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**Research Article**

# Determination of Senior Nursing Students' Mathematical Perception Skills and Pediatric Medication Calculation Performance

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**ABSTRACT**

**Aim:** Math skills in the health field are often used to calculate drug dosage and liquid quantity, body mass and cost analysis. The aim of this research is to determine the senior nursing students' mathematical perception skills and pediatric medication calculation performance.

**Method:** The population of this descriptive cross-sectional research is composed of 103 nursing students in attending a state university in Izmir, Turkey. Of the 103 nursing students, 97 who answered all the questions comprised the study sample. All the participants took one-month training in the pediatric clinics during the last year of their education. The data were collected using the "Personal Information Form and Mathematics Perception, Information and Pediatric Drug Calculator Skills Survey" developed by the researchers by reviewing the literature.

**Results:** The mean age of the study participants was 22.24±0.89. Of them, 76.3% were female, 23.7% completed their Pediatric Internship Training in the pediatric inpatient units or the Pediatric Intensive Care Unit (PICU), 68% thought that their basic mathematics knowledge was adequate, and %30 stated that their dosage calculation, solution preparation and drug preparation skills were insufficient. In addition, the rate of the correct answers they gave to the questions on percentages, fractions and conversions was low.

**Conclusion:** In the drug application process; not only practical skills, but also the theoretical knowledge should be considered. A nurse's responsibility does not end once he/she administers medication. Being careful throughout the entire process is one of the nurse's legal and ethical responsibilities. In this study, the students' drug calculation skills were inadequate.

**Keywords:** Calculation skill, medication, nursing education, nursing student, pediatrics

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## INTRODUCTION

Math skill is used in areas such as health to calculate drug dosage and liquid quantity, body mass and cost analysis (Hutton, 2009). Mathematical calculations are of great importance in medication (Lapham, 2016). Medication has beneficial effects when given in appropriate dosages, but it can be fatal in the wrong dosages (Aştı, & Kıvanç, 2003). Medication process begins with inspection and prescription, and ends with the monitoring of the side effects of drugs (Karaca, & Açıkgöz, 2014).

In the medication process; not only practical skills, but also the theoretical knowledges should be considered. Nurse's responsibility is not ending after the implementation of the drugs, his/her responsibility includes the monitoring of drugs' side effects. Being careful throughout the whole process is one of the legal and ethical responsibilities of nurses (Karaca, & Açıkgöz, 2014).

Medical practices, are one of the most fundamental issues of nursing education and are often carried out in the first year of nursing education. In addition to the comprehensive theoretical training they receive, students find the opportunity to prepare and administer the drugs, and observe and record the side effects of the drugs (Karaca, & Açıkgöz, 2014).

In recent years, it has been determined that nurses' failure to calculate drug dosage and thus studies are now conducted in order to eliminate this deficiency (Bifftu, Dachew, Tiruneh, & Beshah, 2016; Feleke, Mulatu, & Yesmaw, 2015; Karaca, & Açıkgöz, 2014). In Lintern's study (2014), it is stated that the error rate of nursing students in math skills is between 50% and 80% (Lintern, 2014). In McMullan, Jones & Lea's study (2010), they reported that 92% of the nursing students and 89% of the nurses failed the drug calculation test. He also reported that students and nurses were overconfident in calculations and that they did not pay due attention medication calculations (McMullan, Jones, & Lea, 2010).

Nurses and nursing students need to combine their theoretical and practical skills to reduce errors likely to occur during the medication process. The aim of this study is to determine the senior nursing students' mathematical perception skills and pediatric medication calculation performance.

### Research Questions

The research questions of the study were determined as follows:

1) What is the level of math skill perceptions of senior nursing students?
2) What is the level of math skills of senior nursing students?
3) What is the level of pediatric drug dose calculation skills of senior nursing students?

## METHOD

### Study Design

It is a descriptive cross-sectional study.

### Sample

This descriptive cross-sectional studys' population is composed of 103 nursing students attending a state university in Izmir, Turkey. Of the 103 nursing students, 97 who answered all the questions comprised the study sample. The sample size was calculated as 97 according to the calculation made with 5% error margin and 99.9% confidence level. All the participants took Fundamentals of Nursing and Pediatric Nursing lessons as part of their university education which are already in the school's curriculum. All the participants took a one-month training in pediatric clinics already in the school's curriculum during the last year of their education. During the internship program the students

participated in trainings 24 hours a week in the pediatric service with nurses and in theoretical lectures for 2 hours a week and made presentations and discussions about pediatric patients with academicians. Clinical practice trainings of the students were performed in the pediatric inpatient units and pediatric intensive care units of two children's hospitals in Izmir, Turkey. These hospitals are advanced pediatric care hospitals, and deal with complicated cases as well. The trainers also observed the students during their clinical practices and in clinical case discussions made at the bedside. In discussion sessions, they discussed drugs and dosage calculations with the students.

### Data Collection

The data were collected between September-December 2016. After 1 month internship was completed and students were informed about the study, the surveys were administered to them in the clinical settings. Written informed consent was obtained from students' who participated in this study. The surveys were delivered to students and asked to answer questions. The data were collected using the "Personal Information Form", and "Mathematics Perception, Information and Pediatric Drug Calculator Skills Survey". Researchers developed the survey by reviewing the literature (Grandell-Niemi, Hupli, Puukka, & Leino-Kilpi, 2006). Students were not allowed to use a calculator while answering mathematical skill questions on the questionnaire.

**Personal Information Form:** The form consists of 4 items questioning the socio-demographic characteristics of the participants such as age, gender, school and internship clinic.

**Math Perception, Knowledge and Pediatric Drug Calculation Skills Survey:** The form consists of 20 questions about the perception of math skills. Such as the recognition of the Arabic figures, percentage calculation, dose calculation, solution calculation, flow rate calculation, period of drug usage calculation.

### Data Analysis

The data obtained from this study were analyzed using the IBM Statistical Package for the Social Sciences (IBM SPSS Corp., Armonk, NY, USA) version 21.0 statistical software. Sociodemographic characteristics of the nursing students participating in the study were given in numbers and percentage distribution the descriptive analysis was used in this study. Statistical significance was accepted as 0.05.

### Ethical Considerations

For the study, the Ethics Approval was obtained from the İzmir Katip Çelebi University Ethics Committee (Date: July 21, 2016 Decision Number: 211).

## RESULTS

Of the students 76.3% (n=74) were female, their mean age was 22.24±0.89 (min=21, max: 26). Of the participants 62.9% (n=61) completed their Pediatric Internship Training in the Pediatric or Neonatal ICUs (Table 1).

Of the participants, 68% (n=66) thought that their basic math knowledge was adequate, and 57.7% (n=56) thought that their interest in mathematics was good. Of the attendants, 46.4% (n=45) stated that their drug preparation knowledge was good, 41.2% (n=40) considered their drug preparation knowledge as average. Of the students, 51.5% (n=50) indicated that their dosage calculation knowledge was good, 32% (n=31) is average, 61.9% (n=60) stated that their percentage calculation knowledge was good. Of the participants, 30.9% (n=30) indicated that their recognition of Roman-Arabic number knowledge was good, 44.3% (n=43)

**Table 1. Sociodemographic characteristics (n=97)**

| Characteristics | n | % | Age |
|---|---|---|---|
| **Gender** | | | |
| Female | 74 | 76.3 | 22.24±0.89 Min=21 Max:26 |
| Male | 23 | 23.7 | |
| **Internship Clinic** | | | |
| Pediatric Inpatients Clinics | 36 | 37.1 | |
| Intensive Care Units (ICU) (NICU, Neonatal Surgery ICU, Pediatric Surgery ICU, PICU, Pediatric Cardiovascular Surgery ICU) | 61 | 62.9 | |

ICU: intensive care units; NICU: neonatal intensive care units; PICU: pediatric intensive care units

**Table 2. Math skill perceptions (n=97)**

| | Very Good | | Good | | Average | | Not Good | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| In your opinion, how good is your basic mathematical knowledge? | 27 | 27.8 | 66 | 68.0 | 1 | 1.0 | 3 | 3.1 |
| What is the level of your interest in mathematics? | 35 | 36.1 | 56 | 57.7 | 3 | 3.1 | 3 | 3.1 |
| To what extent do you trust your drug preparation knowledge? | 8 | 8.2 | 45 | 46.4 | 40 | 41.2 | 4 | 4.1 |
| What is the level of your medication dose calculation knowledge? | 9 | 9.3 | 50 | 51.5 | 31 | 32.0 | 7 | 7.2 |
| What is the level of your percentage calculation knowledge? | 17 | 17.5 | 60 | 61.9 | 18 | 18.6 | 2 | 2.1 |
| What is the level of your Roman-Arabic number knowledge? | 4 | 4.1 | 30 | 30.9 | 43 | 44.3 | 20 | 20.6 |
| What is the level of your solution preparation knowledge? | 6 | 6.2 | 50 | 51.5 | 37 | 38.1 | 4. | 4.1 |

considered it as average, 51.5% (n=50) specified that their solution preparation knowledge was good, and 38.1% (n=37) were not sure about their skills (Table 2).

Of the students, 52.6% (n=51) gave the wrong answer to the question "Convert 5 mg to gram", 72.7% (n=70) correctly answered the question "Convert a fraction of 1/5 to percentage". Of the students, 56.7% (n=55) gave the correct response to the question "What is result of 5.78 / 0.2?", 48.5% (n=47) did not reply the question. "Convert 32 to a Roman numeral", 80.4% (n=78) correctly answered the question "You are to administer 15 mg of the drug one mL** of which equals to 12 mg. "How many milliliters should you administer?". Of the attendants, 66% (n=64) correctly answered the question "The patient's weight increased from 9.200g to 10 kg. "How would you write it in a percentage?", 36.1% (n=35) gave the wrong answer to the question "1000 mL of 0.9% NaCl solution will be infused in 8 hours. The drop factor of the IV set is 15 drops/1 mL. Calculate the number of drops per minute?" (Table 3).

Of the participants, 71.1% (n=69) gave the correct answer to the question "After diluting a 500 mg vial with 3.5 ml sterile water for injection, you see that the drug is 4.2 mL. "How much is the powder volume of the drug?", 53.6% (n=52) correctly answered the question "Medical order is 4x600 mg Ampicillin Sulbactam. 1 g Ampicillin Sulbactam is with 3.2 mL solvent ampoule. Powder volume of the Ampicillin Sulbactam is 0.8 mL. What is the amount of drug each time you give to

**Table 3. Math skills (n=97)**

| | Correct | | Incorrect | | Don't know | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Converting 5 mg to gram | 44 | 45.4 | 51 | 52.6 | 2 | 2.1 |
| Converting a fraction of 1/5 to percentage | 70 | 72.7 | 27 | 27.8 | - | - |
| What is result of 5.78/0.2? | 55 | 56.7 | 39 | 40.2 | 3 | 3.1 |
| Converting 32 to a Roman numeral. | 45 | 46.4 | 5 | 5.2 | 47 | 48.5 |
| You are to administer 15 mg of the drug one mL of which equals to 12 mg. How many milliliters should you administer? | 78 | 80.4 | 17 | 17.5 | 2 | 2.1 |
| The patient's weight increased from 9.200 g to 10 kg. How would you write it in a percentage? | 64 | 66.0 | 25 | 25.8 | 8 | 8.2 |
| 1000 mL of 0.9% NaCl solution will be infused in 8 hours. The drop factor of the IV set is 15 drops/1 mL. Calculate the number of drops per minute? | 35 | 36.1 | 34 | 35.1 | 28 | 28.9 |

mg: milligram; mL: milliliter; g: gram; kg: kilogram; NaCl: sodium chlorure; IV: intravenous

**Table 4. Students' pediatric drug dose calculation skills (n=97)**

| | Correct | | Incorrect | | Don't know | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| After diluting a 500 mg vial with 3.5 mL sterile water for injection, you see that the drug is 4.2 mL. How much is the powder volume of the drug? | 69 | 71.1 | 5 | 5.2 | 23 | 23.7 |
| Medical order is 4x600 mg Ampicillin Sulbactam. 1 g Ampicillin Sulbactam is with 3.2 mL solvent ampoule. Powder volume of the 1 g Ampicillin Sulbactam is 0.8 mL. What is the amount of drug each time you give to your patients?" | 52 | 53.6 | 18 | 18.6 | 27 | 27.8 |
| Medical order is 2 x 100 mg Ampicillin Sulbactam for a 6- kg baby. 500 mg Ampicillin Sulbactam is with 3 mL solvent ampoule. Powder volume of the 500 mg Ampicillin Sulbactam is 0.5 mL. The limit of the drug is 40 mg/kg/day. Is the amount of drug which is given to the baby safe? | 39 | 40.2 | 20 | 20.6 | 38 | 39.2 |
| Medical order is 2x11 mg Spironolakton. You diluted a 25 mg-pill of the drug with 5 mL sterile water. What is the volume of the drug each time you give to your patients? | 44 | 45.4 | 16 | 16.5 | 37 | 38.1 |

mg: milligram; mL: milliliter; g: gram; kg: kilogram

your patients?". Of the students, 39.2% (n=38) did not reply the questions "Medical order is 2 x 100 mg Ampicillin Sulbactam for a 6 kg baby. 500 mg Ampicillin Sulbactam is with 3 mL** solvent ampoule. Powder volume of the 500 mg Ampicillin Sulbactam is 0.5 mL. The limit of the drug is 40 mg/kg/day. Is the amount of drug which is given to the baby safe?", 45.4% (n=44) gave the correct answer to the question "Medical order is 2x11 mg Spironolakton. You diluted a 25 mg-pill of the drug with 5 mL sterile water. What is the volume of drug each time you give to your patients? (Table 4).

## DISCUSSION

Math skills in the health field are often used to calculate drug dosage and liquid quantity, body mass and cost analysis (Hutton, 2009). Mathematical calculations is of great importance in drug applications (Lapham, 2016). The aim of this research is to determine the mathematical perception, skills and pediatric

drug calculation performance of senior nursing students.

In the present research, of the students 18.6% gave the wrong answer to the question on drug dosage calculation and 27.8% did not reply the question. Similarly, in a study by Eastwood, Boyle, Williams & Fairhall (2011) 36% of the students failed to make drug dosage calculations and this rate is too high to be tolerated.

In the current study, the participating students' drug dosage calculation skills were inadequate, which is consistent with the results of a lot many other studies (Elliot and Joyce, 2005; Grandell-Niemi et al., 2006; Jukes & Gilchrist, 2006; van Gijssel-Wiersma, van den Bemt, & Walenbergh-van Veen, 2005; Wright, 2005; Wolf, Hicks, & Serembus, 2006).

In the present study, the participating students had enough mathematical knowledge. However, they were hesitant to use this knowledge in dosage calculations, drug and solution preparation information. Consistent with the present study, Grandell-Niemi, Hupli, Leino-Kilpi, & Puukka (2003) determined that the participants' mathematical skills were adequate but they did not trust their pharmacological skills such as drug preparation. In contrast with the present study, in Andrew et al. (2009) found that the students with low self-efficacy had low mathematical skills . And also in Røykenes and Larsen's study (2010), it was found that the students had low belief of mastering the drug calculation had low mathematical skills.

In the present study, the rate of students' correct answers to questions on percentages, fractions and conversions was low. Similarly, several authors reported that students' skills about fractions (Harvey, et al. 2009; Wright, 2007), percentages (Wright, 2007), conversions (Grandel-Niemi et al. 2003), construals (Wright, 2007) and omission (Wolf, 2006) were weak.

In a literature review of interventional studies conducted between 1990 and 2012 and aimed at developing drug calculation skills of students, it is emphasized that the benefits of four educational strategy about traditional pedagogics, psychomotor skills, technology and several learning methods (Stolic 2014).

### Study Limitations

In this present study, the relationship between the participating students' age and knowledge levels was not analyzed. The relationship between the participating students' internship clinics and knowledge levels was not checked either. However in a study conducted by Sneck et al. in Finland, the knowledge level of young nurses and nurses who worked in emergency room was higher than that of other nurses (Sneck, Saarnio, Isola, & Boigu, 2016).

In this current study, there is no comparative implementation to identify the participating students' mathematical perception, drug dosage knowledge and skills and the level of self-confidence. Distinctly to the current study, the effects of lecturing by comparing theoretical and situational computerized learning to students's self-confidence and students' knowledge level was analyzed by Weeks et al. As a result, it was determined that the participating students had trouble understanding the issue of drug calculation in theory the same issue better with situational computerized learning (Weeks, Higginson, Clochesy, & Coben, 2013).

### How Might This Information Affect Nursing Practice?

Students may lose interest in math because there is no lesson about mathematics in nursing education. Especially nursing students who take pediatric courses has to perform careful mathematical problems on drug dose

calculations. By the identification of the mathematical skills of nursing students, the educators will be aware of the level of mathematical knowledge of the students. The identification of students with low math skills and the improvement of math skills of these students are critical in preventing drug mistakes.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of İzmir Katip Çelebi University (Date: July 21, 2016 Decision Number: 211).

**Informed Consent:** Written informed consent was obtained from students' who participated in this study.

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