Original Article

Self-Efficacy in Drug Dosage Calculation among Undergraduate Nursing Students

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Abstract

Context: Inappropriate drug dose calculations indicate high risk of medication errors. Students and experienced nurses often lack confidence in math calculations. Assessing students' self-efficacy regarding drug dose calculations is crucial for implementing effective changes in educational course. **Aim:** We aimed to evaluate the self-efficacy and knowledge of students about drug dose calculations. **Settings and Design:** The descriptive survey-based study included 100 undergraduate students of second year BSc Nursing, from the selected nursing colleges in Karad. **Materials and Methods:** Purposive sampling technique was used and collected data were analyzed using Instat software. **Statistical analysis:** Statistical analysis was performed using Instat software. **Results:** Out of 100, only 19% subjects were confident during calculations, whereas 86% were confident while administering drugs and 13% were competent during calculations, whereas 82% were competent while administering drugs. Subjects who performed calculations incorrectly were less confident than those who performed correctly. Knowledge scores of students were significantly associated with age. **Conclusion**: Students definitely face difficulties in drug dosage calculations. They exhibit less confidence and poor competence in math abilities. To improve their self-efficacy emphasis should be given on more practice sessions and effective curriculum. There is a great need for interventional research on large scale.

Keywords: Self-efficacy; Drug dosage calculation; Undergraduate nursing students; Confidence; Competence

Introduction

As defined by psychologist Albert Bandura, self-efficacy is a personal judgment of "how well one can execute courses of action required dealing with prospective situations". To this, educator Kathy Kolbe adds "Belief in innate abilities means valuing one's particular set of cognitive strengths". It also involves determination and perseverance to overcome obstacles that would otherwise interfere with utilizing those innate abilities to achieve goals. It strongly influences both powers: a person has to face challenges competently and the choices most likely to be made. [1] It lies at the center of Bandura's social cognitive theory that emphasizes the role of observational learning and social experience in the development of personality. The main concept in social cognitive theory is that in almost every situation, an individual's actions and reactions, including social behaviors and cognitive processes, are influenced by the actions that individual has observed in others. Because self-efficacy is developed from external experiences and self-perception and is influential in determining the outcome of many events, it is an important aspect of social cognitive theory. Self-efficacy represents the personal perception of external social factors. According to Bandura's theory, people with high self-efficacy-those who believe they can perform well-are more likely to view difficult tasks as something to be mastered rather than something to be avoided. [1]

Medication calculation errors are common administration mistakes made in nursing as the ability to competently and accurately complete drug dosages is often lacking. Medication administration is a large part of providing patient care for both nursing students and registered nurses, and findings show that errors in administration make up 26%–38% of all medication errors. Approximately one in every six medication errors is a result of miscalculations, and in 2003, the American Food and Drug Administration stated that approximately 41% of all medication errors were due to inappropriate drug calculations. [2]

There have been no reviews of the literature on medication errors in practice that specifically look to see whether the medication errors are caused by nurses' poor calculation skills. [3] Most researchers who study drug dose calculation skills of nursing students and their mathematical or computational ability have analyzed the dose calculation errors from conceptual, mathematical, and measurement perspectives. [4]

Need for the study

Studies suggested that nursing students' level of medication calculation skill is problematic, and nursing students often struggle with a low sense of math self-efficacy. [2] To increase the safety of medication care of patients, research focusing on the development of effective teaching methods is needed. This study produced information for future nursing education research in this field, especially for interventional studies. [5]

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Nursing programs play a remarkable role in strategizing constructive approaches to ensure that their students are able to accurately conceptualize and confidently perform drug dosage calculations; this is highly crucial because main aim of nursing programs is to graduate nurses who are confident and competent in a variety of skill sets, including medication calculation. This is essential as nursing students are the future workforce of the nursing profession and must be able to demonstrate competence in every aspect of their practice. [2] Herein, we attempted to evaluate self-efficacy of undergraduate nursing students in a given setting.

Problem statement

A study to evaluate self-efficacy of undergraduate nursing students in drug dosage calculations.

Objectives of the study

- To find out knowledge about drug calculation of undergraduate students of selected nursing college at Karad.
- To observe practices about drug calculation and administration conducted by the students.
- To find out association between knowledge score and selected socio-demographic variables among the students.

Subjects and Methods

The present study is based on a descriptive survey design and was conducted in a tertiary care hospital and nursing college in Karad. The study included a total of 100 undergraduate students from selected colleges at Karad. Purposive sampling technique was used for sample selection.

The study included only those undergraduate students studying in the 2nd year of Basic BSc Nursing at selected colleges at Karad, willing to participate in the study, and present during data collection period. Those not willing to participate were excluded from the study. The students were not allowed to use the calculators.

Data were collected using close-ended questionnaire and observational check list.

A structured questionnaire was prepared by investigator to be used as an instrument in the study. The instrument comprised three parts:

Section I consisted of socio-demographic variables of the sample. The following socio-demographic variables were considered: name, age, sex, education, religion, residence, grades received in Math in the first year, parents' educational background and occupation, and the student's marital status. It was assumed that the knowledge of samples was driven by the following variables.

Section II consisted of multiple questions based on knowledge and arithmetic skills in calculating drug dosage using various formulas. The following formula was used for the calculation; dose to be administered/stock strength=no. of tablets.

Section III consisted of observational check list in drug dosage calculation while administering the drugs. The checklist included factors such as identifying patients and drugs correctly, confirming doses according to the advice by doctors and senior staff, calculating drug dose correctly using appropriate formula, diluting the drugs and preparing appropriate dose whenever necessary, evaluating confidence and competence in drug dose calculation, and recording/reporting correctly.

All the data were collected by the investigator. Prior to the data collection, the study was approved by the institutional ethics committee. A letter from chairman of institutional ethics committee KIMSDU Karad was obtained after presentation and approval. The researcher obtained permission from the present institution to conduct the research study. Written consent was obtained from the subjects before the data collection. The subjects confirmed to keep the data confidential.

Statistical analysis

All the data were computed, and the answers were coded in a Microsoft Excel spread sheet. The data were analyzed by various tools in the Microsoft excel; statistical analysis was performed using Instat software.

Operational definitions

Assess: In this study, it refers the statistical measures of identifying the outcome.

Knowledge: It refers to the response of college students to the questionnaire regarding drug dosage calculation.

Competency: This refers the ability to do something well.

Confidence: This refers to the quality of being certain of your abilities or of having trust in people, plans, or the future.

Results

Out of the 100 subjects, 22% were males and 78% were females. Of all, 4% were 18 years old; 58%, 19 years old; 31%, 20 years old; 6%, 21 years old; and 1%, 22 years old. All the subjects (100%) had opted for Science in their 12th standard. Out of these 100 subjects, 59% and 41% belonged to rural and urban areas, respectively, as their permanent residence. 50% of the sample population were Hindu; 48%, Christian, and 2% Muslim.

In terms of math in 12th Science, 38% did not have math as a subject. Out of the 62 subjects, 5%, 7%, 26%, 19%, 1%, 2%, and 2% had grades A, A+, B, B+, C, C+, and D, respectively.

Section I: Tables 1 and 2 represent classification of the subjects based on their parents' educational background and occupation.

Section II: Table 3 represents the data analyzed for evaluation of the subjects' knowledge related to drug dosage calculation.

Two-tailed P-value was <0.001, which was considered statistically significant. Table 4 represents classification of the subjects based on their knowledge related to drug dosage calculation.

Section III: In terms of the observation check list, 100% subjects correctly identified patients. With an exception of one subject, 99% correctly identified the drugs. Of all, 86% confirmed the doses with doctors and senior staff, whereas 14% did not; 18%

Table 1: Classification of the subjects according to patients' educational background.

Educational background	Mothers	Fathers
No formal education	1%	2%
Primary education	10%	3%
Secondary education	32%	36%
Higher secondary education	35%	38%
Graduation	22%	18%
Post-graduation	-	2%
Not answered	-	1%

Table 2: Classification of the subjects according to their parents' occupation.

Father's occupation	Percentage
Army	2%
army Ex serviceman	1%
Attendant	1%
Bank officer	1%
Business	7%
Carpenter	1%
Chef	1%
Civil engineer	1%
Contractor	2 %
Driver	8%
Electrician	3%
Expired	10%
Farmer	37%
Government service	2%
manager	1%
mason	1%
mechanic	1%
MRF employee	1%
not working(paralyzed)	1%
PA to manager in private	1%
Painter	3%
Photographer	1%
postman	1%
sealing work	1%
single parent (mother)	1%
store keeper hospital Saudi Arabia	1%
supervisor	2%
Tailor	1%
Clark	1%
welder	5%
Mother' occupation	**Percentage**
Business	1%
CDAC admin	1%
DTP work	1%
Expired	2%
House wife	88%
Lab technician	1%
Nurse	3%
Primary teacher	1%
Sales woman	1%
service/canteen	1%

N = 100

correctly calculated drug dosage using appropriate formulas, whereas 82% could not correctly calculate. Moreover, 61% subjects could correctly dilute the drugs and prepare appropriate dose whenever necessary, whereas 39% could not.

While calculating a drug dose, 19% subjects were confident and 81% were not; while administering a drug dose, 86% were confident and 14% were not. While calculating a drug dose, 13% were competent and 87% were not; while administering a drug dose, 82% were competent and 18% were not. All the subjects (100%) correctly recorded/reported the data.

Table 3: Statistical data analysis.

Mean ± SD	2.02 ± 1.792
Standard error of the mean	0.1792
Lower 95% CL	1.664
Upper 95% CL	2.376
Minimum	0 0
Median	0 2
Maximum	0 4

Table 4: Classification of the subjects according to their knowledge.

S. No	Items	Frequency percentage	
		Yes	No
1	Describe various formulas used to calculate drug dosage before administration	60%	40%
2	Dose to be given/ stock strength = No of tablets	58%	42%
3	Drip rate (Drops /Min) = volume (ML) X drops per ML/ Time (hour) X60	42%	58%
4	Calculating Mixtures and solutions=Desire dose /stock strength X stock volume	42%	58%

"Yes" represents the subjects who responded correctly; whereas "No" represents the subjects who responded incorrectly. Moreover, out of the 100 subjects, 60% correctly used the formulas, whereas 40% could not. Also, 40% of the subjects gave no correct answers, whereas 15, 6%, and 38% gave two, three, and four correct answers, respectively.

Table 5: Classification of the subjects based on the association between socio-demographic variables and knowledge score.

Age	Knowledge score				
	0	1	2	3	4	**Total**
18	1	0	3	0	0	4
19	21	0	10	4	23	58
20	15	0	3	1	12	31
21	2	0	0	1	3	06
22	1	0	0	0	0	1
Total	40	0	16	6	38	100
Chi score 79.164, P value is < 0.0001 significantly associated						
Sex	Knowledge score					
	0	1	2	3	4	Total
Male	7	0	3	1	11	22
Female	33	0	13	5	27	78
Total	40	0	16	6	38	100
Chi score 2.360, P value is < 0.8838 not significantly associated						
Religion	Knowledge score					
	0	1	2	3	4	Total
Hindu	20	0	6	2	22	50
Christian	20	0	10	4	14	48
Muslim	0	0	0	0	02	02
Total	40	0	16	6	38	100
Chi score 2.614, P value is < 0.4550 not significantly associated						
Residence	Knowledge score					
	0	1	2	3	4	Total
Rural	25	0	9	1	24	59
Urban	15	0	7	5	14	41
Total	40	0	16	6	38	100
Chi score 2.143, P value is < 0.7095 not significantly associated						
Math Grade	Knowledge score					
	0	1	2	3	4	Total
A	4	0	0	0	3	7
A+	2	0	2	0	1	5
B	9	0	2	2	6	19
B+	12	0	4	2	8	26
C	2	0	0	0	0	2
C+	1	0	0	0	0	1
D	1	0	0	0	1	2
No Math	9	0	8	2	19	38
	40	0	16	6	38	100

Chi score 5.874 P value is < 0.4375 not significantly associated

Mother	Parent's education background					
	0	1	2	3	4	Total
No formal education	1	0	0	0	0	1
Primary	4	0	1	1	4	10
Secondary	13	0	5	1	13	32
Higher secondary	14	0	5	1	15	35
Graduate	8	0	5	3	6	22
Post graduate	0	0	0	0	0	0
Total	40	0	16	6	38	100

Chi score 3.367 P value is < 0.7615 not significantly associated

Father	Parent's education background					
	0	1	2	3	4	Total
No formal education	2	0	0	0	0	2
Primary	1	0	0	1	1	3
Secondary	20	0	4	1	11	36
Higher secondary	13	0	6	2	17	38
Graduate	4	0	6	1	7	18
Post graduate	0	0	0	1	1	2
Not answered	0	0	0	0	1	1
Total	40	0	16	6	38	100

Chi score 2.280 P value is < 0.6845 not significantly associated

Mother	Parent's occupation					
	0	1	2	3	4	Total
House wife	34	0	14	6	34	88
Private	3	0	0	0	3	6
Expired	1	0	0	0	1	2
Nurse	1	0	2	0	0	3
Business	1	0	0	0	0	1
Total	40	0	16	6	38	100

Chi score 11.613.280 P value is < 0.0030 significantly associated

Father	Parent's occupation					
	0	1	2	3	4	Total
Government service	0	0	0	1	4	5
Farmer	14	0	7	0	16	37
Expired	5	0	1	1	3	10
Private sector	17	0	4	3	11	35
Business	4	0	3	1	2	10
Not working	0	0	0	0	1	1
Working abroad	0	0	1	0	0	1
Single parent	0	0	0	0	1	1
	40	0	16	6	38	100

Chi score 1.583 P value is < 0.4531 Not significantly associated

From Table 5, it is evident that the correlation between knowledge of undergraduate students regarding drug dose calculation and the socio-demographic variable of age is statistically significant. On the other hand, the correlation between Chi-square values of knowledge of the students and other socio-demographic variables in the present study was statistically insignificant. The subjects who could not correctly perform drug dose calculations were more anxious and less confident than those who could.

Discussion

Students' and nurses' low knowledge scores in drug dose calculation is a serious issue that can lead to severe medication errors or ultimately death. The present study emphasizes that self-efficacy, confidence, and competence should be considered as key expertise of students and nurses and must be addressed through effective nursing curriculum and training sessions. With respect to the literature review, the present study suggests that it is highly necessary to understand the reasons of drug dose calculation and medication errors by implementing a standardized reporting approach. [6]

Knowledge of students can be improvised by implementing effective teaching methods and practical approaches. This is supported by a study conducted by Deepa who studied effectiveness of planned teaching program with respect to drug dose calculation in a total of 30 students in the fourth year of BSc in Hyderabad. They found out the knowledge of students

regarding drug dose calculation was inadequate. [7] Another study established that nursing knowledge should be reviewed to increase proficiency of drug dose calculation and better pharmacological knowledge. [8] This implies that students' knowledge and self-efficacy in drug dose calculation should be improved by constructive teaching methods.

Özyazıcıoğlu et al. conducted a study to evaluate knowledge of 148 students in the third year of BSc regarding pediatric dose calculation; nearly 38% students majorly lacked knowledge of four basic operations of math and could not perform drug dose calculations correctly. [9] The present study implies the necessity of additional math courses, sessions, and exercises by students to obtain better understanding and confidence in drug dose calculation.

Mathematic is an integrated part of drug dose administration; it is often neglected as unimportant. However, administering incorrectly calculated dose to a patient may lead to drastic medical errors. [10] In the United States, such incorrect math calculations affect over 1.3 million people, killing one person on a daily basis. According to a study conducted in 2012, over 65% to 87% of medication errors mainly occur during drug prescription and administration. In nursing, nurses' 40% of time is associated with drug administration, yet nursing students have been reported to be performing poorly in math examinations throughout their course of education. [11]

In a study by Sulosaari et al. various factors associated with competence of nursing students at the commencement and end of their educational course were studied. [5] As reported, the factors of medication errors remarkably correlate with each other; this underlies the need of providing integrated extensive medication education throughout students' undergraduate courses. Medical teaching staff should design and practice productive methods to successfully identify and guide students with math anxiety or other relevant medication difficulties to increase students' self-efficacy in drug dose calculation in order to eliminate life-threatening errors.

In a quasi-experimental study, researchers studied the complex correlation of math calculations and self-efficacy of a total of 80 nursing students. The study also revealed various difficulties faced by nursing educators striving to stimulate self-efficacy in nursing students. Socio-demographic variables, such as age, sex, math grades in previous standards, and parents' occupation, should be taken into consideration while designing nursing curriculum that promotes self-efficacy, confidence, and competence among students regarding their mathematical abilities.

Our findings suggest that students with high self-efficacy better performed calculations than those with low self-efficacy. As students' anxiety rose, their performance and knowledge scores decreased. [12] These findings are supported by those of another study. Røykenes and Larsen studied knowledge of students and their self-efficacy in terms of math ability in a total of 116 students studying in first year of BSc Nursing. Their results reported a significant positive correlation between the knowledge and self-efficacy. Research shows that nursing students lack mathematical accuracy and problem-solving ability irrespective of their educational background. Self-efficacy in drug dose calculation is an important factor. It is crucial for students to be confident and competent to have high self-efficacy during calculations for performing to fullest of their potential and proffer optimal medication care to patients. [13]

The present study has several implications. During the final year of education or start of employment, students and/or nurses should be assessed for their self-efficacy in drug dose calculation. They must be provided with means to update their knowledge. Constructive training sessions and hands-on training should be implemented in nursing curriculum for students to spend more time in understanding drug dose calculations, ultimately increasing their confidence and competence and patient safety. Teaching staff and nursing faculty must ideally be proficient in math and drug dose calculations to better mentor students and prepare nurses with better expertise for the future.

However, the present study imposes a limitation. The study included total 100 undergraduate students, which is a considerably small sample size. Thus, the study findings cannot be generalized. Further research using larger sample size will help validate the findings.

Conclusion

Nursing students are often less confident and competent in math and face difficulties in drug dose calculations. To improve their self-efficacy, more emphasis should be given on productive practice sessions. Curriculum for nursing students should be redesigned to focus on and enhance students' math abilities. It is necessary to find different educational methods to overcome this issue, indicating a great need of interventional research on large scale.

Competing Interests

The authors declare that they have no competing interests.

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