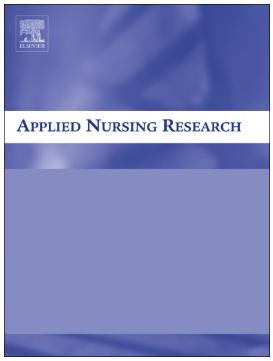

Examining perceived and actual diabetes knowledge among nurses working in a tertiary hospital

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Abstract

Background: With the worldwide increase in the incidence and prevalence of diabetes, there has been an increase in the scope and scale of nursing care and education required for patients with diabetes. The high prevalence of diabetes in Saudi Arabia makes this a particular priority for this country.

Aim: The aim of this study was to examine nurses' perceived and actual knowledge of diabetes and its care and management in Saudi Arabia.

Methods: A convenience sample of 423 nurses working in Prince Sultan Medical Military City in Saudi Arabia was surveyed in this descriptive, cross-sectional study. Perceived knowledge was assessed using the Diabetes Self-Report Tool, while the Diabetes Basic Knowledge Tool was used to assess the actual knowledge of participants.

Results: The nurses generally had a positive view of their diabetes knowledge, with a mean score (SD) of 46.9 (6.1) (of maximum 60) for the Diabetes Self-Report Tool. Their actual knowledge scores ranged from 2 to 35 with a mean (SD) score of 25.4 (6.2) (of maximum of 49). Nurses' perceived and actual knowledge of diabetes varied according to their demographic and practice details. Perceived competency, current provision of diabetes care, education level and attendance at any diabetes education programs predicted perceived knowledge; these factors, with gender predicted, with actual diabetes knowledge scores.

Conclusion: In this multi-ethnic workforce, findings indicated a significant gap between participants' perceived and actual knowledge. Factors predictive of high levels of knowledge provide pointers to ways to improve diabetes knowledge amongst nurses.

Keywords: Diabetes mellitus; knowledge; nursing; education; competency

Introduction

The role of nurses in caring for and educating patients with diabetes has dramatically increased in scope and scale with the worldwide increase in the incidence and prevalence of diabetes. There are currently 415 million people diagnosed with diabetes globally (International Diabetes Federation, 2015); this is projected to rise to 642 million by 2040. People from low/middle-income and developing countries such as Saudi Arabia are, in particular, at increased risk. Effective management of diabetes is essential to reduce the early and long term complications of diabetes and to inhibit the onset of associated chronic diseases (Hark, Deen, & Morrison, 2014). Diabetes self-management requires dietary management, adherence to medication regimens and blood glucose monitoring. Patients' outcomes have been demonstrated to improve when patients receive up-to-date, complete and accurate information about diabetes and its care and management (American Diabetes Association, 2013). Nurses are an indispensable part of this process, guiding patients' self-care practices through education and counselling (Coulter, Parsons, & Askham, 2008).

However, studies have indicated knowledge deficits among nurses in various areas of diabetes care and management. Inadequate knowledge of medication has been found among American and Jordanian nurses (Gerard, Griffin, & Fitzpatrick, 2010; Yacoub et al., 2014) and insufficient knowledge of insulin treatment among 27% of Pakistani registered nurses (RNs) (Ahmed, Jabbar, Zuberi, Islam, & Shamim, 2012). Australasian studies found that some 50% of participating nurses did not know that neuropathy, nephropathy, erectile dysfunction, cardiovascular and cerebrovascular diseases were associated with diabetes (Daly, Arroll, Sheridan, Kenealy, & Scragg, 2014; Livingston & Dunning, 2010). Studies in the United State (US) and United Kingdom (UK) also indicated RNs needing further training in blood glucose monitoring (BGM) (Gerard et al., 2010; Nash, 2009), as was also the case for 75.1% of Nigerian nurses (Oyetunde & Famakinwa, 2014). In a Korean study, 80% of practice nurses scored poorly on diabetes dietary questions relating to sources of carbohydrates for diabetes patients (Park et al., 2011). A qualitative study conducted in Sweden reported that none of the 22 participating enrolled nurses could distinguish the different types of diabetes or the symptoms of diabetes (Olsen, Granath, Wharén, Blom, & Leksell, 2012). Together these findings indicate that the nursing workforces internationally may experience significant knowledge deficits across many areas of diabetes care (Alotaibi, Al-Ganmi, Gholizadeh, &

Perry, 2016). However, no study was found that investigated nurses' knowledge of diabetes and its care and management in the Saudi health care system. Saudi Arabia's health care system comprises 60 % government-run and 40% private organisations. The system suffers from a shortage of local healthcare professionals including nurses (Aldossary, While, & Barriball, 2008). Nurses are recruited from many other countries including Australia, the UK, India, the Philippines, South Africa and the US (Al-Homayan, Shamsudin, & Subramaniam, 2013). As a result, the nursing workforce of Saudi Arabia is predominantly comprised of nurses who have been educated and trained in a large number of other countries, under widely differing curricula. Therefore, they are likely to possess differing levels of knowledge and understanding of diabetes and its management, and of the diabetes-related education needs of patients. This study, conducted in a Saudi governmental hospital, offers a first look at the level of diabetes knowledge held by these nurses in Saudi Arabia and helps to fill this gap in the literature.

Aims and objectives

The aim of this study was to examine nurses' perceived and actual knowledge of diabetes and its care and management in Saudi Arabia.

The specific objective were to:

1) Identify nurses' perceived knowledge and skills in relation to diabetes and its care and management.
2) Assess the accuracy of nurses' knowledge (actual knowledge) of diabetes and its care and management.
3) Examine relationships between nurses' actual knowledge of diabetes and their perceived knowledge, socio-demographic and practice related data.
4) Identify factors predicting nurses' perceived and actual knowledge of diabetes and its care and management.

Methods

Design

This study is one part of a mixed-method study addressing nurses' knowledge of diabetes in Saudi Arabia. It reports the results of the quantitative phase, which employed a cross-sectional survey design to assess nurses' perceived and actual knowledge of diabetes and its care and management, including knowledge of diabetes medications, BGM, nutrition, diabetes pathology and symptoms, diabetes foot care and complications.

Setting

The cross sectional survey recruited participants from a wide range of in-patient and outpatient departments at the Prince Sultan Medical Military City (PSMMC) in the Kingdom of Saudi Arabia. The PSMMC is the largest hospital in Riyadh, the capital city of Saudi Arabia, offering both primary and tertiary health care. It has a primary healthcare centre, and a range of subspecialties including cardiac surgery, medicine, surgery, neurology, nephrology, urology and obstetrics/gynecology. The PSMMC is operated by the Ministry of Defense in Saudi Arabia; it provides healthcare to military employees and their dependents and accepts any emergency and critical cases under specific regulations. Approximately 3,000 nursing staff from multiple nationalities work in this hospital.

Sample and sample size

The study population consisted of Saudi and non-Saudi RNs who met the study inclusion criteria of being employed in the research site hospital (PSMMC) and having a minimum of six months nursing work experience. Nurses who worked in managerial positions, those who were newly appointed, or employed in support services such as operating theatres, radiology, dialysis, laboratory or endoscopy units were excluded. A convenience sample of nurses meeting the inclusion and not the exclusion criteria was sought. Excluding those nurses employed in managerial positions and support services, the estimated population comprised 1500 front-line nurses. A sample size of 305 participants was calculated to demonstrate a moderate sized effect (r = 0.30) with a 5% level of significance and 80% power level (Munro, 2005). The results of an earlier local study indicated an anticipated response rate of approximately 50% (Al-Otaibi, 2014), increasing the minimum sample size to 610 participants. However, the distribution of nurses at the research site hospital within the

nursing specialties obligated distribution of 700 surveys to cover all included nursing subspecialties.

Assessment tools

Data were collected using a set of self-report questionnaires including a socio-demographic and practice-related data sheet, the Diabetes Self-Report Tool (Drass, Muir-Nash, Boykin, Turek, & Baker, 1989) and the Diabetes Basic Knowledge Tool (Drass et al., 1989).

Socio-demographic and practice related data:

For the purpose of this study a demographic and practice related instrument was developed. This consisted of 15 questions about gender, age, nationality, ethnicity, degree level of education, the country in which nursing qualifications were obtained, years of work experience and current work area, attendance at any diabetes education programs, access to diabetes management policies or guidelines, perceived competency in diabetes care and current provision of diabetes care.

The Diabetes Self-Report Tool

This questionnaire was developed by Drass et al. (1989) to assess nurses' perceived knowledge of diabetes care. It contains 15 questions addressing various diabetes-related content areas such as diabetes pathology and symptoms, medications, foot and surgical care, BGM, diet and complications. Responses use a Likert-type scale format ranging from 1 (strongly disagree) to 4 (strongly agree).

The Diabetes Basic Knowledge Tool

This questionnaire was also developed by Drass et al. (1989) to assess nurses' actual knowledge of diabetes care comprising 45 multiple choice-questions in five themed areas: medications, diabetes pathology/symptoms, diet, BGM, surgical and foot care. For the current study four questions were added from other validated tools - the Diabetes Survival Skill Knowledge Test (Modic et al., 2009) and the Diabetes Knowledge Questionnaire (O'Brien, Michaels, & Hardy, 2003) - to assess nurses' knowledge of diabetes complications.

Validity and reliability

Content validity index scores previously demonstrated for the Diabetes Knowledge Survival Skill Test, the Diabetes Knowledge Questionnaire, the Diabetes Self-Report Tool and the Diabetes Basic Knowledge Tool were 0.90, 0.68, 0.91 and 0.94, respectively (Modic et al., 2009; van Zyl & Rheeder, 2008; Yacoub et al., 2014). The most recently reported Cronbach's alpha coefficient scores demonstrating the internal consistency of the Diabetes Knowledge Questionnaires, the Diabetes Self-Report Tool and The Diabetes Basic Knowledge Tool were 0.81, 0.80 and 0.77, respectively (van Zyl & Rheeder, 2008; Yacoub et al., 2014). To demonstrate the validity of these questionnaires for the current study, four content experts with extensive experience in diabetes education and management from Jordan, Saudi Arabia, the US and the United Arab Emirates reviewed the instruments using the content validity index. The wording of some items was slightly revised based on their comments; the content validity index of the study questionnaires overall was 0.98. The study questionnaires were completed at two time points (test-retest) with a 10-day interval between by 25 RNs in the Nursing Education and Staff Development Department at the PSMMC. The test and re-test correlation value for the perceived diabetes knowledge questionnaire was $r = 0.835$, $p < 0.01$, and for the actual diabetes knowledge questionnaire, $r = 0.727$, $p < 0.01$.

Ethical considerations

Ethical approvals for this study were obtained from the Hospital Research Centre (Project No.750) and Human Research Ethics Committee of the University of Technology Sydney (Reference No. 2015000302).

Data collection procedure

As this was the first time these questionnaires had been used with nurses in Saudi Arabia, a pilot study was conducted with another 15 nurses working in the Nursing Education and Staff Development Department at the PSMMC (separate to those who conducted the test-retest assessment). No problems were identified with the questionnaire and nurses reported that it took about 45 minutes to complete. Recruitment flyers were then posted on nursing station

notice boards of the selected departments at the PSMMC. The staff of the Nursing Education and Staff Development Department encouraged nurses to participate in the study and distributed study packages to prospective participants. Each package contained the questionnaire, the study participant information sheet and a prepaid return envelope. The study objectives, inclusion and exclusion criteria were explained in the participant information sheet and were also highlighted on the socio-demographic data sheet for self-screening of eligibility to participate. They were informed that by returning the questionnaires they were consenting to participate in the study. Participants were asked to complete and return only the questionnaires into secure boxes located in the charge nurse's office in each department. In total 500 of the 700 questionnaires were returned, for an overall response rate of 71.4%; of which 77 (10%) questionnaires were incomplete and discarded; overall 423 (60.4% response rate) completed surveys were analysed.

Data analysis

Data were analysed using IBM SPSS version 23. Descriptive statistics (frequencies, percentages, means and standard deviation) were used to summarise the results; Pearson correlation coefficient described relationships between the socio-demographic and practice-related data and diabetes knowledge-related responses. T-tests and one-way analysis variance compared diabetes scores amongst sub-sets of nurses. Stepwise multiple linear regression modelled socio-demographic and practice-related predictors of perceived and actual diabetes knowledge scores based. For both the regression models, assumptions for normality of residuals and multicollinearity were met.

Results

Participants' characteristics

Participants were 423 nurses employed at the PSMMC, of mean age 31.9 (SD=6.9) years. The largest group was of Filipino ethnicity (n=338; 79.9%) and few (n=30, 7%) were Saudi nationals who had received their nurse education in Saudi Arabia. Most were female (n=345; 81.6%) and held a bachelor's degree (n=353; 83.6%), with six to ten years of work experience

(n=178; 42.1%). Participants worked in eleven nursing subspecialties; due to small numbers of participants in some subspecialties, groups were merged to the five specialty groups of Medicine, Critical Care, Surgery, Women and Children, and Ambulatory Care. The majority (65.1%) self-rated their competency in providing diabetes care as fair; 20.6% rated it as good/excellent. More than 50% of nurses were currently providing diabetes care and had access to diabetes management policies or guidelines but few (15%) had attended any diabetes education programs.

Perceived diabetes knowledge and skills

Participants' perceived knowledge of diabetes and its care and management was calculated using the Diabetes Self-Report Tool (Drass et al., 1989). Of a maximum possible score of 60, response scores ranged from 30 to 60, with a mean (SD) score of 46.9 (6.1). This represents an equivalent score of 78.2%, which is comparable to a score of 3 (or 'agree') on the original scale of 1-4, indicating that these nurses generally had a positive view of their diabetes knowledge.

Accuracy of nurses' diabetes knowledge

The accuracy of nurses' knowledge of diabetes and its care and management was calculated for each nurse using the Diabetes Basic Knowledge Tool (Drass et al., 1989). Of a maximum possible score of 49, responses scores ranged from 2 to 35 with a mean (SD) score of 25.4 (6.2). None of the nurses answered all of the multiple-choice questions correctly and the mean score represents an equivalent score of 52.3% correct. Nurses' responses demonstrated particularly low accuracy in questions related to diet and nutrition questions (41.1% correct), diabetes pathology and symptoms (42.7% correct) and diabetes medications (45.7% correct). Greater accuracy in their diabetes knowledge was demonstrated for BGM (71.4% correct) and diabetes foot care and complications (75.6% correct).

Relationships between nurses' characteristics and diabetes knowledge

Nurses' actual knowledge of diabetes correlated positively but only moderately with their perceived knowledge of diabetes (Pearson's $r = 0.424$, $p < .001$). Perceived and actual diabetes knowledge differed significantly according to nurses' socio-demographic and

practice details. Results demonstrated some highly significant difference: for example, gender, providing diabetes care, access to diabetes management policies and guidelines and any attendance diabetes education programs. Compared to female nurses, male nurses had significantly higher perceived diabetes knowledge (t (2.94), p = 0.003), but lower actual diabetes knowledge (t (-1.95), p = 0.02). Compared to those who said they did not deliver diabetes care, nurses who reported current delivery of diabetes care had significantly higher scores for both perceived (t (6.41), $p < 0.001$) and actual diabetes knowledge (t (5.39), $p < 0.001$). Compared to those without access, those who had access to diabetes policies and guidelines had significantly higher scores for both perceived (t (5.14), $p < 0.001$) and actual diabetes knowledge (t (4.36), p = 0.03). Compared to those without specialist post-registration diabetes education, those who attended any diabetes education programs had significantly higher scores for both perceived (t (3.63), $p < 0.001$) and actual diabetes knowledge (t (2.08), p = 0.004) **(Table 1 and Table 2)**.

The total mean scores of perceived and actual diabetes knowledge according to country where the nursing education was obtained, highest qualification and perceived competency in delivery of diabetes care. Ex-patriate nurses scored significantly higher for perceived (F (3.94), p = 0.01) and actual diabetes knowledge (F (10.53), $p < 0.001$) than locally trained Saudi nurses. There was statistically significant difference in perceived diabetes knowledge according to highest education qualification; nurses with bachelor or masters degrees had significantly higher score for perceived (F (3.27), $p < 0.03$) and actual diabetes knowledge (F (8.78), $p < 0.001$) than nurses with only a diploma. However, nurses who reported poor competency with diabetes care scored significantly higher for both perceived (F (41.50), $p < 0.001$) and actual diabetes knowledge (F (9.66), $p < 0.001$) than those who evaluated themselves as having excellent, good and fair competency **(Table 1 and Table 2)**. Nurses' perceived and actual diabetes knowledge scores were examined in relation to their specialty groups using one-way Analysis of Variance (ANOVA) with *post-hoc* analysis using the using `*Scheffe* multiple comparison method. Significant differences were demonstrated in perceived diabetes knowledge between nursing groups (F= 3.52, df (4,418), p = 0.008), with the critical care group reporting significantly greater perceived diabetes knowledge than the medical

group. Statistically significant differences were demonstrated between nursing groups for actual diabetes knowledge of BGM, diabetes medications, diabetes diet/nutrition, diabetes foot care and complications (F= 3.73, df (4,418), p = 0.01). The medical group had significantly less accurate knowledge of BGM (F= 3.05, df (4.418), p = 0.03) and of diabetes medications (F= 4.44, df (4,418), p = 0.03) than the women and children's group, significantly more accurate knowledge of diabetes diet/nutrition than the ambulatory care group (F= 3.74, df (4,418), p = 0.01). The medical and surgical groups had significantly less accurate knowledge of diabetes foot care and complications than the critical care group (F= 4.74, df (4,418), p = 0.02) **(Table 3)**.

Factors explaining nurses' perceived and actual diabetes knowledge

Multiple linear regression analysis conducted to model factors explaining perceived and actual diabetes knowledge; regression equations for perceived and accurate diabetes knowledge were: *Constant value + (unstandardised coefficient "B" * predicted variables)*. The model that best explained perceived diabetes knowledge scores included perceived competency, current provision of diabetes care, education level and attendance at any diabetes education programs. The model that best explained better perceived diabetes knowledge = 39.74 + (3.41* perceived competency) + (-2.17 * provision of diabetes care) + (1.97 * degree level of education) + (1.97 * attended diabetes education programs). The model that best explained better actual diabetes knowledge scores included currently providing diabetes care, degree level education, perceived competency, gender (being female) and access to diabetes management policies or guidelines. The regression equation for accurate diabetes knowledge scores = 14.12 + (-2.37 * provision of diabetes care) + (3.15 * degree level of education) + (1.80 * perceived competency) + (2.81 * gender) + (-1.42 * access to diabetes management policies or guidelines). Regressing the dependent variables on the total scores of perceived and actual diabetes knowledge, the models explained 23% of the variation in perceived diabetes knowledge (F = 31.71, df (4, 418), p < .001, R^2 = 0.23), and about 17% of the variation in actual diabetes knowledge (F = 17.42, df (5, 417), p < .001, R^2 = 0.17).

Discussion

This study found differing patterns of knowledge and insight among nurses working in Saudi Arabia. Nurses generally saw themselves as well informed about the disease, but knowledge gaps existed and nurses' perception of what they knew of diabetes mellitus differed from what they actually knew. This poses a concern since it may significantly affect nurses' competency in caring for patients with diabetes. Numerous studies have found inadequacies in nurses' knowledge of diabetes (Drass et al., 1989; Findlow & McDowell, 2002; O'Brien et al., 2003; Yacoub et al., 2014). This is important because lack of knowledge among nursing staff may contributed to patients with diabetes receiving inadequate health care instruction. Nurses have responsibility to educate patients with accurate and up-to-date information; their knowledge should be maintained at an appropriate standard (Chan & Zang, 2007). This study indicated that nurses were more familiar with the practical skills of managing diabetes (such as BGM) than with theoretical aspects of the disease. This was also reported in a study which compared the knowledge of doctors and nurses in managing diabetes and found that questions relating to the physiology and complications of diabetes were scored higher by the doctors, whereas the nurses scored better on the questions relating to practical management of the disease (O'Brien et al., 2003). For at least a substantial proportion of the nurses, this indicates the presence of a gap between their knowledge of theory and of practice; nurses may know how to perform certain procedures but may not be aware of, or may be confused by, the underpinning theory.

This study found that nurses' actual knowledge of diabetes correlated positively but only moderately with their perceived knowledge of diabetes. This supports with the findings of Yacoub et al. (2014) about nurses' perceived and actual of diabetes knowledge, but was contrary to the study of Drass et al. (1989), which indicated a moderate low negative correlation between their perceived and actual knowledge of diabetes. Further, Baxley, Brown, Pokorny, and Swanson (1997) claimed that nurses' perception of knowledge was not significantly correlated with their actual knowledge. These studies support the need to have continuing in-services diabetes education programs that update nurses' knowledge and provide opportunities to obtain new information on diabetes, its care and management.

A gender difference appeared in the perceived and actual accuracy of responses. Male nurses perceived they had greater knowledge about diabetes, its care and management than female nurses, but they scored worse on the actual diabetes knowledge questions. This concurs with findings of a US study that reported lower female than male nurses' self-evaluations of performance and confidence levels regarding to educating patients (Beyer & Bowden, 1997). It is an important to understand the causes of negative self-perceptions amongst nurses that may enable nursing administration to improve the biases and achieving high quality of diabetes care (Beyer & Bowden, 1997). This suggests that 'unconscious ignorance' may pose a greater barrier to diabetes education for at least some males compared to female nurses. Study findings also revealed that nurses trained in Saudi Arabia had less knowledge about diabetes than ex-patriate nurses. This might be related to the quality of education in the country, which is always a major concern of Saudi officials (Khashoggi, 2014). Jiffry (2013) noted that a number of Saudi organisations preferred to employ ex-patriate health professionals, to be able to improve the quality of healthcare provided. This finding offers a challenge to the government to improve the educational system of the country, and thereby enhance the quality of the professionals produced, especially in the field of healthcare.

Nurses working in differing specialties reported differing patterns of diabetes knowledge. Those working in the medical specialty, for example, had less accurate knowledge of diabetes medications, foot care and complications than those working in women and children's, critical care, and surgical groups. Internationally, a number of barriers have been reported to contribute to nurses' failure to acquire or retain adequate diabetes knowledge. These include, lack of adequate training, lack of access to relevant resources, limited experiences in caring for patients with diabetes and poor attendance at diabetes continuing education (Alotaibi et al., 2016). These factors also featured for these nurses in Saudi Arabia and may at least have contributed to the differences in knowledge among and between groups of nurses. Intuitively, it might have been anticipated that medical nurses would have better knowledge of diabetes than nurses working in other specialties where patients with diabetes might be scarcer. One explanation for this might be the documented phenomenon of pressure on beds causing high movement and numbers of 'outliers' (patients warded outside their diagnostic specialty areas)

resulting in dilution of nurses' specialist skills (Duffield, Diers, Aisbett, & Roche, 2009). High workloads and low job morale have also been identified as barriers to nurses' knowledge of diabetes, its care and management (Alotaibi et al., 2016). It is important that hospitals focus on addressing these barriers, to enhance nurses' knowledge of diabetes. Several strategies may be implemented to enhance nurses' competence in diabetes care and management. Continuing education is an integral component in supporting nurses to update their knowledge of managing patients with diabetes (Gerard et al., 2010). One study suggested 'tailor-made' educational programs to meet the learning needs of each subgroup of nurses (Chan & Zang, 2007). In this study four factors were found to predict nurses' perceived knowledge of diabetes: education level, current provision of diabetes care, attendance at diabetes education programs and perceived competency. Factors predictive of accurate diabetes knowledge scores were identical but included gender. These results emphasise that clinical experience and continuing education are essential to ensure safe and effective care of patients with diabetes. A commitment to lifelong learning is a professional responsibility for nurses owe to themselves and to their patients if excellence and safety in practice is to be achieved (Witt, 2011). A similar point was made by El-Deirawi and Zuraikat (2001), who reported significant relationships between nurses' education and their knowledge of diabetes. The study findings suggest that overall nurses possess insufficient diabetes knowledge in some or all areas that preclude them from providing the full array of quality diabetes care in line with best practice recommendations or to teach patients appropriately.

Study limitations

This study used self-report tools to measure the perceived and actual diabetes knowledge of nurses, and it must be noted that self-report tools are prone to report bias. In addition, careful consideration must be given to the generalisability of results. The sample in this study comprised mostly ex-patriates, principally from the Philippines. Whilst this may reflect a common staffing profile amongst major Saudi Arabia acute hospitals, the small number of the sample cannot be generalized to Saudi nurses overall. Even though the study size was adequate, careful attention must be paid when comparing the results for sub groups and when considering the transferability of findings. Future studies could consider incorporating the effect of clustering and subsampling. Study findings reinforce the need for further research in

terms of knowledge, attitudes, behaviours and competencies among nurses working in Saudi Arabia and other Middle Eastern countries, particularly in light of the burden of diabetes among Middle Eastern populations.

Conclusions

The findings of this study suggest significant gaps between the perceived and actual knowledge of diabetes among nurses in Saudi Arabia, which is concerning as knowledge has a significant impact on nurses' ability in caring for patients with diabetes. These findings have important implications for nursing practice, policy and education. Factors likely to influence both perceived and actual of diabetes knowledge indicated potential success strategies likely to improve nurses' knowledge. These include increasing availability of degree level nursing education and access to specific diabetes education programs; providing skills training to enhance perceived competency; ensuring all staff have ready access to diabetes management policies or guidelines. Based on this, nurse managers should take opportunities to devise strategies to improve nurses' knowledge in all areas of diabetes care. The implications of this study for nurse managers and educationalist are that nurses' knowledge should be assessed in order to identify their specific learning needs, and these should be addressed in the education programs. Rotations could be arranged to provide opportunities to work with experienced diabetes clinicians and gain increased experience of providing diabetes care. When hiring new staff, those with degree level education could be preferred as they are more likely to have better knowledge. Finally, nurses themselves should be encouraged to take the initiative to explore and engage in all possible avenues to improve their knowledge regarding diabetes, as well-educated nurses can educate other nurses and can better contribute to patients' education and outcomes.

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Table 1: Participants' perceived diabetes knowledge scores in relation to demographic and practice related characteristics (N=423)

Variables		Mean (SD) perceived diabetes knowledge score	Test values	*df*	P-values
Gender	Male (n=78) Female (n=345)	48.6 (7.1) 46.4 (5.8)	*t* (2.94)	421	0.003**
Provide diabetes care	Yes (n=278) No (n=145)	48.1 (6.1) 44.3 (5.1)	*t* (6.41)	421	< 0.001***
Have access to diabetes management policies or guidelines	Yes (n=240) No (n=183)	48.1 (6.3) 45.1 (5.3)	*t* (5.14)	421	< 0.001***
Have attended diabetes education programs	Yes (n= 62) No (n=361)	49.4 (7.3) 46.4 (5.7)	*t* (3.63)	421	< 0.001***
Highest qualification	Diploma (n=56) Bachelor (n= 353) Master (n= 14)	45.4 (6.7) 46.9 (5.9) 49.7 (5.7)	*F* (3.27)	(2,420)	0.03*
Country where received nursing education	Philippines (n=338) India (n= 23) Saudi (n=30) Other (n=32)	47.3 (6.1) 45.9 (7.1) 43.6 (5.1) 45.8 (4.9)	*F* (3.94)	(3,419)	0.01*
Perceived competency in diabetes care	Excellent (n=7) Good (n=80) Fair (n=275) Poor (n=61)	46.1 (9.9) 43.5 (4.4) 46.4 (5.2) 53.4 (6.3)	*F* (41.50)	(3,419)	< 0.001***

Note: (*t*) T test, (*df*) decrease of freedom, (*F*) one -way ANOVA, (*) significant at 0.05, (**) significant at 0.01 & (***) significant at 0.001.

Table 2: Participants' actual diabetes knowledge scores in relation to demographic and practice related characteristics (N=423)

Variables		Mean (SD) actual diabetes knowledge score	Test values	df	P-value
Gender	Male (n=78) Female (n=345)	24.1 (6.9) 25.6 (6.1)	*t* (-1.95)	421	0.02*
Provide diabetes care	Yes (n=278) No (n=145)	26.5 (5.2) 23.1 (7.1)	*t* (5.39)	421	< 0.001***
Have access to diabetes management policies or guidelines	Yes (n=240) No (n=183)	26.4 (5.4) 23.8 (6.7)	*t* (4.36)	421	0.03*
Have attended diabetes education programs	Yes (n= 62) No (n=361)	26.8 (4.7) 25.1 (6.3)	*t* (2.08)	421	0.004**
Highest qualification	Diploma (n=56) Bachelor (n= 353) Master (n= 14)	22.3 (7.9) 25.7 (5.7) 28.2 (4.9)	*F* (8.78)	(2,420)	< 0.001***
Country where received nursing education	Philippines (n=338) Indian (n= 23) Saudi (n=30) Other (n=32)	26.1 (5.5) 23.2 (7.1) 20.6 (9.3) 23.1 (6.1)	*F* (10.53)	(3,419)	< 0.001***
Perceived competency in diabetes care	Excellent (n=7) Good (n=80) Fair (n=275) Poor (n=61)	17.7 (11.1) 23.6 (7.0) 25.5 (5.9) 27.8 (3.6)	*F* (9.66)	(3,419)	< 0.001***

Note: (*t*) t-test, (*df*) decrease of freedom, (*F*) one -way ANOVA, (*) significant at 0.05, (**) significant at 0.01 & (***) significant at 0.001.

Table 3: Questionnaire scores by nursing working groups

Mean (SD) scores	Medicine (*n*= 147)	Critical care (*n*= 115)	Surgery (*n*= 84)	Women and children's (*n*=53)	Ambulatory care (*n*= 24)	Total (n=423)
Perceived diabetes knowledge	46.2 (6.1)	48.8 (6.1)	46.9 (6.6)	45.5 (4.7)	45.7 (3.6)	46.9 (6.1)
Diabetes pathology/symptoms	5.7 (2.4)	6.2 (2.1)	5.9 (2.2)	6.1 (2.2)	5.9 (2.7)	5.9 (2.3)
BGM	4.1 (1.4)	4.4 (1.1)	4.2 (1.3)	4.7 (1.1)	4.2 (1.8)	4.2 (1.3)
Diabetes medication	6.8 (2.7)	7.7 (2.3)	7.3 (2.8)	8.2 (2.2)	6.3 (2.5)	7.3 (2.6)
Diabetes diet/nutrition	2.6 (1.1)	2.3 (0.9)	2.4 (1.1)	2.5 (1.3)	1.7 (1.1)	2.4 (1.1)
Diabetes foot care and complications	5.1 (1.5)	5.7 (1.2)	4.9 (1.7)	5.6 (1.3)	5.0 (1.3)	5.2 (1.4)

Note: BGM Blood Glucose Mentoring