Review Article

SAGE Open Nursing
Volume 10: 1–10

DOI: 10.1177/23779608241274543
journals.sagepub.com/home/son

Learning Outcomes of Nursing Students' Experience With Cadaveric Dissection: A Scoping Review

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Abstract

Introduction: Cadaver dissection in anatomy, a cornerstone of medical school education, has been replaced by digital technologies. This study aimed to determine the learning outcomes nursing students could achieve through cadaveric dissection practice (CDP).

Methods: This scoping review was carried out using the checklist outlined in the Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews through August 2023. Articles from PubMed, ERIC, and CINAL were included. This scoping review included studies that focused on the learning effects of nursing students' experiences with cadaver dissection, written in English, and covered all study types.

Results: The cadaveric dissection exercise resulted in a strong interest in the human body and a thorough understanding of anatomy and physiology. It also allows for creating an image of care for the patient before death, the meaning of existence after death, acceptance that death is not frightening, and an understanding of the afterlife. Furthermore, the cadaveric dissection exercise has been reported to improve confidence in patient care, lead to a better understanding of what other professions practice, and involve the development of professional identity.

Conclusions: Studies on the learning effects of CDP have differed in subject matter and educational methodologies. In the future, while determining how the experience of CDP is related to nursing practice of nursing students and graduates, we must explore effective CDP and develop educational methodologies that can achieve similar learning effects.

Keywords

gross anatomy, cadaver, nursing student

Received 17 February 2024; Revised 10 July 2024; accepted 20 July 2024

Introduction

Nursing students recognize that studying anatomy and physiology is one of the most critical subjects associated with nursing practice because it relates to understanding patient pathophysiology, patient observation, treatment choices, and patient safety (Horiuchi-Hirose et al., 2023). Registered nurses with strong knowledge of anatomy and physiology can explain the theoretical foundation of their nursing practice. They also recognized that this knowledge is necessary for communication with multiple professions and is the foundation for building trusting relationships with patients and families (Horiuchi-Hirose et al., 2023).

To ensure that undergraduate nursing students and registered nurses understand basic anatomy and physiology and have nursing practice skills, the teachers should continue to look for effective learning strategies. Research on anatomy and physiology teaching methods has recently reported the effectiveness of blended learning (Meng et al., 2022; Shang and Liu, 2018), flipped teaching (Joseph et al., 2021; Bingen et al., 2020), and professional collaboration education

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(Numasawa et al., 2021; Mackinnon et al., 2021). There has been an increasing trend and discussion of integrating anatomy and physiology knowledge into nursing practice (Montayre et al., 2021). In recent years, the virtual dissection table (DT) has been developed as a tool offered by new technologies to replace human anatomy. This allows students to manipulate organs of the human body in any spatial orientation and observe them repeatedly. As a result, nursing students have reported improved performance and increased confidence when incorporating the virtual DT into their anatomy lectures (Bianchi et al., 2020). Instructions using CT-based 3D anatomy charts and cadaveric specimens have been reported to improve nursing students' confidence in their knowledge of pediatric anatomy (Whited et al., 2019). The effectiveness of anatomical learning using virtual cadavers and CT has been examined in medical education (Chytas et al., 2023a, Chytas et al., 2023b; Paech et al., 2017). Compared to traditional lectures and anatomy laboratories, simulation education has significantly higher student satisfaction and knowledge acquisition, leading to nursing practice (Naylor, 2020). Furthermore, including nurse-qualified educators in anatomy and physiology education has been shown to benefit the development of nursing practice thinking (Mukai et al., 2017). Devices used in teaching anatomy and physiology from a nursing perspective involve integrating anatomy and physiology with related disciplines, encouraging students to visualize human anatomy in three dimensions, and linking what they learn in anatomy and physiology to nursing practice (Satoh et al., 2023). However, Satoh et al. (2023) have reported limitations of the physical teaching environment, difficulties in teaching the importance of anatomy and physiology in nursing practice, difficulties in tailoring teaching content to learner readiness, and difficulties with terminology and concepts unique to anatomy and physiology.

Human cadaver dissection is used as an educational method in nursing to enhance understanding of anatomy and physiology. Autopsies have been reported to provide an opportunity to reflect on the meaning of death (Antonacci et al., 2021) and effective learning outcomes (Romo-Barrientos et al., 2020a). However, before dissecting a corpse, 17.6% of students reported being anxious (Romo-Barrientos et al., 2020b), which reached as high as 31.8 ± 33.7 points, indicating the possibility of a stressful reaction (Romo-Barrientos et al., 2020b). Some students stated that the smell of the corpse, the dissection room, and the sight of the corpse are distressing (Mingorance et al., 2021). Currently, the anatomy and physiology curricula have reduced cadaver dissection. Instead, these are being supplemented by immersive learning, in which virtual reality, dissecting tables, and other hardware and software provide 3D representations of anatomical structures as seen by the naked eye. In the future, educational methods that can surpass the learning effectiveness of dissection training should be considered for nursing students. Thus, this study aimed to determine the learning effects of cadaveric dissection on nursing students.

Methods

Scoping reviews were proposed by Arksey and O'Malley (2005) and later developed and extended by Levac et al. (2010). The methodology for the scoping review was recently refined and implemented concerning the guidelines developed by the JBI and the JBI Collaboration (JBIC) working group (Micah, 2020). This scoping review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) Checklist (Tricco et al., 2018).

Following the JBI's recommended mnemonic for scoping reviews, the present study identified research questions using the participant (P), concept (C), and context (C) framework. Based on the inclusion criteria, participants are nursing students, the concept is exploring the learning effects of cadaver dissection for nursing students, and the context is any educational setting, regardless of the country where the study is conducted.

Establishing Research Questions

What learning outcomes do nursing students gain from cadaveric dissection practice (CDP)?

Identifying the Relevant Studies

This scoping review included studies focusing on the learning effects of nursing students' experiences with cadaveric dissections. The studies included both actual cadaveric and observed dissections. The target audience included undergraduate nursing students and those who had completed their undergraduate studies and were pursuing careers as nurses, doctors, physiotherapists, and so forth. The language was English only. Systematic reviews and qualitative, quantitative, mixed, randomized clinical trials, prospective, backward-looking, cohort, case, and descriptive studies were all considered.

Study Selection

In August 2023, we conducted an electronic search of PubMed, ERIC, and CINAL.

The search terms used were "gross anatomy," "cadaver," and "nursing student." Using Boolean combinations of primitives, our final string was (gross anatomy or cadaver) AND (nursing student). Table 1 shows the search strategy, with the last access being on August 11, 2023.

The following studies were excluded: anxiety, physical reactions, and aversion experienced by nursing students and nurses prior to or following cadaveric dissection; those comparing cadaveric dissection with other studies (virtual dissection); comparisons of learning effects between actual cadaveric dissection and video viewing; and syllabus development. We also excluded studies published in languages

Table 1. Database Search Strategy and Results.

Database	Query	Record Retrieved
PubMed	((“gross”[All Fields] AND (“anatomy and histology”[MeSH Subheading] OR (“anatomy”[All Fields] AND “histology”[All Fields]) OR “anatomy and histology”[All Fields] OR “anatomy”[All Fields] OR “anatomy”[MeSH Terms] OR “anatomies”[All Fields])) OR (“cadaver”[MeSH Terms] OR “cadaver”[All Fields] OR “cadavers”[All Fields] OR “cadaver s”[All Fields])) AND (“students, nursing”[MeSH Terms] OR (“students”[All Fields] AND “nursing”[All Fields]) OR “nursing students”[All Fields] OR (“nursing”[All Fields] AND “student”[All Fields]) OR “nursing student”[All Fields])	97
ERIC	gross anatomy OR cadaver AND nursing student	263
CINAL	gross anatomy OR cadaver AND nursing student	327

other than English, abstracts only, letters to the editor, book chapters, guidelines, and comments. The first author (MHH) screened the article titles and abstracts based on the inclusion criteria. The first author double-checked the final screening, and any disagreements were resolved through discussions with the second author.

Carting the Data

The authors used Microsoft Excel to extract data on the article’s details (author, publication year, journal, country), study objectives, methodology, intervention type, and sample size. Two authors read the results for each paper and charted the data collaboratively. This served as the basis for the analysis.

Collating, Summarizing, and Reporting the Results

The heterogeneity between studies, and even within studies using similar methodologies, made meta-synthesis of qualitative data impossible. To integrate the findings, we took a textual narrative approach. This allows us to report on the study’s characteristics, context, quality, and findings while considering the scope, differences, and similarities between studies.

Results

Study Selection

The search results were exported into the bibliographic software EndNote (Clarivate Analytics, Philadelphia, PA, USA). Duplicate articles were removed with this software. They were then exported to Microsoft Excel, and two researchers evaluated the titles and abstracts using eligibility criteria. Disagreements among the authors were discussed and left intact if there was any doubt about the decision.

Figure 1 shows the PRISMA flowchart of the research process: 26 duplicate articles were removed, and 509 articles were excluded after title and abstract verification. Virtual education, computer learning, and syllabus development were all excluded, as were studies that compared virtual education to human remains dissection. Finally, nine papers met the eligibility requirements.

Summary of the learning effectiveness of nursing students in the practice of dissecting human remains is presented in Table 2. The ten studies were categorized by country, with two papers from Canada, Japan, and Taiwan, and one from Australia, the Isles, the United Kingdom, Ireland, and the United States. Of the ten studies examined, one was qualitative, six were quantitative, and three were mixed-method. Four studies included only nursing students, one included both nursing students and graduates, three included non-nursing students, and two only nurses. The nursing students who provided the articles were the target population for this study’s literature extraction. However, because CDP was carried out with nurses and learning outcomes were reported, articles involving nurses were included in the analysis without exception.

The sample types reported were four papers for “nursing and non-nursing professional students,” two papers for “nursing students,” and one each for “nursing students and faculty,” “BSN degree,” “nursing students and nurses,” and “nurses.” The objectives were met in seven papers on “Student learning, effect on grade, experiences, perceptions, and satisfaction.” One paper each was found on “the effects on academic performance,” “the effects on their nursing practice,” “the effects on professional identity,” and “the effects on cadaver dissection seminars.” Reports on the study design included four papers on “Before-and-after study” and “Cross-sectional survey” and two papers on “Descriptive qualitative design.”

The impact of cadaver dissection on the study of anatomy and physiology includes a deeper interest in the human body (Miyoshi et al., 2019) and a better understanding (Pruitt et al., 2021), which facilitates anatomical imagery and helps to form memories (Smith et al., 2015). It was also reported to be positively correlated with academic performance (Johnston, 2010) and a decrease in the proportion of students who did not earn credit (Fernandes et al., 2015). An autopsy provides an opportunity to construct an image of the significance of death and dying (Antonacci et al., 2021), the image of care for the patient before death, the meaning of existence

Table 2. Summary of the Learning Effectiveness of Nursing Students in the Practice of Dissecting Human Remains.

Author(s)	Year	Sample	Objectives	Study design	Summary of the findings	Country
K. Shinoda, S. Otsuka, K. Umemoto, K. Fukushige, M. Kurosawa, and M. Naito	2023	29 (medical students) 12 (nurse practitioner students) 20 (nursing students)	To investigate the effect of learning about interprofessional education in cadaver dissection seminars for 5 days each in 2021 and 2022 (the number of days of participation was arbitrary).	Before-and-after study	The Readiness for Interprofessional Learning Scale scores of medical and nursing students increased significantly. In terms of the number of days of participation, a significant increase in scores was found for participants who participated for ≥2 days.	Japan
C. Y. Huang, K. C. Lai, and H. L. Lai	2023	21 (nurses)	To explore nurses' perspectives on the effects of a humanistic anatomy program on their nursing practice.	Descriptive qualitative design	Positive learning experiences in human-centered (humanistic) anatomy courses lead to effective clinical practice (adaptation to the professional journey, time management when providing humanistic care, and development of professionalism).	Taiwan
O. Asman, I. Kagan, and M. Itzhaki	2022	223 students from two academic nursing programs (a four-year general baccalaureate nursing program and a two-year accelerated nursing program for non-nursing baccalaureate graduates)	To examine the participants' learning and emotional experiences, and their satisfaction with the anatomy practical sessions.	Cross-sectional study	Positive attitudes and learning experiences were correlated with a sense of identification with the nursing profession.	Israel
W. Pruitt, M. Parianos, N. Faraci, D. Heaner, D. Topping, and J. Burr	2021	22 (nursing students)	To determine whether medical students could create and deliver a cadaver lab workshop for nursing students that would benefit both groups of students at a neutral cost.	Cross-sectional study	The delivery of cadaver dissection training workshops by medical students for nursing students leads to a better understanding of the visualization of the size, spatial relations, and physical interactions between organ systems; increased confidence in patient care concerning physical examination and medical device management; and a better-perceived understanding of each profession's approach to providing patient-centered care.	US
R. Antonacci, L.M. Curiale, N. Ventura, K.E. MacMillan, and A. Tsimicalis	2021	168 (undergraduate and graduate nursing students)	To understand nursing students' experiences in the human anatomy laboratory to inform strategies that can be implemented to optimize learning.	Descriptive qualitative design	Nursing students' experiences in the human anatomy laboratory reflect the importance of death and dying and acknowledge the impacts on future practice.	Canada

(continued)

Table 2. Continued.

Author(s)	Year	Sample	Objectives	Study design	Summary of the findings	Country
H. L. Lai, Y. F. Lee, and K. C. Lai	2020	80 four-year BSN degree	To examine the correlations between students' characteristics (e.g., gender), psychophysiological responses, and academic achievement in anatomy.	Before-and-after study	A small proportion of students experienced physical symptoms and stress. Gender differences were observed in the anxiety of death caused by working with cadavers. None of the students' psychophysiological responses influenced their performance. Furthermore, the students demonstrated that the use of cadavers resulted in a certain level of engagement with the course, which was positively correlated with academic grades.	Taiwan
M. Miyoshi, T. Mori, C. Tanimura, H. Nakane, T. Mukuda, K. Okazaki, Y. Koyama, K. Hanaki, T. Nakano, and T. Kaidoh	2019	93 (nursing and clinical laboratory science students)	To investigate the effects of observing cadaver dissection on the professional identity of nursing and clinical laboratory science students and determine an effective educational support system for developing professional identity.	Before-and-after study	The professional identity score of nursing students decreased significantly after hands-on cadaver dissection experience. The responses of nursing students were classified into the following nine categories: deeper understanding of and interest in organs; deeper understanding of and interest in the human body; building an image of care for patients before death; significance of existence after death; accepting that death is not fearful; view of the afterlife; development of responsibility and awareness as a health professional/ learner; development of a more professional attitude toward work looking at diseased organs; and anxiety about and pride in engaging in work that affects life and death.	Japan
C. F. Smith, S. Hall, S. Border, P. J. Adds, and G. M. Finn	2015	13 institution's heads of anatomy (survey) 2 universities (case study)	To report on the use of anatomy interprofessional education (AIPE) in the UK and Ireland and the experiences of both students and teachers in AIPE courses.	Cross-sectional survey	All six advanced nurse practitioners who attended the AIPE module session completed the feedback form. The average ratings for the overall quality of the session, the enjoyment of the session, the clarity	UK and Ireland

(continued)

Table 2. Continued.

Author(s)	Year	Sample	Objectives	Study design	Summary of the findings	Country
					of the explanation, and the relevance of the material for clinical practice were all 5.0/5.0. All six advanced nurse practitioners also attended the focus group. One positive feeling toward being in the dissecting room was that using the specimens made it easier to visualize the anatomy and aid memory formation.	
A. R. Fernandes, A. Palombella, J. Salfi, and B. Wainman	2015	97 (medicine, midwifery, nursing, physician's assistant, physiotherapy, and occupational therapy programs students)	To clarify the impact of interprofessional education on the attitudes and perceptions of students in health professions.	Before-and-after study	The pre- and post-matched data revealed significant improvements in positive professional identity, competency and autonomy, role clarity, and attitudes toward other health professions. Qualitative analysis of interprofessional focus group interviews revealed significant improvements in several areas, including learning anatomy, clarity of roles, and attitudes toward other health professions.	Canada
A. N. Johnston	2010	189 primarily first-year students, but also some second-year students.	To present systematic feedback from nursing students who have had a single exposure to dissected human anatomical material and who have been able to manipulate and interact with that material concerning the integrated educational objectives and goals of this learning and teaching activity.	Cross-sectional survey	The percentage of students who have not earned credits has decreased because of the incorporation of cadaveric dissections into their education.	Australia

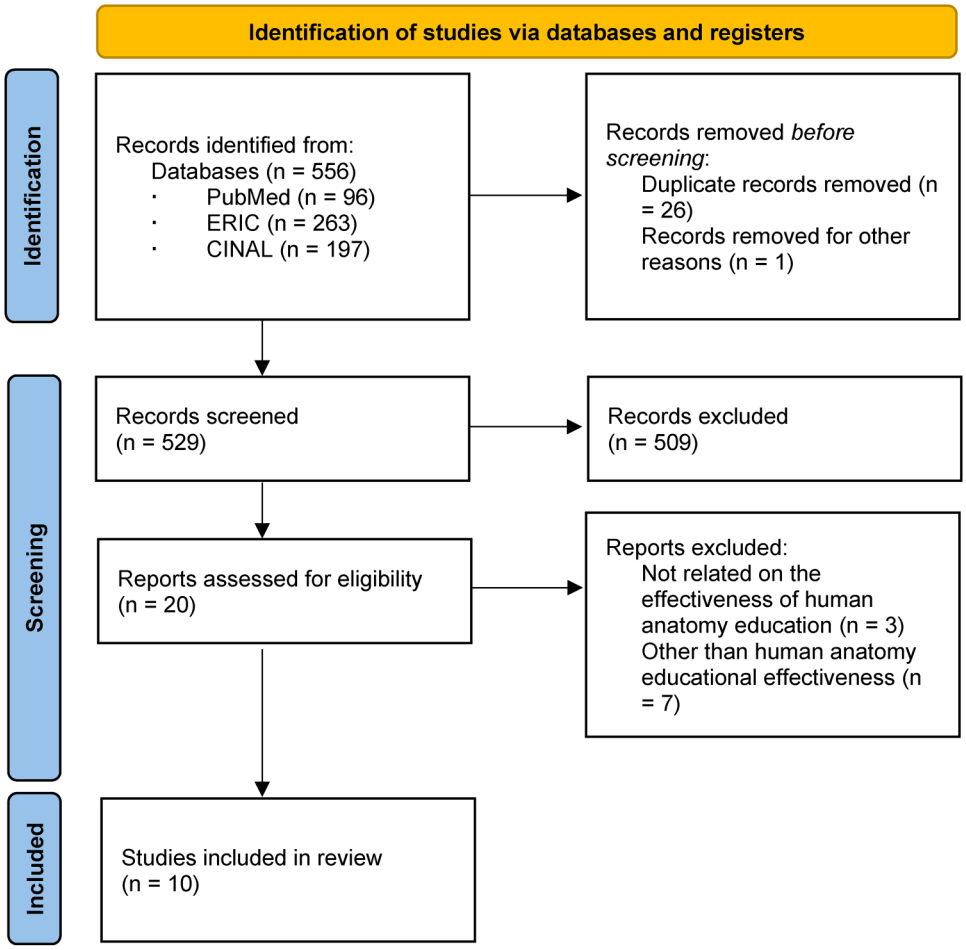

Figure 1. PRISMA flow diagram for the study search and selection process [diagram based on that of Page et al. (2021)].

after death, acceptance that death is not scary, and a view of the afterlife (Miyoshi et al., 2019). The impact of necropsy on clinical practice is improved confidence (Pruitt et al., 2021) and understanding of what other professions do (Pruitt et al., 2021). Significant gains in professional identity, competence and autonomy, role clarity, and attitudes toward other healthcare professionals are evident (Fernandes et al., 2015; Huang et al., 2023; Asman et al., 2022).

Discussion

This scoping review examined ten articles to determine the significance of nursing students' experience in cadaver dissection. The results revealed that cadaveric dissection can pique students' interest in the human body, promote understanding, shape their perspectives on life and death, and link to nursing practice.

Regarding one of the learning effects of CDP, which is a better understanding of anatomy and physiology, Tugtag Demir et al. (2023) reported that CDP greatly facilitates learning in medical education. Although the number of hours spent on CDP may be insignificant in comparison to medical education, it has been reported that in nursing education, "understanding is deepened by actually seeing, touching and feeling the organs" (Hayashi & Tanaka, 2023) based on the analysis of reports from anatomy specimen demonstration practice, which is consistent with this study's extraction. However, there are some specific concerns about CDP. Among the respondents, 17.6% reported feeling anxious prior to CDP (Romo-Barrientos et al., 2020b). In a report measuring state anxiety before and after dissection practice among first-year medical, occupational therapy, speech therapy, and nursing students, nursing students had the highest pre-practice state anxiety values than students from other professions (Romo-Barrientos et al., 2020a). Huang et al. (2023) found that medical students who performed cadaveric dissections were more psychologically affected than those who did not. Furthermore, a report on the impressions of medical, nursing, and physiotherapy students of dissection found that, apart from anxiety, there were many complaints of disgust and nausea, which were attributed to the smell and sight of the cadaver and the smell of the dissection room (Mingorance et al., 2021). Although

reports (Lai et al., 2020) suggest that psychological and physical reactions to cadaver dissection do not affect performance, it is important to consider educational preparation as well as the anxiety and physical reactions that students may have when experiencing CDP.

Students are highly satisfied with CDP (Romo-Barrientos et al., 2020b), and anatomy practice allows them to reflect on the meaning of death (Antonacci et al., 2021). Cadaveric dissection has led to a better understanding of organs, greater confidence in patient care, and a better understanding of the content of multidisciplinary practice (Pruitt et al., 2021). However, some reports claim these learning effects are only present in positive attitudes and experiences in cadaver dissection (Pruitt et al., 2021). Moreover, teachers' educational skills must be improved to maximize the learning effects of experiencing cadaveric dissection and increase satisfaction levels.

The learning effects of virtual autopsies and other methods have been reported in nursing education (Whited et al., 2021). A literature review conducted to determine whether virtual DT education can play an important role as a complement to CDP concluded that learning using virtual DTs can supplement the learning outcomes of CDP (Chytas et al., 2023b). Furthermore, a comparison of viewing a cadaveric dissection and a videotaped cadaveric dissection in first-year medical and nursing students showed a statistically significant difference in state anxiety. However, the video was reported to be less disgusting and did not affect sensitivity or attitudes toward death in either group (Belsiyal et al., 2022). Furthermore, team-based learning of cadaveric dissection significantly improves students' exam performance and positive perceptions (Chytas et al., 2023a). Students are highly satisfied with near-peer interprofessional education (IPE) sessions for prospective physiotherapists and physicians (Shields et al., 2015), and early implementation of IPE activities in CDP is beneficial, fostering both peer learning and positive perceptions of interprofessional roles (Alfaro et al., 2019). However, team-based teaching and incorporating various teaching methods most likely require improved quality on the part of teachers, but this is an issue for the future because teacher competence has not been investigated (Chytas et al., 2023a).

Only two papers limited the sample to nursing students, and many studies included students from professions other than nursing. Some results were extracted specifically for nursing students, but others were not. In addition, because all articles were extracted without any restrictions on the study design, descriptive qualitative design was also included, resulting in a narrative summary. Due to heterogeneity across studies and even within studies with similar methodologies, meta-integration of the qualitative data was not possible. Although a literature review of nursing students' perceptions of anatomy and physiology in this study, few articles specify the extent to which the learning effects are actually performed as dissections of cadavers or observed, and differences in emotions and acceptance of death were not examined.

Research on the learning benefits of CDP was conducted across a wide range of subjects and teaching methods. Thus, drawing specific conclusions about nursing students and nurses is impossible. The number of hours and educational content were also unclear, as was whether cadaveric dissection or specimen tours were performed.

Implications for Practice

Educators have a responsibility to provide effective education in order to discharge nurses with high nursing practice competence into society. The results of the educational effects of autopsies of human remains that have been conducted to date indicate that they provide an opportunity to think about death and lead to nursing practice. We believe that this will serve as an indicator for the development of effective anatomy and physiology education methods, including the consideration of an alternative teaching method.

Conclusions

It is necessary to share information with anatomy and physiology teachers about the learning outcomes obtained, as it has been shown to deepen understanding of anatomy and physiology, provide an opportunity to reflect on death, and have a link to nursing practice. Furthermore, the environmental and teaching staff face limitations when performing CDP. Alternative teaching techniques should be developed in the future.

Author Contributions

MHH did concept design, data collection, analysis and interpretation, and drafting of manuscript; TF participated in the data collection and analysis; SS participated in the study design, data collection, and analysis. All authors read and approved the final manuscript.

Consent for Publication

All authors read and approved the final manuscript.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

This research was funded by the Tokiwa University Research Incentive Grant.

Study Approval Number

SON-24-0087.R2

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