

# Effect of Glove use on Manual Dexterity of Nursing Students

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**Received:** 07-Sep-2022;  
**Revision:** 26-Nov-2022;  
**Accepted:** 01-Feb-2023;  
**Published:** 15-May-2023

ABSTRACT

**Background:** Manual dexterity is vital in nursing. Nurses need to carry out applications requiring manual dexterity in the quickest and most accurate way. However, gloves are also necessary during such applications as a precaution against infections. Therefore, manual dexterity and the effect of gloves on manual dexterity are essential subjects to be investigated in the nursing field. **Aims:** This study aims to determine the effect of using gloves on the manual dexterity of nursing students. **Materials and Method:** The sample of the semi-experimental study consisted of 80 nursing students. The data were collected using a questionnaire and Purdue Pegboard Test. **Results:** The participants were 22.03 ± 1.35 years of age on average; 61.2% of them were 22 years of age or above, 50% were female, 50% were male, 50% were in the third grade, 50% were in the fourth, 80% were high school graduates, and 97.5% did not work in any job. As a result, 47.5% reported that gloves impacted their manual dexterity, 52.5% reported only a partial effect, 12.5% indicated that gloves increased their manual dexterity, 66.3% stated that it reduced their manual dexterity, and 21.2% reported no change. The right-hand and assembly scores were found to be significantly higher in the tests performed with bare hands than in the tests performed with gloves ( $P < 0.05$ ). **Conclusions:** Using latex gloves impacts the dominant-hand dexterity and assembly dexterity. Therefore, designing more ergonomic gloves, increasing nurses' habit of working with gloves already in school, and supporting the improvement of their manual dexterity with gloves are recommended.

**KEYWORDS:** *Gloves, manual dexterity, nursing, nursing education, Purdue Pegboard Test*

## INTRODUCTION

In the prevention of hospital infections, one of the universal measures needed to be applied to minimize the risk of cross-infection between patients and healthcare personnel is the use of gloves.<sup>[1-4]</sup> In the clinical observations and interviews, many healthcare personnel, nurses, and students state that using gloves negatively affects their hand manipulation skills and manual dexterity and usually delays the completion of tasks.<sup>[3]</sup> They indicate that because of the difficulty they experience, they avoid using gloves in applications requiring fine motor skills and make trials with different glove types to minimize such effects. The literature emphasizes that more problems occur with thick gloves than the thin ones.<sup>[5]</sup> It is also highlighted that manual dexterity is also likely to be affected

by the type of the gloves used,<sup>[6]</sup> such as latex<sup>[3]</sup> or chemical protective gloves.<sup>[5]</sup> Especially nitrile gloves are referred likely to produce finger and hand fatigue over time due to the inflexibility of the glove material.<sup>[7,8]</sup> Indeed, in a study conducted by Sawyer and Bennet<sup>[6]</sup> to determine the effect of latex and nitrile laboratory gloves on manual dexterity, despite being made of a thicker material, SafeSkin latex gloves were determined to provide an 8.6% higher level of fine manual dexterity compared to SafeSkin nitrile gloves. And most participants were seen to prefer and use latex SafeSkin gloves. The literature

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**How to cite this article:** Denat Y, Kuzgun H. Effect of glove use on manual dexterity of nursing students. *Niger J Clin Pract* 2023;26:491-6.

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	<b>DOI:</b> 10.4103/njcp.njcp_601_22

also highlights that the size of gloves can also affect manual dexterity; especially gloves that are too small can reduce blood flow to the fingertips, eventually leading to pain and numbness, restricted finger and hand movements, and impaired manual dexterity; on the other hand, too large gloves may tend to slip from the hand and fingers, causing impaired fine motor performance.<sup>[2]</sup> In a study conducted by Drabek *et al.*<sup>[2]</sup> with healthcare professionals to investigate the effect of wearing wrong-sized gloves on manual dexterity, the peg placement duration in the manual dexterity test was determined not to be affected by wearing gloves with the preferred size compared to using bare hands. Whereas the said duration was determined to increase by 7–10% with too small or too large gloves.

As is known, in preventing hospital infection and cross-infection, proper and appropriate use of gloves is one of the universal measures.<sup>[1,3,4]</sup> However, studies show that gloves are not used properly and appropriately in accordance with guides among healthcare personnel, especially nurses and student nurses in the first place who have very close contact with patients.<sup>[4,9-17]</sup> Nurses have opinions and assumptions that using gloves affects manual dexterity in the nursing profession, where caregiving skills often require hand manipulation and fine motor skills. When the literature was reviewed, it was seen that there were studies investigating the effect of using gloves of different sizes, different types, etc., on manual skills in other occupational groups. However, no studies were found investigating the impact of disposable latex gloves used in the nursing routine on manual dexterity compared to bare hands. Whereas good dexterity requires accomplishing many tasks safely and efficiently without unnecessary delays.<sup>[2]</sup> Furthermore, nursing is a profession that requires many hand skills and manipulation. In fact, it requires performing such practices quickly and accurately as much as possible. Nurses also have to use gloves as a preventive measure against infections. Therefore, manual dexterity and the effect of gloves on manual dexterity are important issues in the nursing field. This study aims to determine the effect of disposable latex gloves, frequently used in nursing care applications in the clinic, on the manual skills of nursing students.

## MATERIALS AND METHODS

### Study design

This research is a semi-experimental study.

### Hypotheses

$H_0$ : Using gloves does not affect the manual dexterity of nursing students.

$H_1$ : Using gloves affects the manual dexterity of nursing students.

### Sample and population

The population of the research consisted of 489 individuals studying in the nursing department of the faculty of health sciences of a university in Türkiye in the academic year 2020–2021. The sample size is calculated based on the study by Kuzgun and Denat,<sup>[18]</sup> using the software G\*Power - 3.1.9.2. Since the main data of the study would be analyzed through a *t*-test, in the power analysis made based on the said study using G\*Power 3.1.9.2, power and  $\alpha$  values were accepted to be 0.80 and 0.05, respectively (power: 0.80,  $\alpha = 0.05$ ). The effect size was calculated to be 0.60, and the total size of the sample for the *t*-test was found to comprise 70 individuals. Considering the fact that there could be at least 10% potential case losses, the researchers planned to reach 80 individuals. In the study by Kuzgun and Denat,<sup>[18]</sup> manual dexterity scores of the students were found to increase with their grades. The research was completed with a total of 80 students volunteering to participate in the study and meeting the inclusion criteria from among third-grade (112) and fourth-grade students (135) (247 in total) who were assumed to have higher manual dexterity according to the finding of the abovementioned study.

The inclusion criteria of the study are being a third- or fourth-grade nursing student, not having any missing fingers on either hand, having no problems in grasping and holding skills in either hand, having no known disease likely to impact manual dexterity, having no known latex allergy, and volunteering to participate in the study.

### Data collection tools

In the study, the data were collected using a questionnaire created by reviewing the literature<sup>[2,3,6,8,19,20]</sup> and Purdue Pegboard Test.

The questionnaire consists of two sections. The first section is on descriptive characteristics and glove use, and the second is for recording the Purdue Pegboard Test scores. The descriptive information section consists of questions on age, sex, grade, school of graduation, working status, preference for using gloves, etc.

The Purdue Pegboard Test was developed by Tiffin and Asher<sup>[21]</sup> to measure manual dexterity, and the validity and reliability studies of the test were conducted. The test consists of five subsets, which are right hand (a), left hand (b), both hands (c), right hand + left hand + both hands (d), and assembly subtests (e). The test board has four cups placed side-by-side at the top and two vertical rows at the center. Each row contains

25 small holes. And each of the outer cups contains 25 pins. The inner left cup contains 40 washers, and the inner right cup contains 20 collars. The right-hand and left-hand subtests require participants to use their right hand first and left hand afterward to place as many pins as possible to the consecutive holes within 30 seconds. The score received from each of these subtests is equal to the total number of pins placed by each hand within the allowed time. In the both-hands subtest, participants use their right and left hands simultaneously to place as many pins as possible in both rows within 30 seconds. The score of this subtest is equal to the total number of pin pairs placed within 30 seconds. The right-hand + left-hand + both-hands subtest score is the arithmetical sum of the scores received from the previous subtests. The assembly subtest requires subjects to fulfill different tasks within 60 seconds using their both hands simultaneously. And the score of this subtest is equal to the total number of pins, washers, and collars placed within 60 seconds. Each phase of the test is repeated three times, and mean scores are recorded.

### Data collection

In the study, data were collected through the face-to-face interview method. The participant was taken to a quiet and calm room where the table and chair layout was arranged for the participant to sit comfortably. Before the application, the participant was asked to wash their hands with soap and dry them. First, the participant was informed in detail on how to perform Purdue Pegboard Test. Then the participant was allowed to make several trials until they felt ready to perform the actual test. In the tests performed with gloves, the participants were ensured to wear the gloves with the sizes they felt comfortable with and preferred in practice. The participants were ensured to perform each application with and without gloves three times. And the mean score of the three applications performed without gloves was taken as the score of manual dexterity without gloves, and the mean score of the three applications performed with gloves was taken as the score of manual dexterity with gloves. To minimize the effect of time, practice, and fatigue on the results, whether the participant would initially perform the test with or without gloves was determined by lot. As a result, 60% of the participants started the test with gloves and 40% without gloves.

### Statistical analysis

The data collected for the study were analyzed using the software SPSS version 25.0. Descriptive statistics (number, percentage, mean, standard deviation)

were used to assess the data. Before starting the statistical analysis, the outliers were examined, and it was determined if they were present in the datasets. The compatibility of the used data with the normal distribution was tested. The state of having a normal distribution can be examined through a Q-Q Plot<sup>[22]</sup> In addition, in order for the used data to have a normal distribution, the skewness and kurtosis values must be between  $\pm 3$ .<sup>[23]</sup> In the data with a normal distribution, the independent t-test was used to compare two independent groups. Results were assessed at a confidence interval of 95% and a significance level of  $P < 0.05$ .

### Ethical considerations

Before conducting the research, approval (Protocol No: 2020/198) from Aydın Adnan Menderes University Faculty of Nursing Non-Interventional Research Ethics Committee and research permission from the institution where the research would be conducted were received. The research was carried out in accordance with the principles of the Helsinki Declaration. Written consent was obtained from the students participating in the study.

### RESULTS

The mean age of the students who participated in the study was  $22.03 \pm 1.35$ . It was determined that 61.2% of them were 22 years of age or older, 50% were female, 50% were male, 50% were in the third grade, 50% were in the fourth grade, 80% were high school graduates, and 97.5% did not work in any job. Of the participants, 75% reported that they normally used latex gloves in patient care, and 25% stated that they used nitrile gloves. The percentage of the participants reporting that using gloves affected their manual dexterity was 47.5%, while 52.5% said it had only a partial effect. The participants who reported that using gloves increased their dexterity constituted the 12.5% of the sample. In contrast, 66.3% of them stated that using gloves reduced their manual dexterity. On the other hand, 21.2% reported no change in their manual dexterity. It was observed that 47.5% of the participants preferred small-sized gloves during the tests, 30% chose medium-sized ones, and 22.5% preferred large gloves. It was determined that the dominant hand of 96.3% of the participants was the right hand, and that of the 3.8% was the left hand [Table 1].

When the participants' manual dexterity scores with and without gloves were compared, statistically significant differences were found in the mean right-hand and assembly scores ( $p < 0.05$ ). The right-hand and assembly scores obtained from the tests performed with bare hands were found to be significantly higher than the

scores received from the alevlent tests performed with gloves [Table 2].

**Table 1: Distribution of the participants' descriptive characteristics**

Variable	n	%
Age ( $\bar{X}\pm SD$ , 22.03 $\pm$ 1.35)		
Younger than 22 years of age	31	38.8
22 years of age or older	49	61.2
Sex		
Female	40	50.0
Male	40	50.0
Grade		
3	40	50.0
4	40	50.0
High school of graduation		
Regular high school	64	80.0
Health vocational high school	16	20.0
Working status		
Yes	2	2.5
No	78	97.5
The most common glove type used in the clinic		
Latex disposable gloves	60	75.0
Nitrile gloves	20	25.0
Whether the participant thinks that using gloves affects manual dexterity		
Yes	38	47.5
Partially	42	52.5
No	0	0
The thought of the participant as to how using gloves affects their manual dexterity		
Increases my manual dexterity	10	12.5
Reduces my manual dexterity	53	66.3
Does not change my manual dexterity	17	21.2
Glove size		
Small	38	47.5
Medium	24	30.0
Large	18	22.5
Initially performing the test with or without gloves		
With gloves	48	60.0
Without gloves	32	40.0
Dominant hand		
Right	77	96.3
Left	3	3.8
Total	80	100.0

## DISCUSSION

One of the main universal measures for preventing hospital infections is using gloves.<sup>[1-4]</sup> In fact, many studies have provided important evidence on the issue.<sup>[9,24-28]</sup> However, in the clinical observations and interviews, many healthcare personnel, nurses, and nursing students state that using gloves negatively affects their hand manipulation skills and manual dexterity, usually delaying task completion.<sup>[3]</sup> They indicate that because of the difficulties they experience, they tend to avoid using gloves in applications requiring fine motor skills and make trials with different glove types.<sup>[3]</sup> Most of the participants in the present study also stated that using gloves impacted their manual dexterity either partially or wholly.

In this study, which was conducted to determine the effect of using gloves on the manual dexterity of nursing students, it was determined that most of the nursing students used the right hand as their dominant hand and that their scores of manual dexterity without gloves were generally higher compared to their scores obtained with gloves. Especially the scores obtained without gloves in the right-hand and assembly subtests were significantly higher than those obtained from the equivalent tests performed with gloves. The literature emphasizes that the type of glove used, such as latex<sup>[3]</sup> or chemical protective gloves<sup>[5]</sup> in particular, can have a bearing on reduced manual dexterity.<sup>[6]</sup> Especially, nitrile gloves are emphasized to cause finger and hand fatigue over time as the glove material is not flexible.<sup>[7,8]</sup> Indeed, in a study conducted by Sawyer and Bennett<sup>[6]</sup> to determine the effect of latex and nitrile laboratory gloves on manual dexterity, despite being made of a thicker material, SafeSkin latex gloves were determined to provide an 8.6% higher level of fine manual dexterity compared to SafeSkin nitrile gloves. And most participants were seen to prefer and use latex SafeSkin gloves. In the present study, all the participants preferred latex gloves which they used commonly in the clinic as well. The study results show that nitrile gloves compared to latex gloves and latex gloves compared to bare hands impact manual dexterity.

**Table 2: Comparison of the effect of glove use on different manual dexterity**

Variable	Manual dexterity									
	Right hand		Left hand		Both hands		Right hand + left hand + both hands		Assembly	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
With gloves	18.29	1.68	16.71	1.41	14.41	2.13	48.77	5.33	40.35	6.58
Without gloves	18.90	1.57	16.93	1.59	14.30	1.26	49.89	4.21	42.59	6.07
Test value	-2.362		-0.925		0.372		-1.480		-2.236	
P*	<b>0.019</b>		0.356		0.711		0.141		<b>0.027</b>	

Bolded are statistically significant ( $P < 0.05$ ); SD=Standard deviation. \*Independent samples *t*-test

The literature shows that gloves that are too small can reduce blood flow to the fingertips, eventually leading to pain and numbness, restricted finger and hand mobility, and impaired manual dexterity; on the other hand, too large gloves may tend to slip from the hand and fingers which may cause impaired fine motor performance.<sup>[2]</sup> In the present study, glove size was left to the participants' preference, and they were asked to choose the glove type with which they felt most comfortable. Therefore, the effect of glove size on manual dexterity was not evaluated in the study. In a study conducted by Drabek *et al.*<sup>[2]</sup> with healthcare professionals to investigate the effect of wearing wrong size gloves on manual dexterity, the peg placement time in the test was determined not to be affected by wearing gloves with the preferred size compared to using bare hands. Whereas the said duration was determined to increase by 7–10% with too small or too large gloves. The study design of the present study is of the nature supporting this study result.

Although contributing to the relevant literature, the present study has some limitations. First, our study sample consists of third- and fourth-grade nursing students in the nursing department of one health college only. For this reason, its results cannot be generalized to all nursing students. The glove sizes were determined according to the preferences of the nursing students participating in the study, who were initially told to choose the size they feel most comfortable with during the application. Finally, only one type of glove and one hand function test was used in the research.

## CONCLUSION

Manual dexterity and the effect of gloves on manual dexterity are important issues in the nursing field. Because good dexterity requires accomplishing many tasks safely and efficiently without unnecessary delays.<sup>[2]</sup> The results of the present study support opinions and assumptions among nurses that using gloves impacts manual dexterity in the nursing profession, where caregiving applications that require hand manipulation and fine motor skills are common. Using the gloves with the sizes preferred by the participants themselves impacts their dominant hand and assembly skills. Considering the fact that nurses must both carry out care and treatment applications timely and accurately and use gloves as a preventive measure against infections, designing the gloves offered to nurses in a more ergonomic form, increasing nurses' habit of working with gloves already in school and supporting the improvement of their manual dexterity with gloves can be recommended. In addition, considering that nurses and other medical personnel use different types of gloves or double gloves

in some areas of clinical practice or some special cases, future studies are needed to be planned on the effect of using gloves in such ways on manual dexterity.

## Ethical considerations

To conduct the research, approval (Protocol No: 2020/198) from Aydın Adnan Menderes University Faculty of Nursing Non-Interventional Research Ethics Committee and research permission from the institution where the research would be conducted were received. The research was carried out in accordance with the principles of the Helsinki Declaration. Written consent was obtained from the students participating in the study.

## Acknowledgements

We would like to thank all the nursing students participating in the study.

## Financial support and sponsorship

The study was supported by "Aydın Adnan Menderes University Scientific Research Projects Unit" (Aydın/Türkiye), Project No: HF-20007.

## Conflicts of interest

There are no conflicts of interest.

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