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Assessment of Patients' Knowledge, Attitudes, and Practices Toward Diabetic Complications in Outpatient Clinics in Ibb City, Yemen

Basheer Abdu
Ibb University
AbdulraKeeb Shomais
Ibb University
Asma Salam
Ibb University
Alia Baalwi
Ibb University
Alyah Nahshal
Ibb University
Arzaq Dahish
Ibb University
Ayah AL nuzaili
Ibb University
Enas Lutf
Ibb University
Ghaida Al Faqeeh
Ibb University
Roua Sharian
Ibb University
Roida Al Bana'a
Ibb University
Wadee Abdullah Al-Shehari
Dr.wadee40@yahoo.com

Ibb University

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Abstract

Background

Diabetic mellitus is a common long-term disease worldwide, causing many serious microvascular and macrovascular complications. Knowing how patients understand, feel, and respond to these complications (KAP) is very important for early detection and prevention, especially in countries like Yemen.

Objective

This study aimed to assess the levels of Knowledge, Attitude, and Practice of diabetic patients regarding diabetic complications in outpatient clinics in Ibb City, Yemen.

Method

A descriptive cross-sectional study was conducted among 384 patients selected via convenience sampling. Data were collected through a structured questionnaire that underwent expert review and a pilot study. Data were analyzed using SPSS 27.

Results

More than half of the patients were female (56.5%) and married (83.6%). The largest age group was 40–59 years (49.5%). Most participants were illiterate (39.6%) and worked as housewives (44.5%). A majority (60.9%) lived in urban areas and had a low monthly income (52.6%). Most participants had a diabetes duration of 1 to 5 years (43.2%) and were unaware of their specific diabetes type (70.6%). The disease was most often diagnosed based on symptoms (51.6%). A slight majority (52.1%) had no family history of the disease. Regarding management, the most common plan was Diet and oral drugs (73.4%), with the majority of patients using pills (80.5%). Self-monitoring was the most frequent follow-up method (50.5%). Knowledge of Diabetes complications was moderate to high. (79.6%), with a mean score of 9.55 (SD = 2.15). Their Attitude was positive (87%), with a mean score of 26.20 (SD = 3.16). Their practice level was moderate (63.6%), with a mean score of 24.8 (SD = 5.7). Significant positive correlations between Knowledge, Attitude, and Practice ($p < 0.001$). Knowledge scores were significantly higher among participants with high income ($p = 0.004$), using insulin ($p = 0.033$), and performing self-monitoring ($p = 0.021$). For Attitude, significant differences were observed by gender ($p < 0.001$), marital Status ($p = 0.042$), education ($p < 0.001$), job ($p < 0.001$), discovery method ($p = 0.012$), and follow-up type ($p = 0.007$). Practice scores differed significantly by gender ($p = 0.001$), living area ($p = 0.026$), marital Status ($p = 0.012$), education ($p < 0.001$), discovery method ($p = 0.004$), management plan ($p < 0.001$), drug type ($p = 0.009$), and follow-up ($p < 0.001$ Higher medication burden ($B=-0.475$, $p = 0.025$) and inconsistent

follow-up (B=-0.340, p = 0.026) significantly reduced knowledge scores, while income showed no effect. Male gender (B = -0.756, p = 0.029) and poor follow-up (B = -0.654, p = 0.009) negatively affected attitudes, whereas higher education improved them (B = 0.482, p = 0.001). Inconsistent follow-up was the strongest negative predictor (B = -2.351, p = 0.001), with additional negative effects from male gender, complex management, and polypharmacy. Urban residence uniquely improved practice scores (B = 1.225, p = 0.026), and education enhanced attitudes but not Knowledge or Practice.

Conclusion

Knowledge of the complications of Diabetes was moderate to high; Attitudes were positive, but practices were moderate. significant positive correlations between Knowledge, Attitude, and Practice, with Attitude having the strongest link to Practice. Inconsistent follow-up and male gender consistently impaired all KAP domains, with polypharmacy specifically harming Knowledge and Practice. At the same time, higher education and urban residence emerged as key, yet domain-specific, positive factors for Attitude and Practice, respectively. Enhance Structured Follow-up Programs, Develop Targeted Education Initiatives>

Introduction

Diabetes mellitus (DM), a chronic metabolic disorder characterized by hyperglycemia resulting from insufficient insulin production or insulin resistance (Al-Sharif & Gunaid, 2014; Dika et al., 2023), poses a substantial global health burden, with type 2 diabetes mellitus (T2DM) being the more prevalent form (Dika et al., 2023). is a primary focus of the World Health Organization's prevention and control efforts (Skolnik, 2018).

The global prevalence of DM is rapidly increasing (Cole & Florez, 2022), affecting an estimated 10.5% of adults worldwide (IDF, 2021) and projected to reach 783 million by 2045 (idf.org). The Middle East region, including Yemen, faces a significant challenge related to T2DM (Meo et al., 2019). While regional data suggests a lower prevalence of Diabetes among men in Yemen compared to some neighboring countries (Meo et al., 2019) (

While DM is a recognized health issue in Yemen, with a recent estimate of 9.8% prevalence among men in 2019 (Meo et al., 2019) and an older study reporting an overall prevalence of 4.6% (Abdul Razzak et al., 2017),(The chronic complications of Diabetes are broadly categorized into microvascular (neuropathy, nephropathy, retinopathy) and macrovascular (cardiovascular disease, stroke, peripheral artery disease), with microvascular complications exhibiting a higher prevalence (Deshpande et al., 2008). Diabetic foot syndrome, a serious complication involving foot ulcers, neuropathy, peripheral artery disease, and infection, is a major cause of lower limb amputation (Tuttolomondo et al., 2015).

The effective management of DM and the prevention of its chronic complications, including microvascular (neuropathy, nephropathy, retinopathy) and macrovascular (cardiovascular disease, stroke, peripheral artery disease) conditions (Deshpande et al., 2008)

Relies significantly on patients' Knowledge, attitudes, and practices (KAP) towards their condition. Studies across various regions have revealed varying levels of KAP, with some indicating suboptimal knowledge (Al Shafaee et al., 2008; Nyamagoud et al., 2023), less than optimal attitudes (Herath et al., 2017; Nyamagoud et al., 2023), and inadequate self-management practices (Das et al., 2023; Herath et al., 2017; Nyamagoud et al., 2023; Alhariri et al., 2017(

Local studies indicate a high prevalence of associated metabolic risk factors such as overweight/obesity and hypertension among T2DM patients (Mareai & Gawli, 2023). Factors such as education level, gender, and socioeconomic Status have been shown to influence KAP (Al Shafaee et al., 2008; Obirikorang et al., 2016; Rahaman et al., 2017; Alhariri et al.,2017). While some local studies in Yemen have explored diabetes prevalence and risk factors (Mareai & Gawli, 2023; Alhariri et al., 2017), they have also been shown to influence KAP (Al Shafaee et al., 2008; Obirikorang et al., 2016; Rahaman et al., 2017; Alhariri et al., 2017).

Despite prior local investigations into Diabetes and its risk factors across various regions in Yemen, a significant research gap persists concerning the specific assessment of diabetic patients' Knowledge, attitudes, and practices (KAP) regarding the complications of their condition, particularly within Ibb City. Therefore, this study aims to assess patients' Knowledge, attitudes, and practices regarding diabetes complications in outpatient clinics in Ibb City, Yemen.

Methods

Study Design and Setting

The study was designed as a questionnaire-based, cross-sectional analysis from January 1 to July 1, 2025. It was conducted in outpatient clinics in the city of Ibb. Yemen.

Study population and Selection criteria:

The sample included patients with Diabetes ≥ 18 years attending for follow-up or seeking general treatment in medicine outpatient Clinics. Exclusion criteria included the presence of gestational diabetes mellitus and an age younger than 18 years. Those unable to answer the questionnaire due to dementia, psychosis, or profound deafness were excluded from the study.

Sample size and sampling technique

The sample size was estimated using a formula that considers p = 50%, a 95% degree of certainty, and a 5% margin of error. Accordingly, by employing convenient sampling, 384 patients with Diabetes were recruited from outpatient clinics in the city of Ibb.

Tool of data collection

1. Tool Design

The questionnaire was adapted from relevant literature (Rahaman et al., 2017). A pre-tested, structured, bilingual questionnaire was developed to investigate key research questions, comprising closed-ended questions. The questionnaire was divided into 5 main categories, including Sociodemographic information, Medical History and Knowledge, Attitude, and Practice-related information. Relevant questions were asked of the respondents, such as the emphasis placed on the knowledge module, to assess the level of Knowledge of respondents

for complications of Diabetes. To assess Knowledge, Attitude, and practices, (12) Items (True/False), 10 Items (Positive Attitude, Moderate Attitude, Negative Attitude), and (13) Items (Low, Moderate, High) questions were asked, respectively. related questions regarding diabetes complications. The questionnaire was prepared in English by a language expert, translated into the local language (Arabic), and then back-translated into English by another language expert to ensure consistency and wording. (Supplementary) S1

2.Tools validity:

The questionnaire's validity was verified by presenting the research instrument to a group of experts, and based on their feedback, the necessary adjustments were made. A pilot study was then conducted on 10% of the total sample (30 patients) to assess the validity and clarity of the study tool and to identify potential problems researchers might encounter that could affect the data collection process. Internal consistency validity was calculated using Spearman's correlation coefficient. significant at $p<0.001$, indicating the internal consistency of the instrument items and their components.

3.Tools reliability

The questionnaire's reliability was assessed using Cronbach's alpha coefficient. It was 0.71 for the knowledge domain, 0.71 for the attitudes domain, and 0.71 for the practice domain. At the level of the overall study instrument, it was 0.79, indicating acceptable internal consistency and reliability.

4.Assessment of KAP(The KAP Score)

To calculate the Knowledge, Attitude, and Practice (KAP) score, a scoring system was prepared.

Knowledge score: Each correct answer was coded as 1, while each incorrect answer was coded as 0. The knowledge score was calculated by adding the scores for the correct answers. The total score of Knowledge ranged from (0_12). The mean knowledge score was divided by the highest score of 12, then multiplied by 100 to get the total knowledge percentage. To evaluate the level of Knowledge in general. To evaluate the level of Knowledge of Categories as follows: Low Knowledge: < 50%, Moderate Knowledge: (50% - 80%), High Knowledge (81 – 100 %)

Attitudes score: Each item was scored (3) if the answer is (Positive Attitude), (2) if the answer is (Moderate Attitude), and (1) if the answer is (Negative Attitude). The total attitude score ranged from 10 to 30. The mean Attitudes score was divided by the highest score of 30, then multiplied by 100 to get the

total knowledge percentage. To evaluate the level of Attitudes in general. Also, evaluate the level of Attitudes of Categories: Negative Attitude: Less than 50%, Moderate attitude (50% - Less than 80 %), Positive attitude (80% – 100 %)

Practices Score: Each item was scored (3) if the answer is (high), scored (2) if the answer is (moderate), scored (1) if the answer is (low). The total Practices score ranged from 13 to 30. The mean Practices score was divided by the highest score of 39, then multiplied by 100 to get the total knowledge percentage. To evaluate the level of Practices in general. Also, evaluate the level of Practices of Categories: low Practices: Less than 50%, Moderate Practices: (50% - 80%), High Practices: (81% – 100 %)

Data Analysis

The collected data were entered into the Statistical Package for the Social Sciences (SPSS) version 27 for Windows. All continuous data were expressed as mean (SD), and categorical variables were expressed as numbers and percentages. Descriptive statistics and frequency distributions were used to describe participant characteristics. The Kolmogorov-Smirnov Test revealed a non-normal distribution. Use Spearman's correlation coefficient test to determine the relationship between Knowledge, attitudes, and Practice. Spearman's rank correlation coefficient was used to determine the relationship between the mean KAP score. For variables with two categories, the Mann-Whitney U Test was used, and for variables with more than two categories, the Kruskal-Wallis Test was used to compare means. "To overcome the normality assumption in linear regression, we used the Bootstrap resample technique to calculate corrected 95% confidence intervals, a method that does not require distributional assumptions and provides robust estimates." Variables with p-values less than 0.05 in previous tests were included in the multivariate model. The relationships between each factor and the mean scores for Knowledge, attitudes, and practices were represented by standardized coefficients (beta coefficients) and a 95% confidence interval. A p-value less than 0.05 was considered statistically significant....

Result

A total of 384 patients with Diabetes were enrolled in the study. The gender distribution revealed that the majority of participants were female (N = 217, 56.5%), while males accounted for 43.5% (N = 167). The age group between 40 and 59 years was the largest among participants (N = 190, 49.5%), followed by those aged 60 years and older (N = 138, 35.9%).

The youngest age group, 20 to 39 years, accounted for the smallest proportion (N = 56, 14.6%). The mean standard deviation (SD) of age of the study participants was 52.9 12.96. The vast majority of participants were married (N = 321, 83.6%). Single individuals accounted for 8.3% (N = 32) of the sample, and divorced or widowed participants accounted for 8.1% (N = 31). The participants' educational level indicated that the largest group was illiterate (N = 152, 39.6%). Participants who could read and write comprised 21.4% (N = 82). Smaller proportions had completed primary (N = 49, 12.8%) or secondary (N = 39, 10.2%) education.

While 16.1% (N = 62) had attained university or higher education, the most common occupation reported was housewife (N = 171, 44.5%). Other significant categories included employees (N = 67, 17.4%), workers (N = 56, 14.6%), and retired individuals (N = 54, 14.1%). Students (N = 9, 2.3%) and those out of work (N = 27, 7.0%) constituted smaller segments of the study population. The distribution of living areas showed that the majority of participants resided in urban/civilized areas (N = 234, 60.9%), while 39.1% (N = 150) resided in rural areas. Finally, regarding monthly income, more than half of the participants reported low income (N = 202, 52.6%). Participants with moderate income accounted for 31.3% (N = 120), and only 16.1% (N = 62) reported a high income.

The largest proportion of participants had been living with Diabetes for 1 to 5 years (N = 166, 43.2%). A significant number (N = 105, 27.3%) had a duration of 6 to 10 years. Longer durations, from 11 to 15 years, accounted for 12.0% (N = 46) of participants, while those with

Table 1
Characteristics of the study participants (n = 384).

Variable	Category	Frequency	(%)
Gender	Male	167	43.5
	Female	217	56.5
Age	Mean(SD) 52.9(12.96)		
	20 to 39 Y	56	14.6
	40 to 59 Y	190	49.5
	≥ 60 Y	138	35.9
Marital Status	Married	321	83.6
	Single	32	8.3
	Divorced or a widow	31	8.1
Education Level	Illiterate	152	39.6
	Reads and Writes	82	21.4
	Primary	49	12.8
	Secondary	39	10.2
	University or Higher	62	16.1
Job	Student	9	2.3
	Employee	67	17.4
	Out of work	27	7.0
	Worker	56	14.6
	House wife	171	44.5
	Retired	54	14.1
Living area	Rural	150	39.1
	Civilize	234	60.9
Income	Low	202	52.6

Diabetes for more than 15 years represented 17.4% (N = 67) of the sample. A striking majority of participants (N = 271, 70.6%) reported not knowing their diabetes type. Among those who did know, Type 2 diabetes was far more prevalent (N = 97, 25.3%) than Type 1 diabetes (N = 16, 4.2%). The method of Diabetes discovery was predominantly through symptoms (N = 198, 51.6%), indicating that many patients sought medical attention due to the disease's manifestations. A substantial portion (N = 157, 40.9%) discovered their Diabetes by coincidence, while routine investigations accounted for a smaller percentage (N = 29, 7.6%)

Variable	Category	Frequency	(%)
	Moderate	120	31.3
	High	62	16.1
Duration	From 1 to 5 Y	166	43.2
	From 6 to 10 Y	105	27.3
	From 11 to 15 Y	46	12.0
	More than 15 Y	67	17.4
Type	Type 1	16	4.2
	Type 2	97	25.3
	I do not know	271	70.6
Discovery Method	Routine investigations	29	7.6
	Coincidence	157	40.9
	Symptoms	198	51.6
Family History	Yes	184	47.9
	No	200	52.1
Herbal	Yes	77	20.1
	No	307	79.9
Management Plan	Diet and oral drugs	282	73.4
	Diet and insulin	65	16.9
	Non	37	9.6
Drugs	Insulin	67	17.4
	Pills	309	80.5
	Insulin and pills	8	2.1
Follow Up	Self-monitoring	194	50.5
	Hospital	137	35.7

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Variable	Category	Frequency	(%)
	Non	53	13.8
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Participants were almost equally divided, with slightly more (N = 200, 52.1%) reporting no family history than those who did (N = 184, 47.9%). The use of herbal medication was reported by a minority of participants, with 20.1% (N = 77) indicating 'Yes' and the majority (79.9%, N = 307) reporting 'No'.

Regarding the management plan, the most common approach was Diet and oral drugs (N = 282, 73.4%). A smaller proportion managed their condition with Diet and insulin (N = 65, 16.9%), while 9.6% (N = 37) reported no specific management plan. Concerning drug regimens, the majority of participants were using pills (N = 309, 80.5%). Insulin was used by 17.4% (N = 67) of patients, and a very small percentage (2.1%, N = 8) used both insulin and pills.

Finally, for follow-up methods, self-monitoring was the most common approach (N = 194, 50.5%). Follow-up at a hospital was reported by 35.7% (N = 137) of participants, and 13.8% (N = 53) reported no regular follow-up. in Table 1

Knowledge of diabetic patients towards complications of Diabetes

The maximum knowledge score was 12. The mean score was 9.55 (95% CI 9.3–9.8), and the standard deviation (SD) was ± 2.15, with a range of 2 to 12. Knowledge of the complications of Diabetes was moderate to high. (79.6%). The study indicated that more than 80% of participants had high Knowledge regarding diabetic complications (n = 224; 85.3%). Fewer than 60% % of participants possessed medium Knowledge (n = 141; 36.7%). Only 19 participants (4.9%) possessed low Knowledge, Fig. 1.

A notable majority of participants demonstrated high levels of Knowledge, with over 80% providing correct responses, concerning Coma, dizziness, and fainting (96.4%) Retinopathy (95.1% correct) Hypoglycemia (94.0%) Neuropathy (87.5% correct) Diabetic foot ulcers and wounds (82.8%) Conversely, knowledge levels were relatively lower, but still moderate (below 80% correct responses but generally above 60%), for the following complications: Teeth Decay (78.6%), Renal Complications (75.3%) Skin discoloration in diabetic foot (73.4%), High blood pressure (72.9% correct) Heart and Vascular Complications (70.3%), Stroke (68.8%). Pneumonia (60.2%). Figure 2

LI

Attitude of diabetic patients towards complications of Diabetes

Attitude Score: The maximum attitude score was 10. The mean score was 26.20 (95% CI for

mean 25.9–26.5), and the standard deviation (SD) was ± 3.16 with a range of 14 to 30. Their Attitude was positive (87%). The study indicated that more than 50% of participants had high Knowledge regarding diabetic complications (n = 335; 87.3%). (n = 48; 12.4%) Of the participants had a moderate attitude regarding diabetic complications. About 0.3% (n = 1) of the participants had a negative attitude level. Figure 1

There was Attitude positive in "You believe that healthy food is important for preventing diabetes complications" (95.3%) "You believe that regular examinations are necessary for early detection of diabetes complications" (89.1%) "You believe that regular exercise helps control diabetes complications" (87.2%) "You believe that controlling blood sugar levels reduces complications" (86.7%)"You trust the information you receive from the doctor about diabetes complications" (85.7%), A considerable proportion of participants also "You believe that monitoring cholesterol level is important for diabetes patients" (75.3%) "You worry about diabetes complications" (68.8%) "You are willing to change your lifestyle to control diabetes complications" (57.8%) "You are interested in reading health information about diabetes and its complications" (51.6%) The percentage of Moderate Attitude responses for most items remained relatively low (typically below 15%), "You believe you can control diabetes" (34.6%), and "You are interested in reading health information about diabetes and its complications" (26.3%).

Practice of diabetic patients towards complications of Diabetes

The maximum practice score was 37. The mean score was 24.8 (95% CI for the mean 24.2 to 25.5), and the standard deviation (SD) was ± 5.7, with a range of 13 to 39. The study indicated that more than 50% of participants had moderate Practice regarding diabetic complications (n = 244; 36.5%). The finding was that 25% (n = 96) of participants scored low in Practice regarding diabetic complications. Almost (n = 44; 11.5%) of the participants possessed High Practice. Figure 1

The vast majority of participants reported taking their medications regularly (79.9%), indicating strong compliance with prescribed treatments. However, for most other crucial practices, adherence was notably lower: Regularly checking blood sugar levels was reported as high by fewer than half of the participants (43.8%), with 36.5% at a medium level, and 19.8% at a low level. While following a healthy diet was reported as high by 40.6% (N = 156), an equal proportion (40.6%) reported a medium level, suggesting inconsistent dietary adherence for many. Visiting the doctor regularly and checking blood pressure showed moderate to low adherence: only 29.9% and 30.2% reported high adherence, respectively, while a substantial proportion (33.1% and 34.6%) reported low adherence to these essential activities. Exercising regularly was also a challenge, with only 28.9% reporting high Practice, and 34.4%

reporting low Practice. Reading about diabetes complications had the highest percentage of low Practice among specific items (43.5%).

Furthermore, key preventive practices showed particularly low adherence: More than half of the participants reported low adherence for: Examining their feet daily (57.6% Low), Having regular eye examinations (63.5% Low), Checking their kidneys periodically (56.8% Low), Controlling their weight (52.9% Low), Checking cholesterol levels (55.2% Low)

Correlation Between Knowledge, Attitude, and Practice

Knowledge showed a significant positive correlation with Attitude ($r = 0.237$, $p < 0.0001$) and Practice ($r = 0.268$, $p < 0.0001$; Figs. 3 and 4). Attitude demonstrated a strong positive correlation with Practice ($r = 0.482$, $p < 0.0001$). Figure 5

Factors associated with mean KAP scores towards complications of Diabetes

Factors associated with Knowledge about the complications of Diabetes: The study indicated that Income level, drugs, and Follow-up were associated with mean knowledge scores. Patients with higher income had better Knowledge ($p = 0.004$). Participants in the high-income group (mean rank = 229.10) had higher knowledge scores than those with moderate (mean rank = 195.59) or low (mean rank = 187.39) income. Additionally, the type of drugs used showed a significant association with Knowledge ($p = 0.033$), with patients using both insulin and pills having the Highest mean rank (238.69), followed by those on insulin (219.56), and then those on pills only (185.44). Follow-up methods were also significantly associated with Knowledge ($p = 0.021$); those relying on self-monitoring (mean rank = 207.80) had higher knowledge scores than those attending hospitals or having no follow-up. No significant associations were found between knowledge scores and Gender, Living area, Family History, Herbal Use, Age, Marital Status, Education, Job, Duration of Diabetes, Type of Diabetes, Discovery Method, or Management Plan (Table 2).

Factors associated with Attitude towards complications of Diabetes: Gender was significantly associated with Attitude ($p < 0.001$), with males (mean rank = 220.37) demonstrating more positive attitudes than females (mean rank = 171.06). Marital Status was significantly associated with Attitude ($p = 0.042$). Married individuals (mean rank = 197.11) and single individuals (mean rank = 192.39) tended to have better attitudes than those who were divorced or widowed (mean rank = 144.87). Education level had a Dramatically association with Attitude ($p < 0.001$). Participants with higher education levels (Secondary school: mean rank = 253.18; University or higher: mean rank = 241.83) had more positive attitudes than those with lower educational backgrounds (Illiterate: mean rank = 164.16; Primary: mean rank = 166.29). Job status also showed a strong, significant association with Attitude ($p < 0.001$). Employees (mean rank = 237.88) and workers (mean rank = 231.90) showed better attitudes than other occupational groups, such as housewives (mean rank = 172.01) and the unemployed (mean rank =

152.76). The discovery method of Diabetes was significantly related to Attitude (p = 0.012). Participants whose Diabetes was discovered through routine investigations (mean rank = 222.72) tended to have more positive attitudes than those whose Diabetes was discovered by coincidence or symptoms. Follow-up methods also appear to be significantly associated with Attitude (p = 0.007), with individuals who are self-monitoring (mean rank = 205.06) demonstrating more positive attitudes than those who primarily rely on hospital visits or have no follow-up. No significant associations were reported between attitude scores and Living area, Family History, Herbal Use, Age, Income, Duration of Diabetes, Type of Diabetes, Management Plan, or Drugs. Table 2

Factors associated with Practice towards complications of Diabetes: Gender was significantly associated with Practice (p = 0.001), with males (mean rank = 214.37) reporting better practices than females (mean rank = 175.67). The living area showed a significant association (p = 0.026), with participants from civilized/urban areas (mean rank = 202.55) demonstrating better practices compared to those from rural areas (mean rank = 176.82). Marital Status was also significantly associated with Practice (p = 0.012). Single individuals (mean rank = 217.17) reported the highest practice scores, followed by married individuals (mean rank = 195.17), while divorced or widowed individuals had the lowest practice scores (mean rank = 139.44). Education level exhibited a strong, significant association with Practice (p < 0.001). Participants with higher education levels (Reads and Writes: mean rank = 214.40; Secondary school: mean rank = 227.08; University or higher: mean rank = 222.15) reported better practices compared to those who were illiterate (mean rank = 172.02) or had only primary education (mean rank = 154.33). The discovery method of Diabetes was significantly associated with Practice (p = 0.004). Patients whose Diabetes was discovered through routine investigations (mean rank = 234.55) reported better practices. The management plan was significantly associated with Practice (p < 0.001). Patients on a diet and insulin (mean rank = 220.39) reported the best practices, followed by those on Diet and oral drugs (mean rank = 194.10), while those with no stated management plan had the lowest practice scores (mean rank = 131.30). The type of drugs used was significantly associated with Practice (p = 0.009). Patients using insulin (mean rank = 228.87) or a combination of insulin and pills (mean rank = 215.13) reported better practices than those using only pills (mean rank = 184.03). Follow-

Table 2
Factors associated with mean KAP scores towards complications of Diabetes (n = 384).

Variable	**Mean score**		**knowledge**		**Attitude**		***Practice***	
	Categories	***N***	***Mean Rank***	***. p Value***	***Mean Rank***	***. p Value***	***Mean Rank***	***. p Value***
Gender	Male	167	203.33	0.089	220.37	0.001*	214.37	0.001*
	Female	217	184.16		171.06		175.67	
Living area	Rural	150	204.45	0.087	181.76	0.126	176.82	0.026*
	Civilize	234	202.55		199.38		202.55	
Family History	Yes	184	195.85	0.565	194.01	0.797	188.96	0.548
	No	200	189.42		191.11		195.76	
Herbal Use	Yes	77	192.03	0.967	205.60	0.243	190.12	0.833
	No	307	192.62		189.21		193.10	
Age	20 to 39 Y	56	181.00	0.626	206.73	0.105	184.26	0.395
	40 to 59 Y	190	196.85		199.66		200.28	
	≥ 60 Y	138	191.18		176.86		185.13	
Marital State	Married	321	194.63	0.626	197.11	0.042*	195.17	0.012*
	Single	32	187.70		192.39		217.17	
	Divorced or a widow	31	175.44		144.87		139.44	
Education	Illiterate	152	190.47	0.118	164.16	0.001*	172.02	0.001*
	Reads and Writes	82	195.93		194.54		214.40	
	Primary	49	163.39		166.29		154.33	
	Secondary school	39	187.35		253.18		227.08	
	University or higher	62	219.18		241.83		222.15	
Job	Student	9	152.67	0.344	183.61	0.001*	178.83	0.102
	Employee	67	212.03		237.88		225.29	
	Out of work	27	189.43		152.76		188.04	
	Worker	56	184.59		231.90		204.44	

Variable	**Mean score**		**knowledge**		**Attitude**		***Practice***	
	Categories	***N***	***Mean Rank***	***. p Value***	***Mean Rank***	***. p Value***	***Mean Rank***	***. p Value***
	House wife	171	184.92		172.01		181.15	
	Retired	54	208.65		181.56		179.89	
Income	Low	202	193.37	0.004*	187.39	0.574	183.80	0.222
	Moderate	120	172.13		195.59		198.48	
	High	62	229.10		203.16		209.26	
Duration	1 to 5 Y	166	180.53	0.089	200.95	0.201	190.40	0.797
	6 to 10 Y	105	195.74		189.11		186.97	
	11 to 15 Y	46	187.65		204.00		204.09	
	¬ 15 Y	67	220.40		168.98		198.43	
Type	Type 1	16	194.91	0.316	215.41	0.585	225.97	0.430
	Type 2	97	206.86		197.18		194.99	
	I do not know	271	187.22		189.47		189.63	
Discover	Routine investigations	29	160.86	0.270	222.72	0.012*	234.55	0.004*
	Coincidence	157	195.06		173.35		172.10	
	Symptoms	198	195.11		203.26		202.52	
Management	Diet and oral drugs	282	185.63	0.103	196.64	0.442	194.10	0.001*
	Diet and insulin	65	216.48		178.04		220.39	
	Non	37	202.73		186.38		131.30	
Drugs	Insulin	67	219.56	0.033*	185.73	0.811	228.87	0.009*
	Pills	309	185.44		193.60		184.03	
	Insulin and pills	8	238.69		206.81		215.13	
Follow-up	Self-monitoring	194	207.80	0.021*	205.06	0.007*	217.26	0.000*
	Hospital	137	175.68		190.74		193.01	
	Non	53	179.97		151.07		100.55	

Up methods had a highly significant association with Practice ($p < 0.001$), with self-

monitoring (mean rank = 217.26) associated with the highest practice scores, followed by hospital follow-up, and then no follow-up (mean rank = 100.55). No significant associations were found between practice scores and Family History, Herbal Use, Age, Job, Income, Duration of Diabetes, or Type of Diabetes. Table 2

Factors affecting KAP towards complications of Diabetes

The bootstrapped regression model identified two statistically significant predictors of **knowledge scores.** Medication burden showed a significant negative association (B = -0.475, 95% Bootstrapped CI: -0.892 to -0.062, p = 0.025), indicating that patients prescribed more medications had lower knowledge scores. Follow-up status also demonstrated a significant negative relationship (B = -0.340, 95% CI: -0.625 to -0.054, p = 0.026), with inconsistent follow-up associated with diminished Knowledge. Monthly income did not reach statistical significance (B = 0.197, 95% CI: -0.121 to 0.480, p = 0.174).

Table 3

Factors affecting the mean KAP score towards DM complications among DM patients

	B	Bias	Std. Error	P.value	95% Confidence Interval	
					Lower	Upper
knowledge						
(Constant)	10.662	0.005	0.444	0.001	9.750	11.494
Income	0.197	-0.003	0.148	0.174	-0.121	0.480
Drugs	-0.475	0.001	0.217	0.025	-0.892	-0.062
Follow Up	-0.340	-0.003	0.148	0.026	-0.625	-0.054
Attitude						
(Constant)	26.670	0.000	1.184	0.001	24.381	29.129
Gander	-0.756	-0.003	0.354	0.029	-1.460	-0.076
Marital State	-0.267	0.012	0.261	0.291	-0.798	0.248
Education	0.482	0.001	0.140	0.001	0.208	0.759
Job	0.133	0.000	0.141	0.342	-0.138	0.410
Discover	0.155	0.000	0.225	0.484	-0.297	0.592
Follow Up	-0.654	-0.011	0.242	0.009	-1.135	-0.205
Practice						
(Constant)	34.196	0.088	2.557	0.001	28.639	39.261
Gander	-1.861	-0.014	0.647	0.006	-3.084	-0.522
Living area	1.225	-0.009	0.556	0.026	0.139	2.283
Marital State	-0.435	0.013	0.387	0.258	-1.208	0.350
Education	0.075	0.005	0.231	0.745	-0.375	0.531
Discover	0.404	-0.016	0.439	0.363	-0.477	1.291
Management	-1.257	-0.003	0.475	0.007	-2.216	-0.358
Drugs	-1.914	-0.049	0.760	0.019	-3.436	-0.471
Follow Up	-2.351	0.033	0.352	0.001	-2.997	-1.614

Attitude Score: Three significant predictors emerged. Male gender was negatively associated with positive attitudes (B = -0.756, 95% CI: -1.460 to -0.076, p = 0.029). Higher education level showed a strong positive association (B = 0.482, 95% CI: 0.208 to 0.759, p = 0.001). Inconsistent follow-up again

demonstrated a significant negative relationship (B = -0.654, 95% CI: -1.135 to -0.205, p = 0.009). Marital Status, employment status, and method of disease discovery were not statistically significant predictors in this model

Practice Score: The practice score model revealed the most robust findings. Follow-up inconsistency emerged as the strongest predictor (B = -2.351, 95% CI: -2.997 to -1.614, p = 0.001). Other significant negative predictors included male gender (B = -1.861, 95% CI: -3.084 to -0.522, p = 0.006), complex disease management (B = -1.257, 95% = CI: -2.216 to -0.358, p = 0.007), and higher medication burden (B = -1.914, 95% CI: -3.436 to -0.471, p = 0.019). Urban residence was the sole positive predictor (B = 1.225, 95% = CI: 0.139 to 2.283, p = 0.026). Educational attainment, marital Status, and discovery method showed no significant associations with practice scores. **Table 3**

Discussion

This study aimed to determine the Knowledge, Attitudes, and Practices regarding diabetic complications among diabetic patients, and the demographic factors affecting patients' Knowledge, Attitudes, and Practices toward diabetic complications. Of 384 patients, the majority (56,5%) were female. In contrast (43,5%) were male, which is consistent with the gender distribution seen in the Mumbai study (Kazi et al., 2017). Furthermore, the study found a significant relationship between patients' gender and their Attitude and Practice.

The mean age was 52.9; 190 patients (49.5%) were in the age group (40_59), which is consistent with Aldossari et al. (2015) (KAP) study in Saudi Arabia, 138 (35.9%) were 60 and older. The majority of the sample was illiterate (39.6%) and housewives (44.5%), which has an effect on Attitude and Practice. Most of the sample was living in urban areas (60.9%), which affects patients' practices regarding their disease.

According to the income effect on Knowledge of Diabetes complications, low-income individuals were the dominant group (52.6%), which is comparable with the Ghana study by Obirikorang et al. (2016).In this research, knowledge level increased with the duration of the disease, despite the mean duration of the disease being 1_5 year (43.2%), which contradicts Sana'a's study by Al-omaisi et al. (2023), which showed that older patients had lower knowledge scores. Despite expectations that family history would improve patients' Knowledge, attitudes, and Practice, this study found no association, unlike the Dhaka study, which found an association between family history and patients' Practice (Rahman et al., 2017).

Patients who discovered their disease through symptoms were almost half (51.6%), followed by those who discovered it by coincidence (40.9%). This affected patients' Attitude and Practice. Regarding the management of Diabetes mellitus, 282 of the sample size followed a diet and oral drugs; this improved their Practice toward the disease, whereas patients who took oral drugs with or without Diet had a better level of Knowledge and Practice. In the present study, it is observed that (50.5%) had a self-monitoring follow-up, then (35.7%) had a hospital follow-up, which strongly strengthens their results toward the

Knowledge, Attitude, and Practice; however, patients who did not follow their blood sugar at all (13.8%) had weak results.

Regarding Knowledge, the findings of the present study revealed that the majority of participants (58.3%) demonstrated a high level of Knowledge regarding diabetes complications. In comparison, 36.7% showed moderate Knowledge, and only 4.9% had low Knowledge, with a mean score of 9.55 (79.5). These results align with the study by Aldossari et al. (2015) in Saudi Arabia, which reported good awareness among diabetic patients, especially regarding common complications such as retinopathy, hypoglycemia, and diabetic foot. Supported by other studies, Nyamagoud et al. (2023) in India concluded that improved Knowledge positively impacts diabetes management.

In our study, the maximal awareness was observed for complications such as coma/dizziness (96.4%), retinopathy (95.1%), and hypoglycemia (94.0%). In contrast, Knowledge was lower for pneumonia (60.2%) and stroke (68.8%). These results are consistent with Babelgaith et al. (2013) in Yemen, who highlighted poor awareness of less Obvious complications, such as pulmonary and neurological issues, despite adequate Comprehension of the Observation complication.

Regarding factors influencing Knowledge, the duration of Diabetes showed a statistically significant positive correlation with Knowledge ($p = 0.026$), indicating that longer disease duration is associated with greater awareness. This is in line with Rahaman et al. (2017), who found that patients with a longer history of Diabetes had greater Knowledge of complications. Furthermore, follow-up methods were significantly associated with Knowledge ($p = 0.010$), with patients who practiced self-monitoring scoring higher than those who relied on hospital visits or had no follow-up. This finding is consistent in Wang et al. (2024) and Nyamagoud et al. (2023), who Certain the role of self-monitoring in Optimizing Knowledge and self-empowerment.

Additionally, the type of medication used was significantly associated with Knowledge ($p = 0.033$). Patients using insulin or a combination of insulin and pills had higher knowledge levels than those using pills only, which is consistent with Bin Ahmed et al. (2019), who suggested that more intensive treatments encourage greater patient engagement and awareness.

Interestingly, our study did not find statistically significant associations between Knowledge and variables such as age, gender, educational level, occupation, income, living area, family history, method of diagnosis, or use of herbal medicine. This is unlike findings from Obirikorang et al. (2016) and Al Shafaee et al. (2008), which indicated that younger age, female gender, and higher education were associated with better Knowledge. Similarly, ALhariri et al. (2017) in Yemen found that urban residence and higher education were key predictors of awareness, a finding that was not confirmed in our study.

This divergence may be explained by the lack of Organized diabetes education programs in Ibb city or differences in participants' backgrounds and access to information. It also suggests that Knowledge may be acquired more through personal experience and interaction with healthcare providers than solely through sociodemographic factors.

Therefore, our findings emphasize the need to strengthen diabetes education programs—especially for newly diagnosed patients, those without regular follow-up, and those treated only with oral medications —to improve Knowledge and prevent long-term complications.

With reference to Attitude, plurality of respondents had an attitude percentage (87.3%), which is considered a fair Attitude. (95.3%) Of participants agreed that "healthy food is important for preventing diabetes complications"; this is consistent with the Mumbai study by Kazi et al. (2017). "You believe that regular examinations are necessary for early detection of Diabetes complications "had a positive attitude with (89.1%) percentage, this is consistent with the assessment of the level of (KAP) about diabetes mellitus in the Saudi Arabia study with (79.7%) Aldossari et al. (2015). In this study "you believe that controlling blood sugar levels reduces complications "had an agreement by the participants by (86.7%) which disagreed with Sana'a study Al-Omaisi et al. (2023), also in "you believe that monitoring cholesterol level is important for diabetes patients "disagreed with Mumbai study Kazi et al. (2017) in (75.3%),(12.9%) respectively. (87.2%) of participants had a positive attitude regarding the effect of exercise in controlling diabetes complications, which is almost similar to the result in Adaossari et al (2017), Rahman et al. (2017) with (79.7%), (70%%) respectively.

The current study identified several significant correlations between patients' attitudes towards diabetic complications and their demographic and clinical characteristics. Gender exhibited a significant correlation with attitude scores, with males attaining higher scores than females ($p = 0.000$). This indicates that men might possess greater awareness or concern regarding diabetic complications. Marital Status was significantly correlated with attitude scores ($p = 0.042$), suggesting that married individuals generally exhibit more favorable attitudes. A study conducted in Dhaka found that similarly identified significant sociodemographic predictors of patients' attitudes towards Diabetes complications. In the Bangladesh sample, age, female gender, and marital Status were significantly correlated with more positive attitudes: older patients and women exhibited higher attitude scores. At the same time, married individuals outperformed their unmarried counterparts (Rahaman et al.,2017).

Moreover, educational attainment exhibited a significant correlation ($p = 0.000$), with individuals possessing university degrees indicating higher attitude scores. A KAP study conducted in Karachi, Pakistan, assessed attitudes about Diabetes and its complications. The Pakistani study found that higher education was the only demographic factor significantly associated with more positive attitudes ($p < 0.001$) (Waris et al., 2021). This is similar to what we found in this study, where educational level also had a strong association with attitude scores ($p = 0.000$).

A significant correlation was identified ($p = 0.004$), indicating that individuals with elevated income levels exhibited more positive attitudes. The method of Diabetes discovery was also significant ($p = 0.012$), indicating that people who discovered they had Diabetes through symptoms had better attitudes. This could be because they were diagnosed earlier and got help sooner. Follow-up practices, especially self-monitoring, were strongly linked to attitude scores ($p = 0.007$). This suggests that consistent monitoring

may cultivate a more responsible and informed approach to the management and prevention of complications.

These findings underscore the necessity of directing educational and behavioral interventions towards less-educated, low-income, and non-compliant patient populations to enhance attitudes and ultimately mitigate diabetes-related complications.

About the Practice, the findings of this study revealed that more than half of the participants (56.3%) exhibited low levels of Practice concerning diabetes complications. In comparison, 32.3% showed moderate Practice, and only 11.5% reported high Practice, with a mean practice score of 24.8 (± 5.7). This indicates suboptimal self-care behaviors among diabetic patients, despite their relatively high Knowledge and positive attitudes.

This finding is consistent with previous studies conducted in Yemen and other regions. For example, Alhariri et al. (2017) reported poor adherence to Diet (21%) and exercise (15.2%) among T2DM patients in Hodeidah city, leading to poor glycemic control. Similarly, Das et al. (2023) and Herath et al. (2017) in Sri Lanka and India observed insufficient self-monitoring, irregular foot care, and low commitment to preventive practices. These results reinforce the global trend that Knowledge alone does not always translate into appropriate Practice.

In our study, only 43.8% of participants reported regularly checking their blood sugar levels, 40.6% followed a healthy diet, and 28.9% exercised regularly. Meanwhile, practices such as daily foot examination, regular eye checks, kidney screening, weight control, and cholesterol monitoring were largely neglected by most participants. These gaps may reflect a lack of motivation, limited access to healthcare services, or poor reinforcement of health education.

Statistical analysis showed that several sociodemographic and clinical variables significantly influenced practice levels. Gender was a strong predictor, with males exhibiting better practices than females ($p = 0.001$), a result in contrast to Rahaman et al. (2017), who found better practices among females. The living area also showed a significant effect ($p = 0.026$), with participants from urban areas demonstrating better practices, consistent with ALhariri et al. (2017), who found that urban residents were more adherent to dietary recommendations.

Moreover, education level showed a significant positive correlation with Practice ($p = 0.003$), where participants with secondary or higher education achieved higher practice scores. This is in line with Obirikorang et al. (2016) and Al Shafaee et al. (2008), who confirmed education as a key determinant of Diabetes self-care behaviors. Similarly, marital Status ($p = 0.012$), type of drug used ($p = 0.009$), management plan ($p < 0.001$), and, especially, follow-up methods ($p < 0.001$) were significantly associated with Practice. Participants who practiced self-monitoring had the highest practice scores, supporting the findings of Wang et al. (2024) and Bin Ahmed et al. (2019), which emphasized the impact of active self-involvement in improving diabetes care.

On the contrary, no significant relationship was found between practice and age, income, duration of Diabetes, family history, discovery method, or use of herbal medication. This inconsistency with previous research may stem from cultural, economic, or healthcare system differences in the Yemeni context.

In conclusion, while diabetic patients in Ibb city possess acceptable levels of Knowledge and attitudes toward complications, their actual practices remain insufficient. This calls for targeted interventions focusing not only on education but also on behavior change strategies, practical skill training, and stronger follow-up systems to improve daily diabetes self-management.

The discrepancy between Knowledge and Practice—wherein patients know about complications but fail to implement preventive behaviors—is a recurrent theme in Diabetes research, Heart et al. (2017); Das et al (2023). This gap may stem from socioeconomic constraints, lack of access to health services, or insufficient reinforcement of Knowledge through healthcare provider interactions.

In terms of Attitude, most patients expressed a willingness to prevent complications by adopting healthy lifestyles and acknowledged the importance of medical advice, routine check-ups, and lifestyle changes. These findings align with those of Rahaman et al. (2017), who reported similar positive attitudes in a Bangladeshi cohort. Furthermore, the strong correlation between Attitude and Practice ($r = 0.482$, $p < 0.001$) underscores the potential of attitude-oriented interventions to improve patients' behaviors.

Despite positive attitudes, poor practice scores were observed across essential preventive measures, including regular foot and eye examinations, weight control, and cholesterol monitoring. This supports the findings of ALhariri et al. (2017) in Yemen and Das et al. (2023) in India, both of which found that many diabetic patients lacked adherence to self-care routines. It emphasizes the need for more structured education and support systems to facilitate the translation of Knowledge into behavior. The correlation analysis revealed that educational level significantly influenced both Attitude and Practice, highlighting education as a key determinant in diabetic self-management, as also reported in previous studies (Obirikorang et al., 2016; Rahaman et al., 2017).

In summary, although the study population had commendable knowledge and attitude levels, this was not reflected in Practice. The findings call for comprehensive interventions focused on behavioral change, particularly among females, less educated individuals, and those without structured follow-up care. Health education programs tailored to these subgroups, alongside improved access to diabetes care and follow-up services, are essential for reducing complications and improving patient outcomes.

Conclusion

Knowledge of the complications of Diabetes was moderate to high; attitudes were positive, but practices were moderate. significant positive correlations between Knowledge, Attitude, and Practice, with Attitude having the strongest link to Practice. Inconsistent follow-up and male gender consistently impaired all KAP domains, with polypharmacy specifically harming Knowledge and Practice. At the same time, higher education and urban residence emerged as key, yet domain-specific, positive factors for Attitude and

Practice, respectively. Implement consistent, tailored follow-up systems, particularly for male patients and those with complex medication regimens, to address the strongest negative predictor across all KAP domains. Create gender-sensitive and literacy-appropriate educational interventions that focus on translating Knowledge and positive attitudes into practical self-management skills, especially for rural residents. When clinically feasible, streamline medication regimens and management plans to mitigate the negative effects of polypharmacy and complexity on patient knowledge and Practice.

Abbreviations

(KAP) Knowledge, Attitudes, Practice

(DM) Diabetes mellitus

(T2DM) Type 2 diabetes mellitus

(SPSS) Statistical Package for the Social Sciences

(SD) Standard deviation

Declarations

Ethics Approval and Consent to Participate

The study protocol received approval from the Institutional Review Board of Ibb University (approval number: IU-RB-2024-092, dated December 11, 2024). Given the retrospective nature of the research involving anonymized data collected during routine clinical care, the requirement for informed consent was waived by the ethics committee. Patient confidentiality was safeguarded throughout by anonymizing all data during collection and analysis, with no personal identifiers included in the research database. The study was conducted in accordance with the principles of the Declaration of Helsinki and applicable local regulations governing observational research.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interests

All authors declare that they have no competing interests to disclose.

Consent for publication

Not applicable.

Contributors

BA: Investigation, Methodology, Project Administration, Writing – Review & Editing

ASH, WA: Conceptualization, Data Curation, Formal Analysis, Writing – Original Draft

AS, AB, AN, AD: Investigation, Methodology, Project Administration, Writing – Review & Editing

AA, EL, GA, RS, RA: Conceptualization, Data Curation, Formal Analysis, Writing – Original Draft

WA: Supervision, Validation, Visualization, Writing – Review & Editing

WA: Writing – Review & Editing, Corresponding Author

Corresponding author

Correspondence to Wadee Abdullah Al-Shehari

Data availability

The datasets used and analyzed in the current analysis are available from the corresponding author upon reasonable request.

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Figures

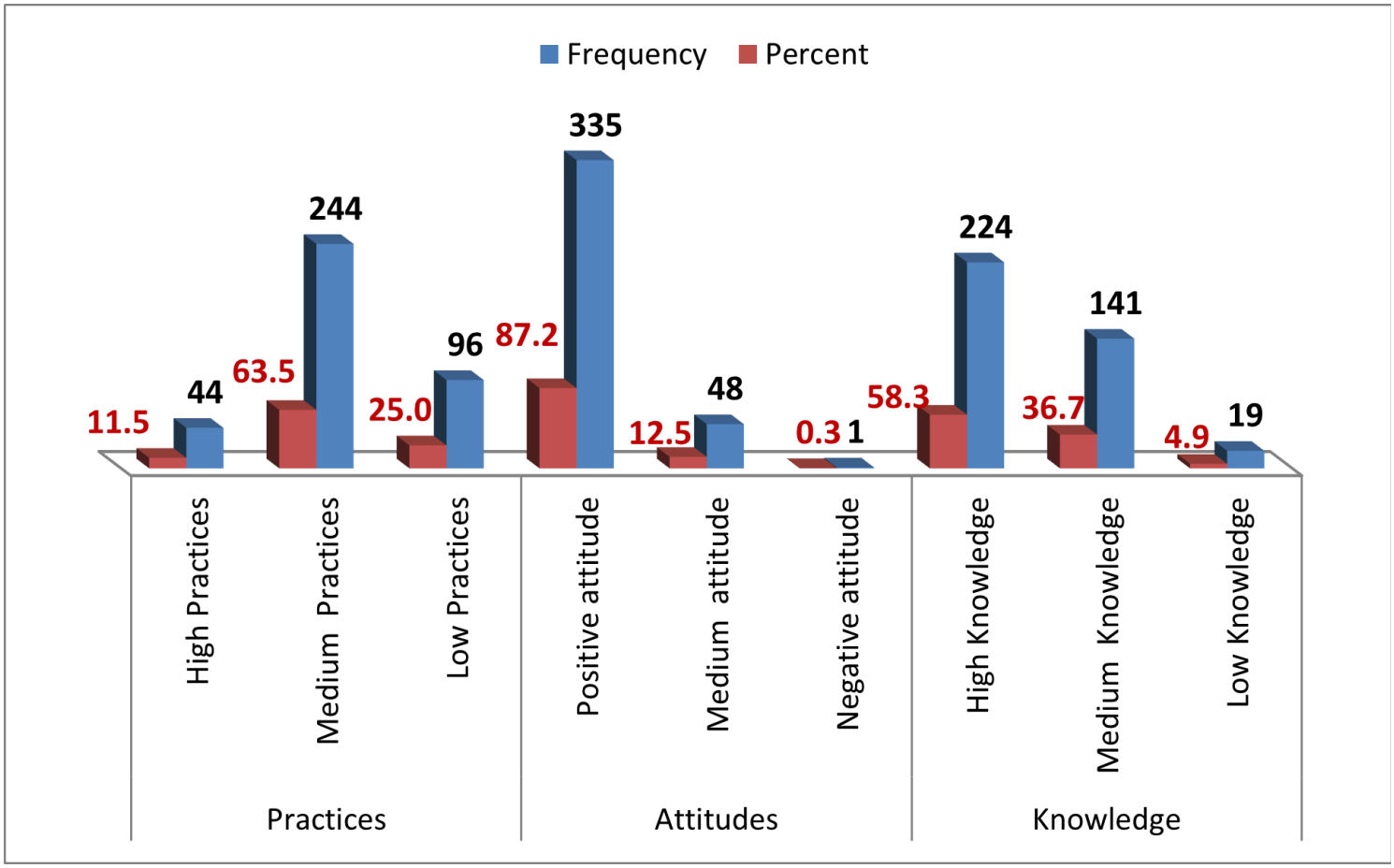


Figure 1

Percentage Distribution Categories of KAP of patients towards Diabetic Complications

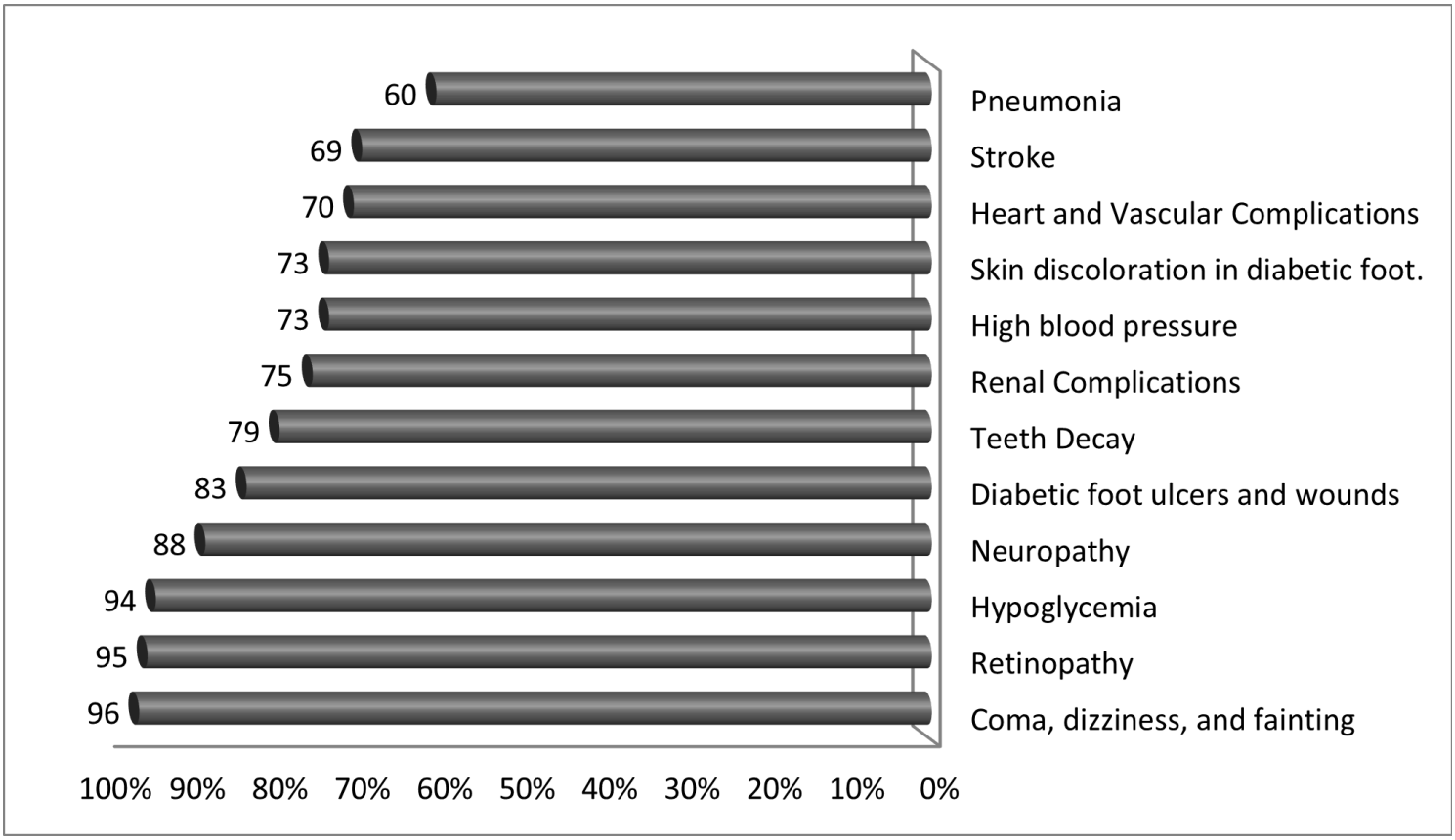


Figure 2

Frequency Distribution of Knowledge Regarding Diabetic Complication

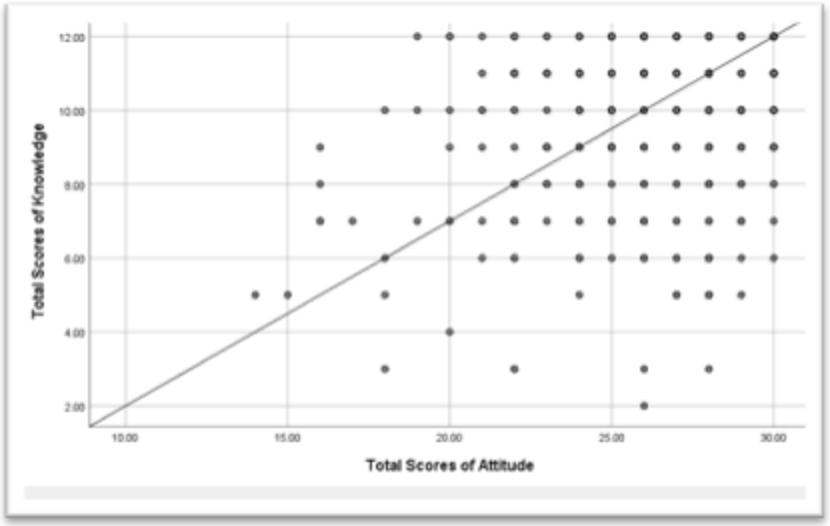


Figure 3

Correlation between total Scores of Knowledge and attitude

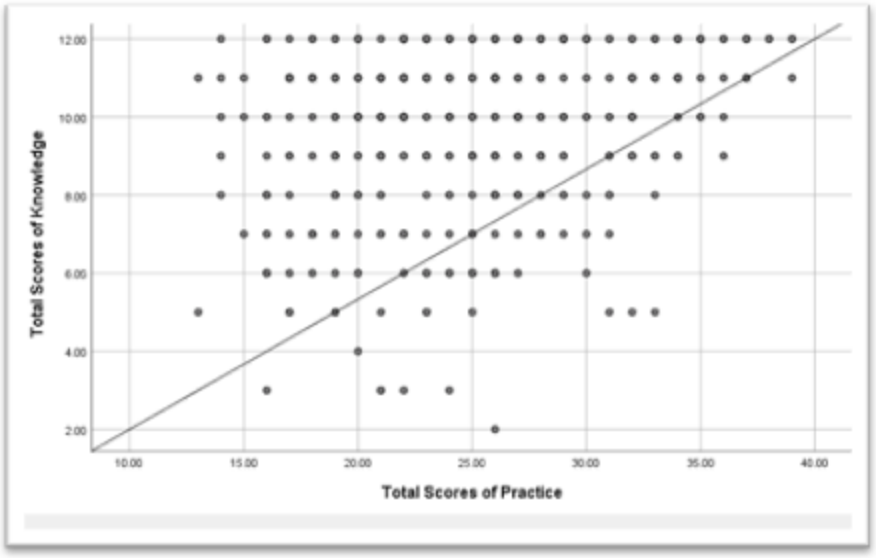


Figure 4

Correlation between total Scores of Knowledge and Practice

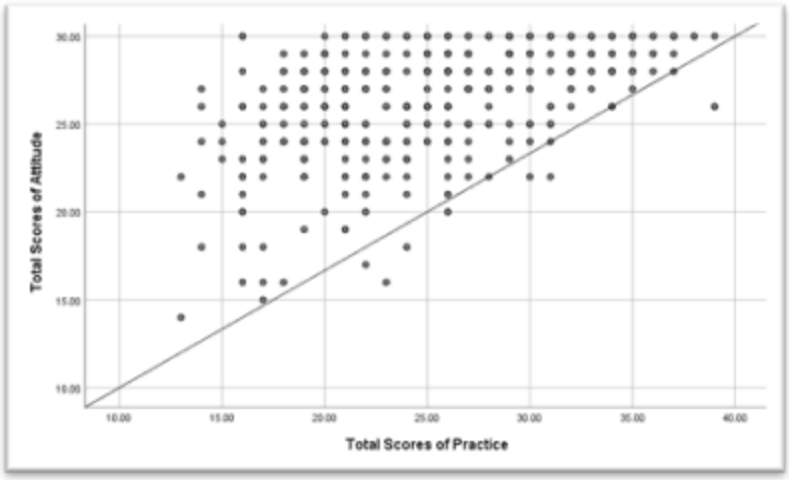


Figure 5

Correlation between total Scores of Practice and Attitude

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