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Diabetes Knowledge among University Nursing Students in the North of Jordan

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Abstract: The purposes of this study were to: assess the diabetes knowledge among university nursing students in the north of Jordan, assess the difference between students' knowledge of insulin-use and general knowledge about diabetes and identify significant predictors of diabetes knowledge. A cross-sectional design was used to assess the diabetes knowledge among nursing university students in the north of Jordan. A convenient sampling technique was used to recruit 134 nursing students. Diabetes Knowledge Test that contained two subscales; insulin-use and general knowledge subscales was used to collect the data from the participants. The results indicated that the mean of the diabetes knowledge was (M = 46.10%, SD = 14.4). Paired t-test showed there was a statistically significant difference t (133) = 3.50, p = 0.001 between the students' knowledge of insulin-use (M = 43.10, SD = 18.27) and general knowledge about diabetes (M = 48.29, SD = 15.15). Regression analysis revealed that gender and Grade Point Average were the only significant (p<0.001) predictors of diabetes knowledge. Grade Point Average significantly predicted 8% of the variance in diabetes knowledge among university nursing students. Diabetes knowledge among university nursing students in the north of Jordan was poor. More focused educational programs should be adopted in nursing curriculum in Jordanian universities to help improve nursing students' diabetes knowledge.

Key words: Diabetes knowledge, insulin-use, nursing students, Jordan

INTRODUCTION
Diabetes is a chronic condition that affects about 25 million people in the United States, or about 8.3% of the population with an estimated cost that exceeds 176 billion dollars for only the direct medical care (American Diabetes Association (ADA), 2013). In Jordan, diabetes is prevalent and is increasing. A National Centre for Diabetes, Endocrinology and Genetics (NCDEG) study showed that 36% of Jordanians aged 25 years and above are diabetic and the overall prevalence rate was 30%. The majority of people with diabetes in Jordan have substandard control (Ajlouni et al., 2008). People with diabetes are at high risk for complications that are life threatening such as heart disease and stroke (ADA, 2013).

Healthy People (2010) first goal regarding diabetes was to increase the percentage of people with diabetes who receive formal diabetes education, because the diabetic patient needs to make a variety of critical decisions on daily bases about diabetes. Informing and motivating the patient is necessary in managing the disease and reducing the risk of complications because the majority of clinicians consider that diabetes is a self-care management disease and that patients should be capable and responsible for taking care of themselves (Sousa et al., 2004).

Diabetes self management education is the cornerstone in promoting successful health-related outcomes (Mensing et al., 2006). People with diabetes acquire their knowledge from various resources such as nurses and formal diabetes self management educational programs (Odili and Eke, 2010). The relationship between diabetes knowledge and diabetes education is affected by many factors, like age, knowledge score, educational level and family income (Pasquier-Fediaevsky et al., 2002).

Norris et al. (2001) reviewed the effectiveness of self management training on various health related outcomes such as self care, lifestyle behavior, psychological and quality-of-life outcomes and glycemic control. In the review of literature, the authors found that diabetes education improved self care, intake of carbohydrates and fat, activity, problem solving ability, anxiety level, glycated hemoglobin measures and frequency and accuracy of self measurement of blood glucose. Furthermore, many studies found that diabetes education improved diabetes knowledge which may mediate or moderate the effect of diabetes education on the health related outcomes (Sousa et al., 2004; Sousa and Zauszniewski, 2005). In other words, diabetes knowledge is a prerequisite for planning effective diabetes management (Heisler et al., 2005).

Nurses have the responsibility for recognizing the acute complications of diabetes such as hypoglycemia and Diabetic Ketoacidosis (DKA) (Chan and Zang, 2007). Also, nurses have the responsibility to provide updated

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and correct knowledge about diabetes self-care management and lack of diabetes knowledge among nurses can contribute to insufficient instruction. However, studies showed that nurses are not adequately trained in diabetes management especially in the topic of insulin-use (O'Brien *et al.*, 2003; Rubin *et al.*, 2007).

Most hospitals in Jordan rely on staff nurses to provide diabetes education since these hospitals do not have formal Certified Diabetes Educator (CDE). Therefore, nurse's knowledge about diabetes care and insulin- use is very important. This nurse's knowledge is a reflection of what they learned about diabetes while they were in class. Also, nursing programs in Jordan require students' enrollment in clinical nursing courses, where the students learn and practice diabetes care and provide diabetes education to diabetic patients. In most of the curricula of the different Nursing Schools in Jordan, the topic of diabetes is covered once in three class-sessions in one of the core courses that is usually taught during the second year. However, students continue to care for people with diabetes over all their clinical courses. Also, searching various databases such as PubMed, EBSCO Host and CINHAL showed scarcity of studies that assessed the student's knowledge about diabetes in Jordan. Accordingly, the purposes of this study were: to assess diabetes knowledge among university nursing students in the north of Jordan, assess the difference between the students' knowledge of insulin-use and general knowledge and identify the significant demographic predictors of diabetes knowledge.

Literature review: Norris *et al.* (2001) published the National Standards for diabetes self management education. In these standards, diabetes knowledge was presented as an integral part of diabetes self management education. Also, Norris *et al.* (2001) indicated that assessment of diabetes knowledge is an important step that should be carried out at the earliest possible moment and should be an ongoing step throughout diabetes care programs to enhance collaboration and joint decision making. Some studies reported limited knowledge about diabetes. For example, Baxley *et al.* (1997) conducted a survey using a sample of 32 staff nurses employed at a rural area in the U.S to assess their perceived and actual knowledge about diabetes. The researchers found that the mean score of diabetes knowledge was 75% and that the staff's perceived knowledge was not correlated with their actual knowledge. The authors concluded that the level of diabetes knowledge is of concern.

Similar findings were reported by Chan and Zang (2007) who conducted a descriptive correlational survey and cluster analysis in Hong Kong and included 245 nurses who completed a structured questionnaire about their perceived and actual diabetes mellitus knowledge. In their cluster analysis, the researchers found a gap in nurse's actual level and perceived level of diabetes knowledge. Chan and Zang (2007) also found that there were nurses with moderate to low level of competence in diabetes knowledge.

While there was a study that addressed the level of knowledge about diabetes among patients in Jordan (Al-Sarihin *et al.*, 2012), no studies examined the knowledge among nursing students. One study (Al-Sarayra and Khalidi, 2012) was conducted in Jordan to assess the awareness about diabetes amongst the overall students in the University of Albalqa. However, the sample, the setting and the tool were different from what was used in this study.

In summary, diabetes knowledge was primarily assessed in people with diabetes, while there is scarcity of the studies that assessed diabetes knowledge among nursing students. In Jordan, diabetes is a major concern due to its extreme prevalence. However, the number of studies that addressed diabetes knowledge among students in health care professions including nursing was inadequate. Therefore, it is essential to assess the level of diabetes knowledge among nursing students.

MATERIALS AND METHODS

Design: A cross-sectional descriptive design was used to: assess the level of diabetes knowledge among university nursing students in the north of Jordan, assess the difference between students' knowledge of insulin-use and general knowledge about diabetes and identify significant predictors of diabetes knowledge.

Participants: A convenient sampling technique was used to recruit nursing students enrolled in the baccalaureate nursing program in a Faculty of Nursing in the north of Jordan. All nursing students were eligible for the study if they were 18 or more years old. Sample size was calculated using G* power software (Faul *et al.*, 2007). A medium effect size is required for the purpose of this study which was (0.15). The sample size was determined according to the power level which was 0.80 and the use of conventional $\alpha = 0.05$ two tailed criterion of the significance. Based on the sample size determination technique, a sample of at least 128 nursing students was required for this study.

Setting: This study was conducted in a Faculty of Nursing in the north of Jordan. This Faculty offers the baccalaureate nursing program which is a 4-year program requiring 134 credit h. The program is accredited both locally and internationally. English is the language of teaching in the School of Nursing and the textbooks used for all the core classes are English books.

Research tool: A self-administered questionnaire was used for data collection to achieve the purposes of the study. The questionnaire is composed of the Diabetes Knowledge Test (DKT) and the demographic sheet. The DKT questionnaire was used to assess the level of diabetes knowledge among the nursing students. It was developed by the Michigan Diabetes Research and Training Center (MDRTC) in 1990s and tested for reliability and validity by Fitzgerald *et al.* (1998). The Fitzgerald *et al.* (1998) reported that the DKT represents a test of general knowledge of diabetes. The test consists of 23 knowledge test items that comprise two subscales; the general test and insulin use subscales. The first 14 items comprise the general test and the remaining 9 items comprise the insulin-use subscale.

The items of the DKT have either 3 or 4 choices and only one choice is correct. For each correct answer one point was assigned. The missing items were scored as incorrect. The score was calculated out of 100 for each person by dividing the number of correct items by the number of applicable items and multiply the result by one hundred; giving the scale a possible range of 0 to 100; higher score indicates higher diabetes knowledge. Fitzgerald *et al.* (1998) developed and assessed the validity and the reliability of the DKT. Content validity of the test was established by a panel of experts. The researchers found that the reliability coefficients for the general test and insulin-use subscales were greater than. 70 in the total sample and the 2 sub-samples of the study. To test the validity of the DKT, three hypotheses were formulated and tested. The results supported the validity of the test. KR 20 for the DKT scale was measured to assess the scales reliability in this study; KR 20 was 0.85

The participant demographic characteristics that were measured in this study are self reported, age in years, gender and number of years of formal education completed, work status, marital status, Grade Point Average (GPA), family history of diabetes, whether they have diabetes and other demographics. The estimated time to complete the questionnaires was approximately 20 min.

Data collection procedure: Human Subject Committee approval was obtained from the Institutional Review Board of the University prior to data collection. Research assistants (RAs) were trained for data collection. The RAs were instructed to approach the students toward the end of their classes in the Faculty of Nursing. The RAs provided a brief description of the study and invited the students to participate. The students, who agreed to participate, received a questionnaire package. A cover letter containing a summary of the study, the participant's rights and the researcher's contact information was included with the questionnaire package. The cover letter also encouraged the participants to complete the questionnaire and returned it as soon as possible to the RAs. The RAs were instructed to keep the interactions between the students at the minimum level during filling of the questionnaire.

Ethical issues: The study method and protocol were reviewed and approved by the Faculty of Nursing Research Committee for Protection of Human Subjects and by the institutional review board. Written informed consent was obtained from all the participants in the study. The participants received both verbal and written information about the purpose; content and extent of the study. The confidentiality of the participants was protected by providing code number for each participant at the stage of data collection and analysis. In addition, the collected questionnaires were kept in a locked cabinet to keep the participants information private and confidential. Participants' participation was completely voluntary and they were assured that their responses will be confidential. All questionnaires were disposed off after study completed.

The participants were informed that they had the right to withdraw from the study at any time without any effect on their achievement. The participants were informed that the demographical data and information regarding the diabetes knowledge will be collected. Also, the procedure of data collection process was explained. The information regarding the estimated time of contact and the number of contacts with participants was provided. The total number and the selection process of participants were communicated to all participants. No risk affected the participants, since the data collection process mainly relied on a descriptive questionnaire.

Data analysis: Statistical Package of Social Science (SPSS) Version 17 was used to analyze the data (SPSS, Inc., Chicago, IL, USA, 2007). Descriptive statistics including mean (M), standard deviation (SD) and percent (%) were used to describe the sample characteristics and to assess the level of diabetes knowledge among nursing students. Paired t-test was used to assess if there was any statistically significant difference between the student knowledge of insulin-use and general knowledge about diabetes. In addition, Standard multiple linear regression was used to identify the significant predictors of the diabetes knowledge among nursing students.

RESULTS

A convenient sample of nursing students (N = 134) participated in this study. The mean of student's age was 20.68 years (SD = 1.70). Approximately 81% of the sample was females (N = 108). The majority of the students were in the third and the fourth year (N = 84). Most of the students were unemployed (N = 122) and single (N = 126). Around two-thirds of the participants

Table 1: Sample characteristics; mean (M); standard deviation (SD) and percent (%) for the nursing students in the north of Jordan (N = 134)

Variables	Range	M (SD)	N	%
Age (Years)	18.00-29.00	20.68 (01.70)		
Gender				
Male			26	18.80
Female			108	81.20
***Educational level**				
First year			21	16.30
Second year			24	18.60
Third year			49	38.00
Forth year			35	27.10
***Work status**				
Working			9	6.90
Not working			122	93.10
Grade point average	56.00-86.00	70.33(6.65)		
***Marital status**				
Single			126	95.50
Married			6	4.50
***Relative with D.M**				
Yes			87	65.90
No			45	34.10
Attended workshop			21	16.00

M: Mean, SD: Standard Deviation
N: Number, *: Indicates a missing data of 2-5 cases from the total sample

have relatives with D.M (N = 87). Only one student reported to have diabetes. In addition, only 15% (N = 21) had attended a workshop about diabetes. The sample characteristics are presented in Table 1.

The total knowledge score among nursing students in the north of Jordan was (M = 46.10%; SD = 14.44). Paired t-test indicated that there was a statistically significant difference t (133) = 3.50, p = 0.001 between the students' knowledge of insulin-use (M = 43.10, SD = 18.27) and general knowledge about diabetes (M = 48.29, SD = 15.15) (Table 2).

Standard multiple linear regression was used to identify the significant predictors of diabetes knowledge among nursing students in the north of Jordan. All the assumptions of multiple linear regressions were examined and met. First, knowledge, GPA and age were measured using interval level and they were normally distributed. The skewness levels for knowledge, age and GPA were -0.02, 0.40, 0.50 respectively, demonstrating an acceptable skewness level (Waltz *et al.*, 2005). Second, applying scatter plot and Pearson product-moment correlation, the results indicated that the correlation among all the pairs of the previous variables was linear. Third, bivariate scatter plot showed that the variance in knowledge was homogenous across all levels of the other variables in which the homoscedasticity assumption was met.

Forth, the interactions between the variables of interest were not significant and thus the interaction term was not included in the regression analysis. Fifth, the standardized residuals graph showed that the points in the plot had fairly uniform band from left to right and the standardized residual was between -3 and 3. Sixth, no

significant multicollinearity appeared. The tolerance was from 0.75 to 0.96 and the very inflation ratio was from 1.03 to 1.50. Gender, work, marital status, relative with diabetes and workshop attendance were nominal variables. These variables were considered as dummy. The results showed that the overall multiple linear regression, including knowledge, age, GPA, gender, work, marital status, educational level, relative with diabetes and workshop attendance was statistically significant. Multiple R = 0.45, R^2 = 0.19, adjusted R^2 was 0.15, F (8, 120) = 3.72; p<0.001. This shows that 15% of variance in knowledge was accounted by all predictors. To examine the contributions of each single predictor, the t ratio for the individual regression slope was assessed. Grade Point Average t (120) = 9.51; p<0.001 was a statistically significant predictor of knowledge when other variables were statistically justified. The only significant predictor of knowledge was the GPA. The proportion of variance explained by GPA was about 8%. The slope for the raw score of GPA was 0.58, demonstrating a 0.58 increase in knowledge for one unit increase in GPA. In addition, the results indicated that gender was a statistically significant predictor of knowledge t (120) = -2.40; p = 0.01. It explained about 4% of the variance in the diabetes knowledge. However, as mentioned in the sample characteristics, most of the sample was females (N = 108, 81%). The results of the multiple linear regressions are summarized in Table 3.

DISCUSSION

The purpose of this study was to assess the level of diabetes knowledge among nursing students in the north of Jordan. The Diabetes Knowledge Test was used to assess student's level of knowledge. This test is composed of two subscales; the general knowledge about diabetes and insulin-use knowledge. The results of this study showed that the students' knowledge can be described as poor because the majority of the students scored low on the scale. Also, the students' knowledge on the two subscales were also poor. Students received lower scores on insulin use compared to the general knowledge. No studies, especially in the Middle East in or in Jordan, addressed nursing student's knowledge about diabetes.

Although no studies were conducted in Jordan that assessed the level of diabetes knowledge among nursing students, one study was conducted to assess level of diabetes knowledge among collage students. Al-Sarayra and Khalidi (2012) found that the college students at Al Balqa University had poor knowledge regarding diabetes and that students lacked awareness of many aspects of diabetes. However, no nursing students participated in this study. Trepp *et al.* (2010) reported similar findings to the current study regarding nurses and nursing students' knowledge about diabetes. In their study, they reported that nursing

Table 2: Paired t-test to assess the significant difference between the student knowledge of insulin use and general knowledge about diabetes

Variables	M (SD)	Range	t (df)	p
Total diabetes knowledge	46.10 (14.14)	08.70-78.26		
General knowledge	48.29 (15.15)	07.14-78.57	3.39(133)**	0.001
Insulin knowledge	43.10 (18.27)	00.00-88.00		

**p≤0.001 level (2-tailed)

Table 3: Standard multiple linear regression analysis to find out the significant predictors of diabetes knowledge among nursing students in the north of Jordan (N = 129)

Predictor	b (Unstandardized coefficients)	B (Standardized coefficients)	Variance	t	p-value	95% Confidence interval for B
Grade point average	0.58	0.27	0.080%	3.20**	<0.001	-63.92-22.70
Age	0.68	0.08	0.004%	0.67	0.44	-01.07-02.44
Gender***	-7.76	-0.20	0.040%	-2.40*	0.01	-14.14-01.37
Work***	-4.69	-0.08	0.005%	-0.93	0.34	-14.55-05.10
Education level	2.71	0.03	0.026%	1.93	0.06	-00.07-05.49
Marital status***	2.48	0.03	0.001%	0.41	0.68	-09.52-14.48
Relative with D.M***	3.97	0.13	0.014%	1.54	0.12	-01.13-01.07
Workshop***	3.69	0.09	0.008%	1.09	0.27	-02.96-10.35

***Gender, work and marital status, relative with D.M and workshop are dummy coded dummy variable

*p = 0.05 level (2-tailed). **p = 0.001 level (2-tailed)

students scored low on all the diabetes knowledge aspects measured by their knowledge questionnaire (insulin therapy, hypoglycemia, targets, oral hypoglycemic agents and ketoacidosis). Trepp *et al.* (2010) attributed the lack of knowledge to the insufficient continuing education for health care personnel.

Other studies in the literature assessed nurse's knowledge about diabetes such as Chan and Zang (2007) who reported in their cluster analysis that nurses' knowledge regarding diabetes ranged from high level to low level of competence. However, this study is reporting nurse's knowledge and not student's knowledge. In Jordan, studies primarily focused on patient's level of knowledge such as Al-Sarihin *et al.* (2012). The Diabetes Knowledge Test was used in this study and results indicated a deficit in diabetes knowledge. The overall scores of the level of diabetes knowledge among the study sample were low with a mean of 49.8 and SD of 13.4. The mean of the general diabetes knowledge was 54 with an SD of 14. Whereas, the mean score of insulin-use knowledge was 43 with an SD of 19.6.

The Diabetes Knowledge Test is composed of two subscales; the general knowledge and the insulin-use subscales. In this study, a significant difference between students' knowledge regarding the two subscales was found. This finding is expected because literature indicated that insulin use requires more complex capabilities to perform specific self-care activities (Sousa *et al.*, 2004).

The regression analysis showed that among the assessed demographic factors, only gender and students GPA were the significant predictors of students' level of diabetes knowledge. We are not aware of a research study that addressed the factors affecting

nursing students' level of knowledge about diabetes. However, studies demonstrated that students GPA was significantly and positively correlated with better awareness. Durongritichai (2012) found that GPA significantly predicted university student's awareness about HIV.

American Diabetes Association (2012) identified diabetes self-management education (DSME) as a standard of medical care for people with diabetes. DSME was found to improve knowledge, self care behaviors and clinical outcomes such as glycated Hemoglobin, quality of life, healthy coping and lower cost. Funnell *et al.* (2010) identified the national standards for DSME on 2010 as part of the task force effort to update these standards every 5 years. In the current updated standards of DSME, the instructional staff was identified as an integral part of the process of diabetes education. The instructional staff included many disciplines like nursing, dietitian and pharmacists. Members of these disciplines who deliver DSME should receive specialized diabetes and educational training with documentation of continuing education. The findings of this study showed a concern about the insufficiency of the nursing students to contribute into the formal diabetes education. In addition, the findings became of more concern because the study by Trepp *et al.* (2010) found that no progression in diabetes knowledge was found from student nurses to graduate nurses.

Study Limitations, Recommendations and Implications Several study limitations were identified such as the limitation of the instrument used to measure the level of diabetes knowledge. The DKT was used to assess student's knowledge. This questionnaire was developed

in the 1990s and could be out of date. However, several studies till now use this questionnaire to assess basic knowledge about diabetes. Also, the questionnaire was delivered in its original language; English, whereas the native language of the students was Arabic. The variation between the instrument language and the native language could have contributed to some confusion regarding the questions or the answers. However, the reason for delivering the questionnaire in English is that the primary language of teaching in the classes was primarily delivered in English.

The study was a descriptive cross-sectional design. Shadish *et al.* (2002) indicated that the use of cross sectional study may introduce threat to the internal validity of the study. More robust designs can be used in future studies to assess diabetes knowledge using longitudinal design. Another limitation was the use of convenience sample which may limit the generalizability of the study findings. The results of the current study recommend that it may be worth to replicate this study using larger and more heterogeneous randomly selected sample. This study has direct and important implications in nursing education since diabetes mellitus is a core and essential topic that is included in nursing curriculum and taught in Jordanian universities. Nursing curriculum in Jordanian universities should be modified to include focused and specific educational programs that improve the general knowledge about diabetes and the insulin use related knowledge among university nursing students in Jordan.

Conclusion: The results of this study revealed that the diabetes knowledge among university nursing students in the north of Jordan was inadequate. More focused diabetes educational programs should be included in nursing curriculum in Jordanian universities, which may help improve nursing students' diabetes knowledge. The educational programs may help equip nursing students with the required information that may help reduce the burden of diabetes on the society.

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