there is a need to conduct interventions to increase students' drug dosage calculation power (13).

On the other hand, drug dosage calculation requires the use of mathematical and arithmetic rules. These calculations are difficult to perform (10), which can lead to students' math anxiety. Math anxiety is a psychological condition that occurs when people are confronted with mathematical content, whether in teaching and learning or in resolving mathematical problems or mathematical exams (14). This condition has been observed among nursing students. In Norway, for example, 44.3% of nursing students reported high levels of math anxiety before taking the drug dosage test (15). This type of anxiety leads to tension and reduced self-esteem among students; it can also decrease the students' ability to do mathematical and drug dosage calculations (16, 17). Therefore, it is necessary to consider this issue in the studies of drug dosage calculations.

Despite the relationship between math anxiety and drug dosage calculations (18), most of the previous studies only focused on improving the nursing students' calculation skills. For example, different studies were conducted to determine the effectiveness of the drug dosage calculation training programs in the form of a workshop, the use of actual clinical scenarios, the practice of such skills in the clinical environment (19); online education (7), and e-learning classes based on face-to-face lectures (20) on nursing students' mathematical and medication skills. In another study, the researchers investigated the effect of experimental education strategy on reducing the drug dosage calculation error among nursing students (21). In the context of Iran, most studies have been conducted to determine the effect of lecture, small groups, and multimedia software (22, 23) on the improvement of students' skills in the calculation of drug dosage; the results of all of these studies indicate the positive effect of such interventions. Nevertheless, it should be noted that the subject of drug dosage calculations should be included in the clinical pharmacology course. Hence, the respective students can be familiar with administering drugs in the proper dose (10). However, nursing students might receive dispersed training on drug dosage calculation within the course of fundamentals of nursing as well as in internships in Iran; this procedure does not contain all the items and standards of drug dosage calculation, and therefore the drug dosage calculation training programs should be included in clinical pharmacology courses.

Math anxiety is considered as important as drug dosage calculations. However, only limited studies have been performed on interventions that aim to reduce math anxiety. A study in New Zealand investigated the effectiveness of voluntary supplementary math tutorials on math anxiety and skills as well as nursing students' drug dosage calculation test scores; the results showed that this training helped reduce math anxiety, improve mathematical skills, and nursing students' drug dosage calculations (16). On the contrary, the results of another study in Alaska indicated that basic math tutorials did not lead to a significant change in the reduction of math anxiety among the students (24). The inconsistency between these results can be due to the effect of different factors such as cultural background, genetics, as well as personal and educational factors on math anxiety (25); In contrast, math anxiety has not been examined in Iran, and therefore, there are no interventions on the reduction of math anxiety among nursing students. Hence, if students receive mathematical and drug dosage calculation instructions and are provided with repeated related practices at the bedside, one can expect a decrease in students' math anxiety and an increase in their drug dosage calculation skills. Therefore, the present study was conducted so as to determine the effect of drug dosage calculation training programs on math anxiety and calculation skills among nursing students.

Methods

This non-randomized trial study was based on pre-and post-intervention conducted from October 12, 2019, to February 20, 2020.

Setting and Participants

The present study was conducted in the School of Nursing and Midwifery of Tehran University of Medical Sciences (TUMS), which registers nursing students at all education levels, including bachelor's, master's, and Ph.D. degrees. The bachelor's degree in nursing lasts 4 years, including a clinical pharmacology internship course. The students pass the clinical pharmacology course under a clinical instructor's supervision in 10 days in hospitals. 80 senior nursing students who were passing clinical pharmacology internships course participated in this study. Both the control group and the intervention group contained 40 students. The following inclusion criteria were considered for the present study: studying as a nursing student in the School of Nursing and Midwifery of TUMS, passing the clinical pharmacology internship course, and not participating in any drug dosage calculation courses outside the school. Reluctance to participate in the study, not participating in any workshops on drug dosage calculation, and unauthorized absence in the internship course were considered the exclusion criteria in the present study.

Intervention

The intervention of the present study included training programs for drug dosage calculation. This program was planned to perform during ten days of pharmacology internship. On the first day of the training program using lectures, the decimal numbers, percentages, and basic mathematical skills were explained. Also, how to use the calculator was explained to the participants. Moreover, different measurement units and methods of converting these measures to each other, drug dosage calculation based on weight, and calculation of oral and injectable drugs were discussed. Different formulas were presented regarding drug dosage calculation, including drug forms, how to calculate different drug forms (injectable and non-injectable). Practical training on drug dosage calculation and calculation methods were also proposed. They were also taught how to adjust the calculated drug dosage in the syringe pump and infusion pump; besides, there was also an attempt to solve students' problems. A booklet on drug dosage calculation was delivered to students. This booklet's content included mathematical and drug dosage calculations, which were prepared from other books related to drug dosage calculations.

The second day of the internship was dedicated to practical work. At first, various scenarios were presented, including a brief history of the patients along with the respective prescriptions. The students were then clustered in groups of three and calculated the appropriate drug dosage based on the physician's prescription. The designed scenarios included oral and injectable drugs, vaginal or rectal suppositories, ointments, or topical creams. According to the designed scenarios, different types of injectable drugs were also provided to the students in order to create conditions similar to clinical conditions. These drugs include potassium chloride vials, magnesium sulfate, sodium bicarbonate, heparin, dopamine, dobutamine, epinephrine, and atropine ampoules. After completing the practice exercises, all the students were informed of the method of calculating the drug dosage for each scenario.

The designed scenarios were developed based on the literature review and were approved by the authors and professors of clinical pharmacology. For instance, "A patient undergoes open-heart surgery due to coronary artery occlusion and the physician prescribed 0.7 μg/kg/min Milrinone. If each 10 ml ampoule contains 10 mg milrinone, how would you set the infusion rate (ml/h) in case the injection of the drugs is provided

Given the significance of the interactions between the results of the comparisons of each two times, Bonferroni correction was performed separately in each group. The results indicated that no significant difference was observed between the first and the second times (P=0.991), between the first and the third times (P=0.949), and also between the second and the third times (P=0.982) in the control group. On the other hand, after the Bonferroni correction, there was a significant difference observed between the first and the second times (P<0.001) and also between the first and the third times (P<0.001) in the intervention group. Nonetheless, no significant difference was observed between the second and the third times (P=0.977). In other words, the drug dosage calculations score remained unchanged in the control group, but it significantly increased after the intervention in the intervention group. Besides, the drug dosage calculations score remained unchanged at the third time compared to the second time in the intervention group (Table 3). The results of the independent t-test showed that there was a significant difference between the intervention and control groups in terms of drug dosage calculations in the second time (P<0.001) and the third time (P<0.001) compared to the first time (Table 4).

In order to determine the effect of anxiety on the score of drug dosage calculations, initially, the changes in anxiety and drug dosage calculation scores were calculated for the second and third times compared to the baseline. Then, Pearson correlation was calculated separately for the intervention and control groups where the results indicated no significant correlation. In other words, anxiety did not affect drug dosage calculation scores (Table 5).

Table 3. Comparing drug dosage calculation score between control and intervention in different times

	Intervention Mean ± SD	**Control Mean ± SD**	**Time effect***	**Intervention effect***	**Interaction effect***
First time	15.70 ±3.48	14.70 ±4.98	F (2, 234) = 43.86	F (1, 234) = 10.8	F (2, 234) = 40.62
Second time	26.75 ±3.54	14.82 ±5.10	P<0.0001	P<0.0001	P<0.0001
Third time	26.50 ±3.50	15.00 ±5.05			

*Two-way Analysis of Variance with Repeated Measures utilizing Greenhouse-Geiser adjustment for the interaction effect of the group by measures interaction and the main effects

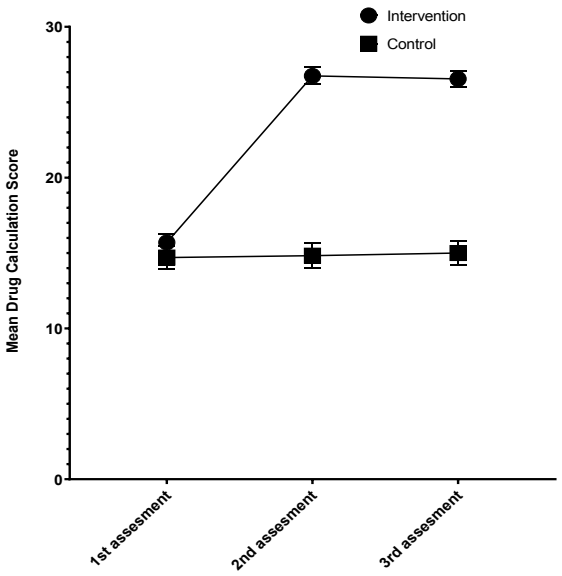

Figure 3. Comparing the drug calculation score across assessment times in intervention and control groups. Two-way Analysis of Variance with Repeated Measures utilizing Greenhouse-Geiser adjustment for the interaction effect of the group by measures interaction and the main effects

Table 4. Comparison of differences from baseline for math anxiety and drug dose calculation between intervention and control groups

	Group	Mean	Std. Deviation	P-Value
Anxiety change 2_1	Control	.3750	.70484	<0.001
	Intervention	-.3750	.80662	
Anxiety change 3_1	Control	.2500	.49355	<0.001
	Intervention	-.3000	.72324	
Drug change 2_1	Control	.1250	.82236	<0.001
	Intervention	11.0500	2.67898	
Drug change 3_1	Control	.3000	.93918	<0.001
	Intervention	10.8500	2.67515	

P-values were calculated using independent t-tests on changes of measures from baselines

Table 5. Correlation between changes in anxiety and drug dosage calculation

Correlation	Group	Correlation	P-value
Anxiety with the drug dosage calculation for the second time	Intervention	-0.145	0.371
	Control	0.049	0.760
Anxiety with the drug dosage calculation for the third time	Intervention	-0.037	0.820
	Control	0.277	0.084

Discussion

The study results regarding math anxiety showed that the same trend was observed in the measured time changes in both the intervention and control groups, which indicates no statistically significant difference. Nonetheless, the comparison between the two groups showed a significant decrease in math anxiety scores among the students in the intervention group. Unlike the control group, the intervention group's results indicated that the mean score of drug dosage calculations was significantly higher in the second and third times compared to the first time. Moreover, a comparison of the two groups showed a significant increase in the score of drug dosage calculations in the intervention group compared to the control group. The findings also showed no significant relationship between anxiety and the score of drug dosage calculations.

The results showed that although the math anxiety score was not statistically significant within the three-time intervals in each of the control and intervention groups, the math anxiety score was generally lower in the intervention group. In other words, the intervention could lead to the reduction of students' math anxiety. In New Zealand,

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