 2 diabetes is closely linked to MASLD in both directions. How does it work? Insulin resistance promotes the accumulation of hepatic fat, while liver fat and metabolic inflammation can impair glucose control. NAFLD was found in 55.5% of type 2 diabetic patients and around 17% with advanced fibrosis, according to a well-researched meta-analysis [5]. More recent analyses indicate that the prevalence of diabetes may be even higher, with pooled estimates suggesting that almost 65% of type 2 diabetic individuals are affected. The prevalence of MASLD in diabetes care is consistent across different regions and diagnostic methods, as shown by various figures.

Saudi studies have found a similar burden.? In a study using ultrasound, Abha found that 72.8% of type 2 diabetic patients had NAFLD. [7]. In the CORDIAL cohort, 80.8% of Saudi individuals with type 2 diabetes experienced hepatic steatosis, which was confirmed by using transient ultrasound and measurements of controlled attenuation [8]. In Saudi Arabia, a national systematic review found that people with diabetes and obesity are more likely to develop the disease fatty liver. [9].

The condition is often underrecognized. In several cases, asymptomatic patients may not be diagnosed with steatosis or fibrosia until routine liver enzyme tests are conducted. A significant European primary care study revealed a considerable discrepancy between the predicted frequency of diseases and actual diagnosed cases [10. Individuals with type 2 diabetes, obesity, abnormal liver enzyme levels, or other risk factors may be directed to a risk-based case finding according to current professional guidance. Typically, noninvasive tests are used as the first line of defense against potential defects, and in cases where the initial outcome is uncertain or elevated, elastography or specialist evaluation follow.

But clinical recommendations alone will not solve this problem.Clinical action is key:. Understanding the importance of liver health, how MASLD is related to diabetes management, and ways on how to reduce the risk are crucial for patients. In the absence of that knowledge, individuals may be less inclined to comprehend the significance of weight control, physical activity, glucose regulation, lipid management, or fibrosis diagnosis. Being aware is not a secondary educational outcome.' It has the potential to impact patients' willingness to inquire, their acceptance of screening, or their participation in long-term care.

1.2. Research problem.

Many individuals with type 2 diabetes experience MASLD, but it is frequently left undiagnosed or poorly understood. The disease can develop without sound, and the lack of symptoms can create a false sense of safety. Patients may have erroneous beliefs, such as the belief that alcohol consumption solely results in fatty liver disease or that it has no significant impact on their health.

A significant number of people with obesity and other metabolic risk factors may be affected by the presence of diabetes services in the Eastern Provinces. The suggested plan uncovered a regional discrepancy in understanding of how type 2 diabetic patients comprehend MASLD, its association with diabetes, the complications it can cause, and its prevention. Patients who are not cognizant of their risk may experience a delay in diagnosis and missed opportunities for prevention.

Knowledge and awareness were analyzed separately in this study, rather than being treated as one and the same things. Knowledge primarily refers to the correct interpretation of facts. Knowledge has a wider scope and encompasses personal relevance, perceived importance, and knowledge of diagnosis, complications (infection control), and prevention.

1.3. Rationale and significance.

Diabetes education typically emphasizes glucose monitoring, medication, diet, kidney disease, eye complications, and cardiovascular risk. However, there is also a focus on teaching diabetes. Even though MASLD is prevalent in the same clinical population, liver health may be less emphasised. By observing the level of awareness among individuals with diabetes, clinicians can identify areas where communication is lacking.

A comprehensive questionnaire is also a valuable asset of this study. It doesn't require a single inquiry to inquire about someone's familiarity with fatty liver disease. Instead, it concentrates on understanding the causes, symptoms, risk factors, complications, treatment, and prevention. In the awareness section, there are topics such as silent disease, cardiovascular risk, diagnosis and testing, weight loss, glucose control, and previous discussion with a physician.

Practical measures can be taken based on the results. Educational content can be simplified and presented visually if individuals with inferior education have limited comprehension. The effectiveness of diabetes follow up visits can be improved if participants frequently request additional information from clinicians. If there is no connection between awareness and actual metabolic risk, education should be provided proactively instead of being limited to patients who already seek information about liver disease.

1.4. Research gap.

MASLD research has grown rapidly, but those with type 2 diabetes typically prioritize studies on its frequency, diagnostic effectiveness, or fibrosis. Patient knowledge receives less attention. Direct comparison is not possible in awareness studies due to the varying questionnaires, scoring rules, and population composition.

There is a growing but incomplete amount of Saudi evidence.' The study's awareness threshold was met by 52.9% of participants in a cross-sectional survey conducted in Jazan, but many individuals were unaware they had any knowledge of NAFLD [11]. According to a recent national survey, less than half of the respondents in Saudi Arabia had heard about and were educated on MASLD. [12]. Despite the fact that these studies provide valuable public data, there are less studies that focus solely on patients with type 2 diabetes and combine awareness measures with body measurements.

A further question remains: whether having MASLD or worsening metabolism makes the person more aware, etc. (or both). The clinical risk may be higher for those with obesity, dyslipidemia, or poor glycaemic control, but they may not have been adequately informed about it. The present study directly investigates this gap.

1.5. Study objectives.

General objective.

To determine if knowledge and awareness of metabolic dysfunction-related steatotic liver disease is common among patients with type 2 diabetes mellitus in the Eastern Provinces.

Specific objectives.

1. To depict the sociodemographic and clinical attributes of those included in the study....
2. The purpose of measuring MASLD participants' knowledge is to determine its causes, risk factors and associated complications.
3. To gauge the level of familiarity with MASLD among individuals suffering from type 2 diabetes.'
4. To know the areas where knowledge and awareness are strongest and weakest.
5. To investigate the link between sociodemographic traits and MASLD awareness.'
6. To assess connections between actual MASLD status and clinical features, including body mass index, dyslipidemia level (such as blood pressure), heart function, HbA1c, diabetes severity, and complications of diabetes.
7. To assess the relationship between complete understanding and consciousness.'
8. To identify independent factors that predict MASLD status and awareness.

1.6. Research questions.

1. How much information do people in the Eastern Provinces have about MASLD?
2. In what ways is MASLD not commonly known, and which aspects are underrepresented? Which ones should
3. be considered significant?
4. Does diabetes awareness vary based on age, gender, education, income, or duration?

5. Are body mass index, dyslipidemia, glycaemic index (some kind of clinical signs), or something else? Does it correlate with recorded MASLD status.
6. Does having a documented MASLD impact the level of knowledge or understanding in patients who do not have it?
7. Are knowledge and awareness closely linked?
8. What are some of the demographic and clinical factors that predict awareness and recorded MASLD status independently?

2. METHOD AND METHODOLOGY.

2.1. Study design.

A cross-sectional analytical approach was taken to conduct the study. This method permits the researcher to specify the population and investigate connections between variables collected during the same timeframe. It can be used to estimate knowledge and awareness, as well as to determine which groups might need additional education. As the exposure and outcome information are both collected simultaneously, causation of observed relationships cannot be determined by design.

2.3. Study population.

2.4. Eligibility criteria.

These conditions are listed below.'

Inclusion criteria.

1. People who are over the age of 18.
2. Having been diagnosed with type 2 diabetes for at least six months.
3. Attendance at a participating health care centre during study.
4. Ability to write in the language of the questionnaire or with trained response.
5. Willingness to take part and consent fully informed.

Exclusion criteria.

1. An unknown condition of the liver associated with MASLD, which may affect its meaning.'
2. Cognitive disability and was unable to answer the meaningful questions.'
3. Language barrier prevented the data collection process from being authorized..
4. Opposition to acceptance or refusal of consent.

2.6. Data collection instrument.

A structured questionnaire was used. The publication was available in English and Arabic, and it had sections on demographics, clinical information, knowledge, perceptions. It was suggested in the proposal that the device was based on published tools and adjusted to suit the conditions.

Demographics categorized included age group, gender, education, marital status, employment, income, living arrangement, and smoking.

The clinical section comprised of variables such as weight, height, waist, thigh or hip circumference, diabetes duration, current fasting blood glucose level, new HbA1c, complications related to diabetes, treatment for diabetes and chronic conditions. Documented signs of the chronic condition included: fatty liver disease, hypertension; ischemic heart disease (myocardial infarction); stroke; cardiac arrhythmia; dyslipidemia; widespread inflammatory disorders (gout), respiratory disease; and malignancy.

In the knowledge section, there were general information on fatty liver disease, known risk factors, and preventative measures. The awareness section utilized statements ranging from strongly disagree to strongly agree. The statement focused on the occurrence of MASLD in various diseases, including diabetes, silent illness, cancer progression, cardiovascular risk, obesity, glucose regulation, diagnosis, lifestyle modification (including exercise), personal risk discussion, and an appetite for additional information.

2.7. Knowledge score.

The knowledge items in the analytical file were scored on 23 occasions:

1. Seven general knowledge items.
2. Ten risk factor items.
3. Six prevention items.

The correct answer received a score of one point. Incorrect answers received zero. Fatty liver was reverse scored on

negative scoring after being treated with a negatively phrased item that suggested it could be caused by either JCV or HBV. Scores were calculated as follows:
General knowledge: 0 to 7.
Between 0 and 10, individuals have knowledge of risk factors.
Prevention knowledge: 0 to 6.
Total knowledge: 0 to 23.
The more information one has, the higher their factual knowledge.'

2.8. Awareness score.

15 awareness statements were analyzed. Responses were coded as:

- Strongly disagree = 1.
- Disagree = 2.
- Neutral = 3.
- Agree = 4.
- Strongly agree = 5.

The overall score on awareness was calculated by dividing the total number of statements into 15 and placing 1 through 5, with a theoretical range of 5. The descriptive presentation included awareness in the following categories:

- Low: below 3.0.
- Moderate: 3.0 to 3.99.
- High: 4.0 or above.

These groups served as a summary of the distribution and were not intended to serve as thresholds for diagnosis or clinical validation.

2.9. Derived clinical variables.

Body mass index was calculated by dividing the weight in kilograms by the height in metres. It was grouped as:
Average weight per unit volume is 18.5 to 24.9 kg/m2. Normal.
Overweight: 25.0 to 29.9 kg/m^2.
Class II: 30.0 to 39.9 kg/m2.
Class II obesity rates range from 35.0 to 39.9 kg/m2.
At 40.0 kg/m2 or more, individuals with obesity class III. is considered above.
The range of HbA1c was under 7.0%, 7.0 to 8.9%, or 9.0% and above.?
Diabetes was classified as lasting no more than 5 years, 5 to 9 years (range 7 years and over).

2.10. Data preparation and quality checks.

We assessed the analytical dataset for any missing data, indistinguishable labels, or implausible values. Value imputation was not necessary as the 500 records for all variables in the reported analyses were complete.
Prior to analysis, categorical responses were standardized. The ranges in the supplied file were compared to numerical measurements. An outlier was not used to remove any record.

2.11. Reliability assessment.

Cronbach's alpha was applied to the calculation of internal consistency. The coefficient provides a rough estimate for the knowledge items that were scored differently, which is comparable to the Kuder Richardson 20 statistic. The group level analysis was considered acceptable for anything above 0.70.

2.12. Statistical analysis.

The sample was summarized using descriptive statistics.. Means, standard deviations (SD), medians and minimums were used to represent continuous variables. They presented categories as variables such as numbers and percentages. Pearson chi square tests were employed to assess the correlation between categorical participant characteristics and recorded MASLD or NAFLD status. A Cramer's V was used to depict the extent of each association.
Independent samples t tests were used to compare the mean knowledge or awareness between two groups, including gender and recorded MASLD status, as well as diabetes complication status. Cohen's d was employed to determine the effect size.
A variance analysis was conducted to compare mean scores between groups based on their education, age, and income. Eta squared outlined the proportion of variance for each grouping variable. Significant results in terms of education were used as tukio post hoc comparisons,
Knowledge, awareness, body mass index, HbA1c, fasting blood glucose, diabetes duration and waist circumference were found to be related in a Spearman rank correlation.

The predictors of recorded MASLD status were identified as independent using binary logistic regression. The model analyzed the following: body mass index, HbA1c, diabetes duration, gender, age group rank, dyslipidemia, and hypertension. Annotated odds ratios and 95% confidence interval were presented.
To determine the factors linked to mean awareness, we employed several linear regression analyses. The predictors comprised of overall knowledge, educational attainment, income, age bracket, and gender..
All tests were two sided. Anything less than a 0.01 or 0.15 was considered statistical.

3. RESULTS.

3.1. Participant characteristics.

An analysis was conducted on 500 complete records. 50 to 59 years old was the most populous age group, with 30.0% of participants falling within this range. This was followed by an additional period of 40 to 49 years (24.8%) and 60 to 69 years (21.6%). The study revealed that 3.8% of those aged 18 to 29 years were involved, while 8.8% were aged 70 years or older.
51.2% of the population was made up of 256 men, while 48.8% were made out of 244 women. Out of the total, 38.6% had no formal education, while 45.0% (55.4%) had school education and 46 Prozent (44.0%) had university education.
93.8% of the respondents lived with family and 76% were married. The highest category of individuals reported was middle income (56.4%). Nearly 76% of the participants had never smoked, while 124% were ex-smokers and 13.0% were current smokers.

Table 1. Demographic characteristics of participants.

Characteristic	n	%
Age group (years)		
18–29	84	16.8
30–39	110	22.0
40–49	124	24.8
50–59	30	6.0
60–69	108	21.6
≥70	44	8.8
Sex		
Male	256	51.2
Female	244	48.8
Education level		
No formal education	43	8.6
School education	225	45.0
University education	232	46.4
Marital status		
Single	52	10.4
Married	373	74.6
Divorced	30	6.0
Widowed	45	9.0
Income level		
Low income	156	31.2
Middle income	282	56.4
High income	62	12.4
Living arrangement		
Lives with family	469	93.8
Smoking status		
Never smoker	373	74.6
Former smoker	62	12.4
Current smoker	65	13.0

3.2. Anthropometric and diabetes related findings.

In terms of weight, the mean was 86.76 17.28 kg and the average height was 165.14. In the obesity category, the average participant had a body mass index of 31.73 5.38 kg/m2. A waist circumference of 108.63 10.63 cm was recorded as the average result.'
Diabetes was diagnosed at an average of 7.85 5.47 years, Mean HbA1c was 7.79 1.16%, and the average fasting blood glucose was 160.76 - 22.75 mg/dL.
(30.4%) of the 152 participants had diabetes complications. Out of 419 individuals, 83.8% had at least one chronic illness. There were 37.2% hypertension, 35.8% dyslipidemia, 8.6% ischemic heart disease, 5.4% respiratory illness (DFD), 3.6% cardiac arrhythmias, 3.4% stroke, 2.4% heart failure and 2.2% malignancy.
The source variable for fatty liver disease was NAFLD.? In 241, 48.2% of participants were exposed to it, whereas in 51% were not exposed due to lack of effort.

In terms of body mass index categories, 50 individuals (10.0%) had a normal weight and 12.8% were overweight, 39.6% fell into obesity class I, 20.4% fell in obesity category, and 6.2% fell to obesity Class III.

Table 2. Continuous clinical measures.

Variable	Mean	SD	Median	Range
Body weight (kg)	86.76	17.28	85.55	41.80–150.30
Height (cm)	165.14	8.52	165.00	145.00–189.00
Waist circumference (cm)	108.63	10.63	107.60	77.80–145.00
Thigh circumference (cm)	56.81	4.92	56.99	42.30–74.60
Diabetes duration (years)	7.85	5.47	6.00	1.00–31.00
Fasting blood glucose (mg/dL)	160.76	22.75	161.00	96.00–230.00
HbA1c (%)	7.79	1.16	7.80	5.50–10.90
Body mass index (kg/m²)	31.73	—	30.68	19.00–46.60

3.3. Overall knowledge and awareness.

Out of 7, the average score for general knowledge was 3.50, which is less than 1.65. The mean probability of knowing about a risk factor was 5.02 2.19 out of 10 while the average probability for knowing (PR) was 3.33 д 1.49 к 6.

Out of the 23 participants, the average knowledge score was 11.85 out of 10. There was a 12-point average and observed scores fell within the range of 1 to 23. On average, respondents answered correctly to 51.5% of the knowledge items they completed.

A score of 0.52 out of 5 was associated with an awareness score, while the median score was 3.13. Averaged marks fell within the range of 1.80 to 4.60. The descriptive categories showed that 39.8% of the 199 participants had low awareness, 55.4 percent had moderate awareness and 4.8% had high awareness. All other groups were evaluated.

A 0.725 reliability coefficient for the total knowledge measure was found to be consistent. This is considered reasonable.? Cronbach's alpha for the awareness scale was 0.813, indicating good internal consistency. However, it is not reliable.

Table 3. Knowledge and awareness measure

Measure	Items	Mean	SD	Observed / Possible Range	Reliability
General knowledge	7	3.50	1.65	0–7	—
Knowledge of risk factors	10	5.02	2.19	0–10	—
Prevention knowledge	6	3.33	1.49	1–6	—
Total knowledge	23	11.85	4.29	1–23	0.725
Average awareness	15	—	—	1.80–4.60	—

3.4. Knowledge item findings.

Practical prevention-related topics were the areas of expertise for participants.. 63.4% of the participants correctly identified a healthy diet as protective, and only 6.3 percent recognized the importance of weight loss. Regular exercise was reported as the activity by 59.2%.

Risk factors for MASLD included obesity and type 2 diabetes, with 60.2% being recognized as risk factors. A total of 58.2% admitted low physical activity was observed. About half of the participants correctly identified high cholesterol, high blood pressure, and high sugar intake, as well as cardiac complications, cirrhosis,and silent disease.'

The weakest risk factor was older age, which had been correctly identified at 35.0%. Treatment was correctly identified by only 38.8% of those surveyed, while 40.2% considered family history to be a risk factor.

The results indicate that the participants had a greater understanding of general lifestyle messages than with less obvious clinical characteristics, disease development, or medical intervention.

3.5. Awareness item findings.

A desire to educate oneself on fatty liver disease and its prevention was the most successful awareness statement. 59.8% of the respondents expressed their agreement or strongly agreement with this item, which had an average score of 3.66 0.91 for all items.

The mean was 3.33, and the mean also indicated that individuals with diabetes should be educated about MASLD. Awareness of the potential for reduced risk by blood glucose control was higher. The average for the statement on healthy diet and exercise was 3.31.15...

A questionnaire was administered to determine whether a doctor had previously addressed the participant's potential risk of MASLD, with the lowest scoring option being used. The mean was 2.01 0.87, and only 5.4% expressed agreement or strongly disagreement.'s.

There was also a reduced awareness that MASLD is not exclusively alcohol-related, with 28.0% agreeing. The majority of people, only 30.0%, believed that individuals with diabetes may not have MASLD at the time, while 30% believed it could be detected through ultrasound or blood tests.

A significant communication divide is evident when comparing interest in learning to previous discussions in clinical discussion.

3.6. Factories connected to MASLD-related evidence.

Pearson chi square analysis demonstrated two primary connections.?
The category of body mass index was the most closely linked to recorded MASLD status (2 = 52.201, df = 4, p 0.001; Cramer's V = 0.323). The number of recorded cases of MASLD increased consistently across different categories:

Normal weight: 22.0%.
Overweight: 37.8%.
Obesity class I: 45.5%.
Obesity class II: 66.7%.
Obesity class III: 87.1%.

2 = 4.789, with df = 1, p is 0.092, and Cramer's V represents the significant relationship between dyslipidemia and mortality. Participants with dyslipidemia had recorded MASLD, which was present in 54.7% of participants and in 44.5% of those without the condition. The connection, while crucial, was insignificant.

The associations between MASLD status, smoking frequency (if present), HbA1c group, diabetes duration and complications such as hypertension were not significant.

Table 4. MASLD status was tested using Chi squares.

Variable	χ^2	df	p value	Cramer's V
Gender	0.218	1	0.641	0.021
Age group	2.639	5	0.755	0.073
Education	0.330	2	0.848	0.026
Income	0.673	2	0.714	0.037
Smoking status	2.277	2	0.320	0.067
Body mass index category	**52.201**	**4**	**<0.001**	**0.323**

This correlation could be true but there is still a conceptual difference between these measures. Knowledge reflects accuracy. Sensibility entails perceived significance, assurance, and acknowledgement. An individual patient may be aware that obesity is a risk factor but not believe that the information applies to them.

Future research should consider incorporating factor analysis to determine whether knowledge and awareness are separate dimensions. The score should be used to assess whether it predicts actual behavior, screening attendance, or a long-term lifestyle change

4.9. Limited clinician patient discussion.

Only 5.4% of respondents acknowledged having been spoken to by a doctor about their potential risk of developing MASLD. Meanwhile, 59.8% of those surveyed wanted to learn more. The discovery was one of the most remarkable.

Previous studies have reported a comparable communication issue. Approximately half of the participants reported having spoken to their doctor about NAFLD, as noted by Ghevariya and coauthors. Awareness levels were found to be low even among those who are likely to have fatty liver disease in United States population studies.

Several explanations are possible. The diabetes consultations are crowded, and risk factors for the liver compete with glucose control, medications (hepatic), cardio-vascular care, renal monitoring, eye care. The screening pathways are unclear to some clinicians, and others may find weight and exercise advice to be adequate.

The results show that patients want more information than they. read. A brief discourse could clarify that MASLD is frequently found in individuals with diabetes, typically exhibiting no symptoms, can eventually lead to fibrosis, and may be evaluated through indirect methods. Including this message in regular diabetes follow up can avoid treating every appointment as an expert liver consultation.

4.10. Increased awareness of clinical risk was not associated with it.

There was no significant correlation between body mass index, HbA1c, fasting glucose, waist circumference, and diabetes duration. However, awareness was found to be significantly higher than other variables. Participants with MASLD were not more aware or knowledgeable than those without it.' Scroll down for video.

The differentiation between understanding and clinical risk is significant. People who have a poorer metabolic profile are unlikely to be more knowledgeable about liver disease. It is possible that the diagnosis in a medical file was not clearly defined or remembered. Why?

Education based on risk is more advantageous than using patient interest.' Active counseling can be advantageous for individuals with diabetes and obesity, regardless of not revealing their concerns.'

4.11. Implications for diabetes care.
This study supports the inclusion of a healthy liver in routine diabetes control.' There is no need for each patient to follow a separate programme. A practical approach might include:

- A summary of how liver fat is linked with diabetes and obesity.
- Determinable warnings that MASLD can occur without alcohol and without symptoms.' Body mass index, waist circumference, blood pressure, glycaemic control, and lipid levels are all evaluated.'
- The utilization of established non-invasive fibrosis pathways when it is clinically applicable. Elaborate discourse on shedding pounds, exercise, and eating habits.
- Additional evaluation if the likelihood of fibrosis is higher.'
- Curriculum adjusted to varying literacy levels.

The emphasis should remain respectful. The complex chronic condition of obesity can result in a lack of engagement with healthcare due to weight-based stigma. Communication of risk involves providing support and treatment, rather than holding others accountable.'

4.12. Strengths.

The study has several strengths. It contained 500 full records, as well as combined demographic data, anthropometric readings, diabetes markers, chronic disease indicators and detailed knowledge and awareness items....

Internally, both major measures were acceptable. Instead of using p values exclusively, the analysis reported both effect sizes and confidence intervals.ml? The use of adjusted models allowed for the identification of both simple and independent predictors.

By analyzing items, they gained practical knowledge about the specific subjects that were well or poorly understood. The outcome related to the discussion among healthcare providers indicates a distinct target for intervention.

4.13. Limitations.

The cross-sectional design makes it difficult to draw conclusions about cause and effect.matter of. Over time, it is unclear whether education contributed to greater awareness or influenced health behaviour, or whether clinical counseling had a positive impact on knowledge retention.

Notable information on recruitment, facilities involved in the process and available data collection dates, response rates as well as consent and ethics approval were not included in that analytical file. These details must be verified before a journal submission.

This binary variable, MASLD or NAFDL, did not include other biomarkers like ultrasound; liver enzymes; fibrosis scores; or biopsy. The examination reflects the disease status, not a standardized clinical diagnosis made using merely one documented method.

Details about diet, exercise, alcohol consumption, medication compliance/adherence, health literacy, access to care and information source were not included in the survey. The additional differences could be due to these factors.

The awareness categories were designed for descriptive reporting and have not undergone clinical validation.

Numerous statistical comparisons were made without adjusting for multiple tests. Strong effects, confidence intervals, and adjusted models should be given more weight than isolated borderline p values.

Knowledge and awareness were measured using the same questionnaire at a later time. Their strong correlation may have been due to a shared wording and response context.'...

5. CONCLUSION.

Knowledge and awareness of metabolic dysfunction-associated steatotic liver disease in a 500 record dataset of patients with type 2 diabetes were investigated in this study. Roughly 50% of those had MASLD or NAFLD, and

their average body mass index was in the obesity range.

The level of knowledge was low, while the level or awareness was typically low. Education had the greatest impact on both outcomes. Individuals with higher education levels achieved higher scores than those without formal education. i.e.

Among the clinical variables, body mass index was the most crucial. Recorded MASLD became more prevalent with each increase in body mass index category, and after adjustment, body weight index remained the only significant independent predictor.

A communication divide was also noted in the study. Despite the demand for more information, only a few individuals reported having had personal conversations with therapists or physicians about their potential risk of MASLD. The data points to the need for clear liver health education to be part of daily diabetes care.".

Confirming disease status using validated clinical methods, evaluating the questionnaire informally and testing whether targeted education enhances knowledge, screening, and long-term behavior are all important aspects of future work.

6. RECOMMENDATIONS AND FUTURE SCOPE.

Maintain regular diabetes appointments and offer a brief education program on MASLD.'
Use clear words, and visual aids appropriate for different literate people.

1. Describe how MASLD is associated with metabolic health and can occur without alcohol consumption.
2. Design an assessment of fibrosis in patients with high risk who do not require surgery.
3. Provide non-judgmental guidance on nutrition, exercise, and weight loss.
4. Future studies will use ultrasound, transient elastography, or validated non-invasive pathways to confirm liver fat and fibrosis.
5. Adapt future datasets to include liver enzymes, lipid results, scores of fibrosis, medication use, diet, exercise and alcohol intake.Full the dataset now.
6. Determine from which individuals were informed about MASLD and record the information obtained.
7. Conduct evaluations on the knowledge and awareness survey through expert review, pilot testing, and factor analysis.
8. Carry out multicentre research across the Eastern Provinces to ensure regional.
9. Apply longitudinal or intervention designs to determine if awareness results in behaviour change and improved clinical outcomes.

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Data Analysis

Analysis	Variables / Purpose	Reported Statistics
Descriptive statistics	Demographic, clinical, knowledge and awareness variables	n, %, mean, SD, median, range
Reliability	23 knowledge items and 15 awareness items	Cronbach's alpha / KR-20
Chi-square tests	MASLD status versus categorical characteristics	Chi-square, df, p, Cramer's V
Independent t-tests	Knowledge or awareness across two groups	Group mean +/- SD, t, df, p, Cohen's d
One-way ANOVA	Knowledge or awareness across education, age and income groups	F, df, p, eta-squared
Spearman correlation	Relationships among scores and clinical measurements	rho and p-value
Regression	Predictors of MASLD and awareness	OR or B, 95% CI, p-value

continuous and scale variables

Variable	Valid N	Mean	SD	Median	Minimum	Maximum
Weight (kg)	500	86.76	17.28	86.55	41.80	135.30
Height (cm)	500	165.14	8.52	165.05	145.00	189.80
Waist Circumference (cm)	500	108.63	10.63	108.60	77.80	145.00
Thigh Circumference (cm)	500	56.81	4.92	56.70	42.30	74.60
Diabetes Duration (years)	500	7.85	5.47	6.00	1.00	31.00
Latest Fasting Blood Glucose (mg/dL)	500	160.76	22.75	161.00	96.00	230.00
Latest HbA1c (%)	500	7.79	1.16	7.80	5.50	10.90
Body Mass Index (BMI)	500	31.73	5.38	31.85	19.00	46.60

General Knowledge Score (0-7)	500	3.50	1.65	3.00	0.00	7.00
Risk Factor Knowledge Score (0-10)	500	5.02	2.19	5.00	0.00	10.00
Prevention Knowledge Score (0-6)	500	3.33	1.49	3.00	0.00	6.00
Total Knowledge Score (0-23)	500	11.85	4.29	12.00	1.00	23.00
Mean Awareness Score (1-5)	500	3.11	0.52	3.13	1.80	4.60

Demographic characteristics of the study records

Variable	Category	n	%
Age Group	18-29 years	19	3.8
	30-39 years	55	11.0
	40-49 years	124	24.8
	50-59 years	150	30.0
	60-69 years	108	21.6
	70 years or older	44	8.8
Gender	Male	256	51.2
	Female	244	48.8
Education Level	No formal education	43	8.6
	School	225	45.0
	University	232	46.4
Marital Status	Single	52	10.4
	Married	373	74.6
	Divorced	30	6.0
	Widowed	45	9.0
Employment Status	Not working/Student	159	31.8
	Government sector	154	30.8
	Private sector	133	26.6
	Self-employed	54	10.8
Income Level	Low	156	31.2
	Middle	282	56.4
	High	62	12.4
Living Arrangement	Lives alone	31	6.2
	Lives with family	469	93.8
Smoking Status	Never smoker	373	74.6
	Former smoker	62	12.4
	Current smoker	65	13.0

Interpretation. The 50-59-year group was the largest age category, accounting for 30.0% of all records. Participants aged 40-49 years made up 24.8%, while those aged 60-69 years represented 21.6%. The gender distribution was nearly balanced, with males comprising 51.2% of the sample. University education was reported by 46.4%, and almost three quarters were married. Most participants lived with family, and approximately three out of every four identified as never smokers.

Clinical characteristics, chronic conditions and derived categories

Variable	Category	n	%
Diabetes Complications	No	348	69.6
	Yes	152	30.4
Any Chronic Disease	No	81	16.2
	Yes	419	83.8
Metabolic Dysfunction-Associated Steatotic Liver Disease	No	259	51.8
	Yes	241	48.2
Hypertension	No	314	62.8
	Yes	186	37.2
Ischemic Heart Disease	No	457	91.4
	Yes	43	8.6
Stroke	No	483	96.6
	Yes	17	3.4
Heart Failure	No	488	97.6
	Yes	12	2.4
Cardiac Arrhythmia	No	482	96.4
	Yes	18	3.6

Dyslipidemia	No	321	64.2
	Yes	179	35.8
Gout	No	466	93.2
	Yes	34	6.8
Respiratory Disease	No	473	94.6
	Yes	27	5.4
Cancer/Tumors	No	489	97.8
	Yes	11	2.2
BMI Category	Normal weight	50	10.0
	Overweight	119	23.8
	Obesity class I	198	39.6
	Obesity class II	102	20.4
	Obesity class III	31	6.2
Awareness Level	Low (<3.0)	199	39.8
	Moderate (3.0-3.99)	277	55.4
	High (>=4.0)	24	4.8

Interpretation. Diabetes-related complications were present in 30.4% of the records, and 83.8% included at least one chronic condition. MASLDwas reported in 48.2%. Obesity class I was the single largest BMI category, representing 39.6%, followed by overweight and obesity class II. Taken together, the clinical profile reflects a population with a substantial burden of metabolic risk.

Reliability and overall score distribution

Scale	Items	Possible Range	Mean +/- SD	Median	Observed Range	Reliability
General knowledge	7	0-7	3.50 +/- 1.65	3.0	0-7	Included in knowledge alpha
Risk-factor knowledge	10	0-10	5.02 +/- 2.19	5.0	0-10	Included in knowledge alpha
Prevention knowledge	6	0-6	3.33 +/- 1.49	3.0	0-6	Included in knowledge alpha
Total knowledge	23	0-23	11.85 +/- 4.29	12.0	1-23	alpha/KR-20 = 0.725
Mean awareness	15	1-5	3.11 +/- 0.52	3.13	1.80-4.60	alpha = 0.813

Interpretation. The awareness scale demonstrated good internal consistency, with an alpha coefficient of 0.813. Reliability for the 23-item knowledge measure was acceptable at 0.725. These values suggest that the items within each measure were sufficiently consistent to support the comparisons and relationship analyses reported in the following sections.

Distribution of derived awareness levels

Awareness Level	n	%
Low (<3.0)	199	39.8
Moderate (3.0-3.99)	277	55.4
High (>=4.0)	24	4.8

Correct-response percentages for the 23 knowledge items

No.	Knowledge Item	Correct Response (%)
1	General: Fat accumulation in the liver causes fatty liver disease	51.2
2	General: Fatty liver disease is common in Saudi Arabia	48.8
3	General: Fatty liver may be caused by JCV or HBV virus	51.2
4	General: Fatty liver disease can cause liver cirrhosis	48.0
5	General: Fatty liver disease is associated with heart problems	51.2
6	General: Patients with fatty liver disease experience general fatigue	47.8

7	General: Patients with fatty liver disease often have no symptoms	51.6
8	Risk factor: Older age	35.0
9	Risk factor: Family history	40.2
10	Risk factor: Obesity	60.2
11	Risk factor: Type 2 diabetes	60.2
12	Risk factor: High blood cholesterol	51.2
13	Risk factor: High blood pressure	50.6
14	Risk factor: Excessive food intake	44.6
15	Risk factor: Low physical activity	58.2
16	Risk factor: High fat/oil intake	49.2
17	Risk factor: High sugar intake	52.4
18	Prevention: Fatty liver disease can be prevented	56.2
19	Prevention: Weight loss can help prevent it	63.0
20	Prevention: Regular physical activity can help prevent it	59.2
21	Prevention: A healthy diet can help prevent it	63.4
22	Prevention: Treatment is available for fatty liver disease	38.8
23	Prevention: It can be controlled when properly diagnosed	52.4

Interpretation. Knowledge was strongest for practical prevention messages. A healthy diet was correctly identified as protective by 63.4%, and 63.0% recognized the role of weight loss. Recognition of obesity and type 2 diabetes as risk factors was also relatively common. In contrast, older age was identified by only 35.0%, and fewer than four in ten correctly recognized that treatment is available. The pattern suggests that respondents were more familiar with lifestyle advice than with some of the less visible clinical and epidemiological aspects of MASLD.

Mean item scores and agreement percentages for the awareness scale

No.	Awareness Statement	Mean	SD	Agree / Strongly Agree (%)
1	I am aware of Metabolic Dysfunction-Associated Steatotic Liver Disease(MASLD)	3.02	1.02	31.4
2	MASLD is common among people with type 2 diabetes	3.10	0.97	34.6
3	MASLD may lead to cirrhosis and liver cancer	3.12	1.02	36.6
4	MASLD increases cardiovascular disease risk	3.12	0.97	35.0
5	Obesity increases the risk of MASLD	3.28	0.99	40.0
6	MASLD may progress without obvious symptoms	3.11	0.98	33.8
7	Weight loss can improve MASLD	3.27	1.01	40.6
8	Blood glucose control may reduce MASLD risk	3.33	0.98	44.6
9	MASLD may be diagnosed by ultrasound or blood tests	3.03	1.03	30.8
10	People with diabetes may have MASLD without knowing it	3.01	1.01	30.0
11	A healthy diet and physical activity are important for prevention	3.31	0.99	43.0

12	MASLD is not only related to alcohol consumption	3.01	0.95	28.0
13	My doctor has discussed my possible risk of MASLD	2.01	0.87	5.4
14	MASLD awareness is important for people with diabetes	3.33	0.98	44.0
15	I would like to learn more about MASLD and its prevention	3.66	0.91	59.8

Interpretation. The strongest response concerned willingness to learn more about MASLD and its prevention (mean = 3.66; agreement = 59.8%). The weakest item asked whether a doctor had discussed the respondent's possible MASLD risk (mean = 2.01; agreement = 5.4%). This gap is important: interest in receiving more information was high, yet reported discussion during clinical encounters was uncommon.

chi-square tests

Variable	Chi-square	df	p-value	Cramer's V	Interpretation
Gender	0.218	1	0.641	0.021	Not significant
Age Group	2.639	5	0.755	0.073	Not significant
Education Level	0.330	2	0.848	0.026	Not significant
Income Level	0.673	2	0.714	0.037	Not significant
Smoking Status	2.277	2	0.320	0.067	Not significant
BMI Category	52.201	4	<0.001	0.323	Significant association
HbA1c Group	0.124	2	0.940	0.016	Not significant
Diabetes Duration Group	1.317	2	0.518	0.051	Not significant
Diabetes Complications	0.194	1	0.660	0.020	Not significant
Hypertension	0.015	1	0.904	0.005	Not significant
Dyslipidemia	4.789	1	0.029	0.098	Significant association

Interpretation. Only two categorical variables were significantly related to MASLD status. BMI category showed the strongest association (chi-square = 52.201, p <0.001), while dyslipidemia showed a smaller but still significant relationship (chi-square = 4.789, p = 0.029). The remaining demographic and clinical categories did not reach the 5% significance threshold.

BMI category

BMI Category	MASLD: No n (%)	MASLD: Yes n (%)	Total
Normal weight	39 (78.0%)	11 (22.0%)	50
Overweight	74 (62.2%)	45 (37.8%)	119
Obesity class I	108 (54.5%)	90 (45.5%)	198
Obesity class II	34 (33.3%)	68 (66.7%)	102
Obesity class III	4 (12.9%)	27 (87.1%)	31
Total	259	241	500

Chi-square test

effect size

Test	Value	df	p-value	Effect Size
Pearson chi-square	52.201	4	<0.001	Cramer's V = 0.323

Interpretation. MASLD prevalence increased steadily as BMI category rose. It was recorded in 22.0% of normal-weight participants, 37.8% of those who were overweight, 45.5% in obesity class I, 66.7% in obesity class II, and 87.1% in obesity class III. The association was statistically significant (chi-square = 52.201, df = 4, p <0.001) and moderate in strength (Cramer's V = 0.323). This was the clearest clinical pattern identified in the analysis.

Dyslipidemia

Dyslipidemia	MASLD: No n (%)	MASLD: Yes n (%)	Total
No	178 (55.5%)	143 (44.5%)	321
Yes	81 (45.3%)	98 (54.7%)	179
Total	259	241	500

Interpretation. MASLD was reported in 54.7% of participants with dyslipidemia compared with 44.5% of those without it. The difference was statistically significant (chi-square = 4.789, df = 1, p = 0.029), although the effect size was small (Phi/Cramer's V = 0.098). This means that dyslipidemia was related to MASLD in the unadjusted comparison, but the strength of that relationship was limited.

independent-samples t-tests

Outcome	Grouping Variable	Group 1 Mean +/- SD	Group 2 Mean +/- SD	t (df)	p-value	Cohen's d
Awareness score	Gender	Male: 3.12 +/- 0.50	Female: 3.10 +/- 0.53	0.482 (498.0)	0.630	0.043
Awareness score	Metabolic Dysfunction-Associated SteatoticLiver Disease	Yes: 3.11 +/- 0.52	No: 3.12 +/- 0.51	-0.180 (498.0)	0.857	-0.016
Awareness score	Diabetes Complications	Yes: 3.18 +/- 0.53	No: 3.09 +/- 0.51	1.799 (498.0)	0.073	0.175
Knowledge score	Gender	Male: 11.86 +/- 4.09	Female: 11.83 +/- 4.49	0.092 (488.3)	0.927	0.008
Knowledge score	Metabolic Dysfunction-Associated SteatoticLiver Disease	Yes: 11.93 +/- 4.20	No: 11.76 +/- 4.37	0.441 (498.0)	0.660	0.039
Knowledge score	Diabetes Complications	Yes: 12.26 +/- 4.65	No: 11.66 +/- 4.11	1.373 (258.7)	0.171	0.140

Interpretation. None of the six two-group comparisons was statistically significant. Knowledge and awareness scores were almost identical for males and females and were also similar between participants with and without MASLD. Participants with diabetes complications had a somewhat higher awareness score, but the difference remained below the conventional significance threshold (t = 1.799, p = 0.073; Cohen's d = 0.175). Overall, the group differences were small.

one-way ANOVA

Outcome	Factor	F (df1, df2)	p-value	Eta-squared	Interpretation
Awareness score	Education Level	115.185 (2, 497)	<0.001	0.317	Significant
Awareness score	Age Group	4.329 (5, 494)	<0.001	0.042	Significant
Awareness score	Income Level	12.933 (2, 497)	<0.001	0.049	Significant
Knowledge score	Education Level	122.019 (2, 497)	<0.001	0.329	Significant
Knowledge score	Age Group	3.604 (5, 494)	0.003	0.035	Significant
Knowledge score	Income Level	14.487 (2, 497)	<0.001	0.055	Significant

Interpretation. Education level, age group, and income were each associated with both

knowledge and awareness. Education produced by far the largest effects, explaining 31.7% of the variance in awareness and 32.9% of the variance in knowledge. Age differences were statistically significant but comparatively small. Income showed small-to-moderate effects. These findings indicate that access to education was the most prominent demographic factor in the score analysis.

Awareness and knowledge scores by education level

Education Level	n	Awareness Mean +/- SD	Knowledge Mean +/- SD
No formal education	43	2.56 +/- 0.42	7.30 +/- 3.62
School	225	2.92 +/- 0.44	10.12 +/- 3.59
University	232	3.41 +/- 0.42	14.36 +/- 3.43

Tukey post-hoc

Outcome	Comparison	Mean Difference	Adjusted p-value	Significant
Awareness	No formal education vs School	0.355	<0.001	Yes
Awareness	No formal education vs University	0.847	<0.001	Yes
Awareness	School vs University	0.492	<0.001	Yes
Knowledge	No formal education vs School	2.822	<0.001	Yes
Knowledge	No formal education vs University	7.055	<0.001	Yes
Knowledge	School vs University	4.233	<0.001	Yes

Interpretation. Mean awareness rose from 2.56 among participants with no formal education to 2.92 in the school group and 3.41 among university-educated participants. Knowledge followed the same pattern, rising from 7.30 to 10.12 and then to 14.36. Tukey post-hoc testing confirmed that every pair of education groups differed significantly for both outcomes. The size and consistency of these differences suggest that educational background played a major role in how participants understood MASLD.

Spearman correlations

Variable 1	Variable 2	Spearman rho	p-value	Interpretation
Total Knowledge Score (0-23)	Mean Awareness Score (1-5)	0.766	<0.001	Strong; significant
Body Mass Index (BMI)	Mean Awareness Score (1-5)	0.006	0.898	Very weak; not significant
Latest HbA1c (%)	Mean Awareness Score (1-5)	-0.024	0.596	Very weak; not significant
Latest Fasting Blood Glucose (mg/dL)	Mean Awareness Score (1-5)	0.030	0.506	Very weak; not significant
Diabetes Duration (years)	Mean Awareness Score (1-5)	0.041	0.359	Very weak; not significant
Waist Circumference (cm)	Mean Awareness Score (1-5)	0.023	0.611	Very weak; not significant
Body Mass Index (BMI)	Total Knowledge Score (0-23)	-0.022	0.618	Very weak; not significant
Latest HbA1c (%)	Total Knowledge Score (0-23)	0.006	0.893	Very weak; not significant

Interpretation. Total knowledge and mean awareness were strongly and positively related (Spearman's rho = 0.766, p <0.001). In other words, participants who answered more knowledge questions correctly generally reported greater awareness of MASLD. By contrast, BMI, HbA1c, fasting blood glucose, diabetes duration, and waist circumference showed little or no relationship with awareness. Clinical risk and health

understanding therefore appeared to operate as largely separate dimensions.

Multivariable logistic regression

Predictor	B	SE	Adjusted OR	95% CI for OR	p-value
BMI (per 1 kg/m2)	0.136	0.021	1.146	1.101-1.193	<0.001
HbA1c (per 1%)	0.026	0.084	1.026	0.870-1.209	0.760
Diabetes duration (per year)	0.011	0.018	1.012	0.977-1.047	0.516
Male gender	0.053	0.190	1.055	0.727-1.532	0.779
Age-group rank	0.027	0.081	1.028	0.876-1.205	0.737
Dyslipidemia	-0.017	0.206	0.983	0.657-1.472	0.935
Hypertension	-0.194	0.212	0.824	0.544-1.248	0.360

Interpretation. The logistic regression model was significant overall (likelihood-ratio p <0.001), although its explanatory power was modest (McFadden pseudo-R2 = 0.081). BMI was the only independent predictor that remained significant after the other variables were taken into account. Each one-unit increase in BMI was associated with a 14.6% increase in the estimated odds of MASLD (adjusted OR = 1.146, 95% CI 1.101-1.193, p <0.001). HbA1c, diabetes duration, gender, age, dyslipidemia, and hypertension were not independently significant in the adjusted model.

Multiple linear regression

Predictor	B	SE	t	95% CI for B	p-value
Total knowledge score	0.080	0.004	19.023	0.071 to 0.088	<0.001
School education	0.130	0.054	2.396	0.023 to 0.237	0.017
University education	0.271	0.061	4.432	0.151 to 0.391	<0.001
Middle income	0.029	0.033	0.890	-0.035 to 0.094	0.374
High income	0.098	0.049	2.006	0.002 to 0.194	0.045
Age-group rank	-0.012	0.012	-0.998	-0.035 to 0.011	0.319
Male gender	0.003	0.029	0.106	-0.053 to 0.059	0.915

Interpretation. The awareness model explained 62.4% of the variation in mean awareness scores (adjusted R2 = 0.618; overall p <0.001). Total knowledge was the strongest predictor: each additional knowledge point was associated with an estimated 0.080-point increase in awareness. School and university education remained positively related to awareness after adjustment, and high income had a smaller positive effect. Age-group rank and gender did not make independent contributions.