Biological Forum – An International Journal **15(3): 614-617(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Impact of Dimensional Analysis Teaching Strategy on Reducing Medication Errors in B.Sc. Nursing Students

Manjinder Kaur[1], Parvesh Saini[2] and Gopal Singh Charan[3]*
[1]Ph.D. Scholar,
SGRD University of Health Sciences Amritsar (Punjab), India.
[2]Principal, SGRD College of Nursing,
SGRD University of Health Sciences Amritsar (Punjab), India.
[3]Associate Professor, SGRD College of Nursing,
SGRD University of Health Sciences, Amritsar (Punjab), India.

(Corresponding author: Gopal Singh Charan)*
(Received: 21 January 2023; Revised: 16 February 2023; Accepted: 25 February 2023; Published: 22 March 2023)
(Published by Research Trend)

ABSTRACT: Medication errors are a significant and pervasive issue in healthcare, contributing to increased morbidity and mortality rates. Nurses primarily aim to promote and enhance human health. Medication errors, which are a prevalent issue affecting patient care, pose a significant threat to health worldwide. A quasi-experimental study was conducted to evaluate the effectiveness of a teaching strategy that involved using the dimensional analysis approach for drug dose calculation (DDCP), with the aim of reducing medication errors among B.Sc. nursing students in Amritsar. Purposive sampling was used to select 182 nursing students. The result showed a statistically significant difference in the medication calculation errors related to DDCP posttest scores between the two groups ($U = 0.001$, $p < 0.05$). Hence, it can be deduced that the intervention applied in the experimental group led to a significant reduction in DDCP medication calculation errors when compared to the control group. The researcher encountered challenges that nursing students had a lack of familiarity with dimensional analysis, and the process was time-consuming and mathematically complex, which could lead to errors in medication dosing. The study highlighted that using dimensional analysis as a teaching strategy has the potential to significantly reduce medication errors in nursing students by improving their ability to accurately calculate medication dosages

Keywords: Medication errors, nursing students, dimensional analysis.

INTRODUCTION

Medication errors are a significant and pervasive issue in healthcare, contributing to increased morbidity and mortality rates. The traditional methods for dosage calculation, including ratio-proportion, formula, and dimensional analysis, offer different advantages and disadvantages. A major component of medication errors is incorrect dosage calculations, often resulting from mathematical errors or misinterpretations of medication orders.

Nurses primarily aim to promote and enhance human health. Medication errors, which are a prevalent issue affecting patient care, pose a significant threat to health worldwide. These errors contribute to increased mortality rates, longer hospital stays, and higher associated costs. The study showed that two-thirds of the nurses possessed knowledge about medication errors (Kaur and Charan 2018). Medication errors can occur at different stages in the medication use process, resulting from imperfect systems or human factors (Al-Ahmadi et *al.,* 2020).

The execution of patients' medication prescriptions is a central and vital responsibility for nursing students, as they are on the path to becoming professional nurses in healthcare institutions. It is essential for them to have the capacity to determine the appropriate dosage, volume, and administration rate of prescribed medications precisely and accurately. Furthermore, they must be adept at safely and effectively executing these pharmaceutical instructions in order to ensure the well-being of their patients (Trim, 2004).

Consequently, it is imperative for nursing students to acquire expertise and proficiency in multiple domains, such as understanding diverse medical conditions, mastering pharmacological principles, and performing accurate mathematical calculations (Koohestani and Baghcheghi 2010; Koohestani *et al.,* 2008). Deficiencies in these areas, particularly in pharmacology and pharmaceutical calculations, can contribute to medication errors, which may lead to extended hospital stays, escalated expenses, and potentially severe, irreversible harm or even fatalities. Furthermore, medication errors represent a prevalent and grave concern within healthcare institutions (Ehsani *et al.,* 2013; Anderson and Webster 2001).

Medication calculation errors frequently occur during drug administration in nursing due to a lack of

competency and accuracy in completing drug dosages. Medication administration is vital for nursing students and registered nurses, as 26%-38% of medication errors involve administration. One in six errors are due to miscalculations, and in 2003, the FDA reported 41% of errors resulted from inaccurate drug calculations (Veldman, 2016).

Nursing programs bear the crucial task of equipping students with the skills to perform drug dosage calculations accurately and confidently. This is essential as nursing programs strive to produce graduates who are proficient and self-assured in diverse skill sets, including medication calculation.

MATERIAL AND METHODS

A quasi-experimental study assessed the efficacy of a dimensional analysis teaching strategy for drug dose calculation to decrease medication errors among B.Sc. nursing students in Amritsar. Using purposive sampling, 182 students (88 control, 94 experimental) were selected from a nursing college. Ethical approval and written consent were obtained from SGRD Hospital, Vallah, Amritsar, and participants, respectively. Data on socio-demographic profiles and drug dose calculation problems were collected using a questionnaire. A pretest was conducted on both groups, followed by implementation of the teaching strategy in the experimental group. After seven days, a posttest was conducted using the same questionnaire for both groups.

Statistical analysis: Data were analyzed using the Statistical Program for Social Sciences (SPSS) v26.0 (IBM Corp., Armonk, NY, USA). After conducting a normality test, descriptive statistics such as frequency and percentage were employed. For inferential statistics, the Mann Whitney test was utilized to compare groups.

RESULTS AND DISCUSSION

Table 1 presents the socio-demographic profile of B.Sc. nursing students out of 182 students; 88 were allocated in control and 94 were allocated in experimental group. For age, the majority of students were in the age range of 21-23 years ,43.2% in control group and 42.6% in experimental group. Regarding gender, the majority of students in both groups were females; 90.9% for control group and 91.5% for experimental group. In terms of board of high school examination, both groups had a similar proportion of students who appeared for the Punjab School Education Board (PSEB) exam, 35.2% for control group and 48.9% for experimental group. The distribution of high school math score was similar between the two groups for gap after senior secondary education, the majority of students in both groups had no gap after completing senior secondary education 84.1% for control group and 81.9% for experimental group. In terms of habitat, the distribution of students was similar between the two groups. The chi-square test was applied to assess homogeneity, and no statistically significant difference was found. Both groups were considered homogeneous. (Ullah *et al.,* 2021) showed 37.2% of participants were aged 31-35 and 28.3% aged 26-30, with 22% male and 78% female. (Fathy *et al*., 2020) found most nurses were 20-29 years old, averaging 26.7 ± 1.30 years. About 61.6% held technical institute degrees. Farag *et al*. (2017) reported under one-third of nurses were 41-49 years old, while around one-fifth were below 30. Most had less than 18 years of departmental experience.

Table 2 reveals the experimental group's mean rank (93.76) was slightly higher than the control group's (89.09). The Mann-Whitney U test values (3924 for control, 8813 for experimental) revealed no significant difference in DDCP pretest scores between groups ($U = 0.542$, $p = 0.542$). This suggests no significant difference in DDCP medication calculation errors between groups before the intervention. Similarly, (Montazer *et al.,* 2022) found average pretest scores for calculating infusible drug dosages among ICU nursing students were 5.15 ± 2.35 (intervention) and 5.25 ± 2.56 (control), with no significant difference ($P = .86$). Supported research by Abeer *et al*. (2017) reported an average knowledge score of 10.7 ± 2.29 among nurses, indicating unsatisfactory medication administration error knowledge. (Samundeeswari and Muthamilselvi 2018) found one-third of nurses had average knowledge about medication errors, less than one-third had poor knowledge, over a quarter had very low knowledge, and only 8% had good knowledge on prevention.

Table 3 demonstrate that comparison of posttest score related DDCP medication calculation error among nursing students. The results indicate that the mean rank for the experimental group (130.34) was significantly higher than the control group (43.17). Additionally, the Mann-Whitney U test value of 14.50 and 11730.50 for the control and experimental group, respectively, showed a statistically significant difference in the medication calculation errors related to DDCP posttest scores between the two groups ($U = 0.001$, $p < 0.05$). Hence, it can be deduced that the intervention applied in the experimental group led to a significant reduction in DDCP medication calculation errors when compared to the control group. Similarly, (Kohtz and Gowda 2016) showed the implemented intervention effectively reduced medication errors. (Montazer *et al*., 2022) found that dimensional analysis training significantly improved ICU nursing students' ability to calculate infusible drug dosages. Similarly, (Koohestani *et al*., 2008) observed a significant difference in post-test scores between groups. Simpson *et al.* (2004) reported a significant decrease in average monthly medication errors per 1000 neonatal activity days after interventions. This is consistent with (Abukhader and Abukhader 2020), who found a significant reduction in medication errors after teaching intervention.

Table 1: Socio-demographic profile of B.Sc. nursing students of selected colleges of nursing Amritsar, Punjab. N=182.

Sr. No.	Variables	Ctrl. (n=88)		Exp. (n=94)		χ^2value	df	P value
		f	%	f	%			
1.	**Age (years)**							
	18-20	20	22.7	23	24.5	.251	3	.966 NS
	21-23	38	43.2	40	42.6			
	24-26	25	28.4	27	28.7			
	≥27	5	5.7	4	4.3			
2.	**Gender**							
	Male	8	9.1	8	8.5	.019	1	.890 NS
	Female	80	90.9	86	91.5			
3.	**Board of high school examination**							
	CBSE	31	35.2	28	29.8	3.674	3	.299 NS
	PSEB	31	35.2	46	48.9			
	ICSE	16	18.2	12	12.8			
	J & K	10	11.4	8	8.5			
4.	**High school math score**							
	<70	21	23.9	24	25.5	.317	3	.957 NS
	71-80	28	31.8	32	34.0			
	81-90	28	31.8	28	29.8			
	>90	11	12.5	10	10.6			
5.	**Gap after senior secondary education**							
	No gap	74	84.1	77	81.9	.672	2	.715 NS
	One year	10	11.4	14	14.9			
	More than one year	4	4.5	3	3.2			
6.	**Habitat**							
	Urban	47	53.4	54	57.4	.300	1	.584 NS
	Rural	41	46.6	40	42.6			

Table 2: compare pretest score related DDCP medication calculation error among nursing students in control and experimental group.

Sr. No.	Group	Mean Rank	Sum of Ranks	Mann-Whitney U value	P value
1.	Control	89.09	7840	3924	0.542
2.	Experimental	93.76	8813		

Table 3: Compare posttest-I score related DDCP medication calculation error among nursing students in control and experimental group.

Sr. No.	Group	Mean Rank	Sum of Ranks	Mann-Whitney U value	P value
1.	Control	43.17	3669.50	14.50	0.001
2.	Experimental	130.34	11730.50		

CONCLUSIONS

The study concluded that the implemented teaching strategy effectively improved B.Sc. nursing students' knowledge of dimensional analysis for drug dose calculation, reducing medication errors and enhancing patient care quality. The results emphasize the importance of incorporating effective teaching strategies in nursing education to develop competent students. This study contributes to nursing education knowledge and can guide the development of strategies to improve students' skills and ultimately, patient outcomes and healthcare quality.

FUTURE SCOPE

Implementing dimensional analysis approach for drug dose calculation in nursing education could explore long-term retention rates, adaptability to evolving medical technology, and integration with interdisciplinary curricula. Additionally, assessing its global applicability and tailoring the method to accommodate diverse learning styles will help establish a universally effective teaching strategy to minimize medication errors.

Acknowledgment. We are grateful to all participants for making this research possible.
Conflict of Interest. None.

REFERENCES

Abeer Mohammed Abdalhamid Farag, A. A., Eweda, S. M. and Elsayed, N. F. (2017). Nurses knowledge and practice in dealing with high alert medications. *Alexandria Scientific Nursing Journal*, *19*(2), 1-24.

Abukhader, I. and Abukhader, K. (2020). Effect of medication safety education program on intensive care nurses' knowledge regarding medication errors. *Journal of Biosciences and Medicines*, *8*(6), 135.

Al-Ahmadi, R.F., Al-Juffali, L., Al-Shanawani, S. and Ali, S., (2020). Categorizing and understanding medication errors in hospital pharmacy in relation to human

factors. *Saudi Pharmaceutical Journal*, *28*(12), 1674-1685.

Anderson, D. J. and Webster, C. S. (2001). A systems approach to the reduction of medication error on the hospital ward. *Journal of advanced nursing*, *35*(1), 34-41.

Ehsani, S. R., Cheraghi, M. A., Nejati, A., Salari, A., Esmaeilpoor, A. H. and Nejad, E. M. (2013). Medication errors of nurses in the emergency department. *Journal of medical ethics and history of medicine*, *6*.

Farag, Amany, Mary Blegen, Amalia Gedney-Lose, Daniel Lose, and Yelena Perkhounkova (2017). Voluntary medication error reporting by ED nurses: examining the association with work environment and social capital. *Journal of Emergency Nursing, 43*(3), 246-254.

Fathy, A. S. M., Khalil, N. S., Taha, N. M. and M. Abd-elbaky, M. (2020). Nurse's knowledge and Practice regarding Medication Errors in Critical Care Units: Descriptive study. *Minia Scientific Nursing Journal*, *8*(1), 111-120.

Kaur, A. and Charan, G. S. (2018). A study to assess the knowledge regarding medication error among staff nurses at SGRD Hospital, Amritsar, Punjab. *International Journal of Health Sciences and Research*, *8*(8), 213-218.

Kohtz, C. and Gowda, C. (2016). Teaching drug calculation in nursing education: A comparison study. *Nurse Educator, 35*(2), 84.

Koohestani, H. R., Baghcheghi, N. and Khosravi, S. H. (2008). Frequency, type and causes of medication errors in student nurses. *Iran Journal of Nursing, 21*(53), 17-27.

Koohestani, H. and Baghcheghi, N. (2010). Comparing the effects of two educational methods of intravenous drug rate calculations on rapid and sustained learning of nursing students: Formula method and dimensional analysis method. *Nurse Education in Practice*, *10*(4), 233-237.

Montazer, F., Namjou, Z., Mirzaei, S. and Nasiriani, K. (2022). Effects of Dimensional Analysis on Infusible Medication Calculation Skills among Nursing Students in an Intensive Care Unit. *Journal of Infusion Nursing*, *45*(6), 320-325.

Samundeeswari, A. and Muthamilselvi, G. (2018). Nurses knowledge on prevention of medication errors. *J. Med. Sci. Clin. Res.*, *6*, 274-296.

Simpson, J. H., Lynch, R., Grant, J. and Alroomi, L. (2004). Reducing medication errors in the neonatal intensive care unit. *Archives of Disease in Childhood-Fetal and Neonatal Edition*, *89*(6), F480-F482.

Trim, J. (2004). Clinical skills: a practical guide to working out drug calculations. *British journal of nursing*, *13*(10), 602-606.

Ullah, T.A.R.I.Q., Afzal, M.U.H.A.M.M.A.D., Hajra Sarwar, A.H., Gilani, S.A. and Tariq, A.M.I.N.A., 2021. Measuring the effect of dimensional analysis on nurses' level of self-efficacy in medication calculation errors. *Pak. J. Med. Health Sci.*, *15*, pp. 3579-3582.

Veldman, K. T. (2016). A quasi-experimental study measuring the effect of dimensional analysis on undergraduate nurses' level of self-efficacy in medication calculations. University of Lethbridge (Canada).

How to cite this article: Manjinder Kaur, Parvesh Saini and Gopal Singh Charan (2023). Impact of Dimensional Analysis Teaching Strategy on Reducing Medication Errors in B.Sc. Nursing Students. *Biological Forum – An International Journal, 15*(3): 614-617.