The use of postmortem exposure to improve the learning of anatomy and physiology in nursing students

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Background. Anatomy and physiology are crucial subjects in medical and nursing education curricula. However, many students find these subjects challenging owing to their complexity. To bridge the gap between theory and practice, a study was conducted to explore the use of postmortem exposure (PME) as a visual teaching strategy to enhance students' understanding of anatomy and physiology.
Objective. To explore how PME influences the learning of anatomy and physiology among enrolled nursing students.
Methods. The study adopted a qualitative methodology within an interpretivist paradigm. Data were generated through individual telephonic semi-structured interviews with the study participants. An inductive thematic analysis process was followed to identify themes in the data.
Results. The findings suggest that enrolled nursing students have difficulty comprehending anatomy and physiology when practical sessions are lacking. PME was identified as a valuable teaching tool that enhances students' knowledge acquisition and retention of these subjects. The findings suggest that PME influences various aspects of students' learning, including their knowledge, skills, behaviour and emotions in clinical practice.
Conclusion. The study concludes that PME helps enrolled nursing students to apply theoretical knowledge in clinical settings and has a positive impact on their learning of anatomy and physiology. Educators are encouraged to consider using PME as a teaching tool to improve their students' understanding of anatomy and physiology.

Keywords: postmortem exposure; anatomy and physiology; nursing students; health professions education; nursing education

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Anatomy and physiology are regarded as essential foundational subjects in 21st century medical and nursing education. Cannon and Bauer[1] highlight the importance of all health science students having a sound knowledge of anatomy and physiology to practise safely and effectively in their respective fields. Despite the importance of these subjects, many health science students may find the learning of anatomy and physiology daunting owing to their educational backgrounds,[2-4] including students who have different learning styles. Only one method of teaching is not sufficient to meet students' diverse needs; therefore, the incorporation of different teaching tools and methods to enhance understanding during learning is emphasised.[5] It is, therefore, vital that educators implement teaching strategies that could enhance health science students' engagement with the learning of anatomy and physiology.

A comprehensive understanding of basic anatomy and physiology subject matter is critical for nursing students in delivering high-quality care.[1,2,4] Furthermore, knowledge of anatomy and physiology lays the foundation for taking a patient's history, formulating a nursing diagnosis and implementing an effective nursing care plan.[1,2,4] Enrolled nursing students in this context are students pursuing a 2-year general nursing and midwifery science programme at Welwitchia Health Training Centre (WHTC) in Namibia to qualify as enrolled nurses/midwives/accoucheurs. However, not all of them had biology as a subject at secondary school, which makes it difficult for them to understand anatomy and physiology concepts.

Interactive learning, by making use of visual and practical activities, is one of the ways students can more effectively achieve the outcomes set for anatomy and physiology modules. As a lecturer of anatomy and physiology for nursing students, I (ANTL) have observed the importance of acquiring subject-specific knowledge as a foundation for understanding the anatomy and physiology of the human body. Although the enrolled nursing students in this study are trained in a resource-limited environment without technological teaching aids or access to 3D anatomy and physiology software, there is a forensic mortuary where postmortems are performed daily. Furthermore, I assumed that exposing students to a postmortem would contribute to the visual learning experience that enhances their development of anatomical and physiological knowledge. The assumption was that postmortem exposure (PME) would aid students in having a better understanding of the relationship between anatomy, physiology and pathophysiology. It was envisaged that this teaching approach would enable enrolled nursing students to more effectively link theoretical and practical knowledge, thus assisting them in easily connecting the patient's subjective and objective data during clinical practice. Students were exposed to a postmortem to enable them to consolidate what they learnt in theory with the observation of a real human body and its internal structures. In a single session, assisted by two pathologists, students were exposed to multiple bodies. This assisted them in visualising the wide range of different pathological manifestations of the internal organs due to various causes of death. The pathologists interacted with the students as they conducted the postmortem, and the lecturer took part in all the sessions. Due to a paucity of literature exploring the teaching method of using postmortems to visualise anatomy and physiology in an undergraduate nursing curriculum, this study aimed to explore whether enrolled nursing students found the intervention of exposing them to a

postmortem useful in their learning process. The study aimed to fill this research gap by investigating enrolled nursing students' perceptions and experiences of the learning of anatomy and physiology after PME in a resource-constrained setting in sub-Saharan Africa.

Methods

A qualitative exploratory study within an interpretivist paradigm was used to develop a deeper understanding of the human experience specifically related to nursing students after PME.[6,7] An interpretivist paradigm was employed, as the study focused on a group of students to understand their experiences, feelings and perceptions of PME. Interpretivists believe that reality should be understood through the meaning that research participants bring to their world.[8] Data were generated through individual semi-structured telephonic interviews using baseline questions for each participant, followed by probing. Telephonic interviews were conducted because of COVID-19 restrictions. Fourteen interviews were conducted with enrolled nursing students after ethical clearance was obtained from Stellenbosch University (SU)'s Health Research Ethics Committee (ref. no. S/20/07/172), the Namibian Ministry of Health and Social Services (MOHSS), as well as the WHTC. Interviews were transcribed verbatim, coded and analysed inductively using the six-phase thematic analysis described by Braun and Clarke.[9]

Results

The data analysis included the grouping of codes into themes and subthemes. The themes identified were: (*i*) students' conceptualisation of PME; (*ii*) diverse experiences and students' coping mechanisms; (*iii*) influence of PME on the learning of anatomy and physiology and clinical practice. In theme three, four subthemes were identified (Fig. 1). PME influenced the students in four primary areas: cognitive influences, which include knowledge acquisition, affective influences, psychomotor influences leading to professional growth and changed behaviour (Fig. 1).

The findings suggest that most students were uncertain about what to expect during PME. However, other students simply said they were curious to know what happens during a PME:

> P1: 'I didn't know what happens when a person dies so I came to find out that they open a person just to check the cause of death and what causes the disease.'

Students revealed the different emotions they went through, such as sadness, fear and anxiety, as well as the unpleasant smell, while the majority found PME interesting:

> P8: 'It was not easy for me it was so emotional that why I just started crying like I am feeling sorry for person who is there. Regardless of what happened to them I was just there feeling pity for them and started crying.'
>
> P7: 'I was very interested in seeing the brain itself like touching it and feeling it because I never saw one before, it was really interesting.'
>
> P9: 'And when I came there the only thing that disturbed me was the smell, like there was just this unique smell, I never really experienced such a smell.'

Students described how they learnt anatomy and physiology before PME and how their learning changed afterwards:

> P12: 'When the lecturer is lecturing she could just basically show us pictures and then we could just imagine in our heads … I use to imagine as if the stomach is just like maybe always like a balloon sort of.'

Most students elaborated on how PME positively impacted their grasping of concepts in clinical practice and also the learning of anatomy and physiology. Some students gave examples of how PME influenced their learning of a particular topic in anatomy and physiology:

> P11: 'I remember the heart when you use to tell us the heart is located in the thoracic cavity under the sternum, as I was reading those things I was remembering like, the doctor said it is under the sternum, it is under the lungs and, I was like a bit on the left side and I was like this is interesting, and as I was reading I was remembering the colour, the shape and the arteries the veins and the muscles I was remembering those and it was easy to study anatomy and I think that is why I passed anatomy.'
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> P5: 'They were talking of the lymph nodes and they even had to cut and show us how it looks like, they even had to show us all the organs inside

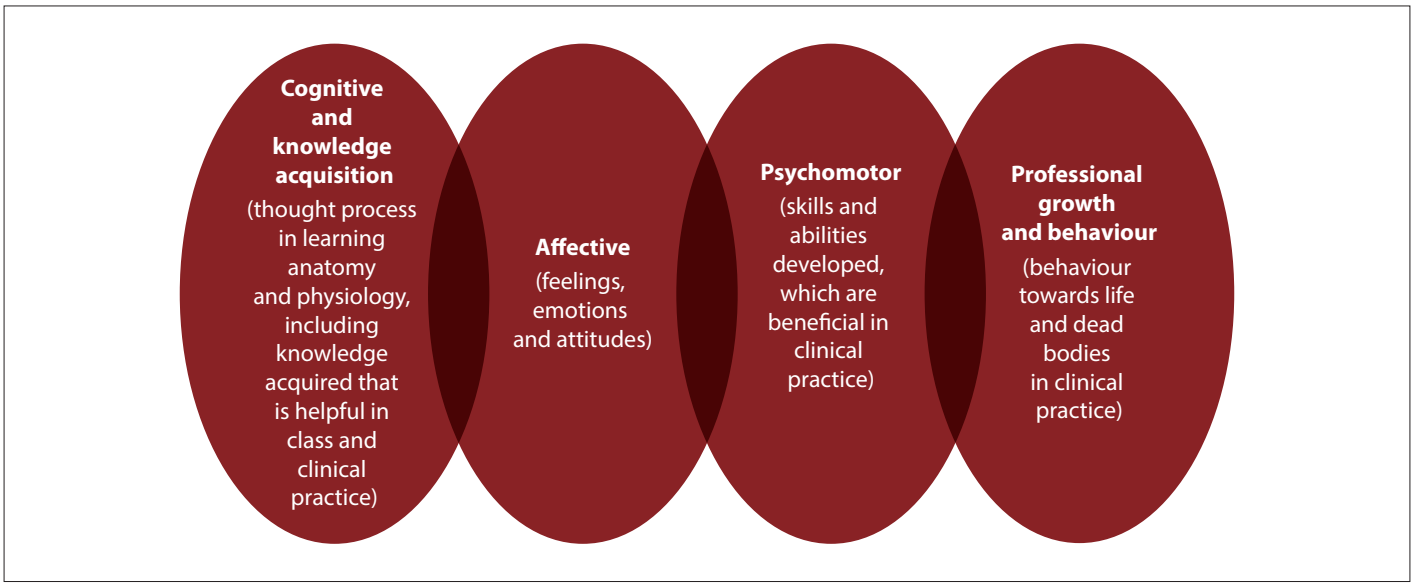

Fig. 1. Effects of postmortem exposure on enrolled nursing students.

and how they are actually in a nice order, and they are not just there they are actually being protected by either their sacs or certain fats because they even said fat is needed to protect certain organs but for example the kidneys they need a little bit of fat just to protect them so that even if you hit yourself somewhere at least that fat will make a cushion and help the kidney not to get damaged so all that I have to know and I have to relate.'

Other students simply described the influence of PME on their learning by using words such as 'relate' and 'visualise'. In addition, all the students agreed that PME was a valuable learning experience:

P3: 'Saying anatomy and physiology is not an easy subject, personally speaking it wasn't easy for me it was just too much that I couldn't relate to, before that you know I was just cramming, you just cram because anatomy seriously or physiology it's not a joke so before I was just cramming to pass the test or the exam but now it's from memory.'

P12: 'I still see it clearly, when you see something physically it is more difficult to forget it than when somebody has described something to you … I no longer visualise in my head to see how it looks like that but actually my mind takes me back to where the post mortem was being done and then I can see it clearly in my head, it makes me learn better, understand things better … it is like reinforcing, relearning unlearning, it was like to my advantage putting more on that learning side like trying to boost it, boosting the learning that we had in class.'

Furthermore, it became evident that nursing students felt sidelined by not having the same PME opportunity as medical students. A few students emphasised that they were labelled incompetent during clinical practice, but their limitation was linked to a lack of practical teaching during anatomy and physiology lessons. They therefore recommended that because they were the ones at the bedside of patients and directly involved in the care of the deceased, PME should become standard practice for all health professions students. PME not only added value to their anatomical and physiological knowledge, but prepared them to cope with death, and to perform nursing interventions with deeper understanding, which could contribute positively to caring for patients:

P1: 'It also helped me when a person for example now is telling me that he or she is having pain somewhere I will be able to tell which organ could be in danger.'

P11: 'It is removing your fears, it is making you get used to the dead bodies and it is making you want to do more nursing … it made me stronger, imagine if I was never at the mortuary and then I go and see the person dying for the first time in the big room, I will panic and I will even start crying.'

Students concurred that PME for nursing students is beneficial and should continue. Most of the students concluded that PME has educative benefits and is important in determining the cause of death. Some students felt that PME contributed to helping them manage their emotions, especially when involved in a case of death. PME boosted their confidence due to the knowledge gained, and contributed positively to their learning by encouraging them to become self-directed learners. Many of the students recommended that PME be extended to all health professions students but noted that debriefing and counselling should be provided for the students who might need support to manage their emotions and make sense of their learning during PME.

Discussion

Preconceptions of PME

It was evident that enrolled nursing students had their preconceptions of PME, influenced by diverse backgrounds and the anecdotal stories they had heard about a postmortem. Most enrolled nursing students had minimal information about the purposes of PME, and a few students thought PME was to build emotional capacity in preparation for clinical practice. This finding contradicts the findings of McNamee[10] and Cannon and Bauer,[1] as the students in their studies were knowledgeable about the rationale for PME. The differences in the study results can be attributed to the diverse backgrounds of the students and the pre-knowledge during the high school years. In addition, the anxiety, fear, and sadness that students in this study experienced were the same as in other studies that employed PME as a teaching tool.[1,4,5,11,12] These similarities could be attributed to human emotions that are universally shared.[13]

A postmortem is not a widely discussed topic in most cultures in Namibia, and it was not surprising that some enrolled nursing students had no idea of what PME entails. Furthermore, PME is not mandatory in nursing schools in Namibia and there is equally no literature that has explored the use of PME as a teaching tool in the country. The available literature on the use of PME as a teaching tool involving nursing students is mainly from Europe, where students who were exposed to postmortems had previous information of what happens during a postmortem, either by watching videos on YouTube or through the lecturer's instructions and, thus, knew what to expect.[1,12] There is a paucity of literature exploring the preconceptions of students of PME, and this study has provided some further insight.

Changed perceptions

Although the focus of the study was not on determining whether the students knew why postmortems were conducted, it became evident that at the end of the postmortem, they understood the reasons. The enrolled nursing students also appreciated the visual anatomical and physiological content offered by PME. Furthermore, the knowledge students acquired during the postmortem was beneficial to them – not only as enrolled nursing students but also as future enrolled nurses who may be involved in educating the communities they serve. The call upon educators to help students to become reflective practitioners by using teaching methodologies that challenge students to be critical and reflective thinkers is important in the 21st century. However, reflective thinking may not always be achieved in a traditional curriculum. The incorporation of PME was aimed at helping enrolled nursing students to understand what human organs look like in reality. The assumption was that as students view the organs, they will comprehend the link between theory and practice and that the new understanding will aid them in making new meaning and develop depth of understanding of the human body. However, it is important to acknowledge that the new knowledge and understanding that the students derive from PME are influenced by students' reflections on the experience.[4] In addition, when enrolled nursing students understand a postmortem and its implications for the bereaved family, they may be able to offer emotional support to the relatives of the deceased. This finding is similar to findings in the studies by Cannon and Bauer,[1] Bamber and Quince[2] and Keiser and Murray-Wright.[14]

Diverse experiences and students' coping mechanisms

Feelings and emotions

Students experienced various feelings and emotions such as sadness, fear and disgust during the postmortem. A feeling that the body was treated inhumanely, anxiety before the postmortem, difficulty eating meat and nightmares were reported effects of students in this study. These findings are consistent with those in studies that reported on PME as a teaching tool.[1,2,10] It was noted that students adapted and were able to focus during the postmortem. This result is in line with what Cannon and Bauer[1] and Keiser and Murray-Wright[14] found in relation to student adaptation. Furthermore, although PME was a difficult experience for most nursing students, they appreciated its benefit. Medical and nursing students in different studies expressed fear of infection and contamination,[1,2,10] which was not expressed by the enrolled nursing students in this study. They experienced strong sensory stimuli and found the sight of the bodies to be gruesome, a finding consistent with those in other studies.[1,2,11] Feelings of empathy were also consistent with those in other studies.[1,10,14] Students who attend a postmortem for the first time may find the experience difficult compared with those who have attended multiple postmortems, which is the result of desensitisation and familiarity.[3,12] Consequently, this means that for students to benefit fully from PME, multiple visits are useful rather than a once-off PME.

Sources of support and coping mechanisms

Students applied various coping mechanisms, including having discussions with peers and motivating themselves during PME. Support from the forensic team was key in assisting students to attend PME from start to finish. Internal motivation was the main driving energy, and the students who endured to the end kept motivating themselves. The recommendation of other studies to debrief students before and after PME as it reinforces the positive experience of the students is similar to what our study found.[1,14] Other studies suggest the use of background music and preparing the students in advance for what they can expect.[11,15] Counselling for students who had severe emotional effects was recommended. Some students felt comfortable discussing their emotions and feelings and engaging with peers after the exposure. The pathologists' understanding and empathy made students feel comfortable, as reported by many students. However, in line with the study by Anders *et al.*,[12] the students highlighted that the physical nature of the autopsy and the pathologists' behaviour were equally important in how they coped after PME. Therefore, debriefing with the pathologists before and after PME is considered vital in how students respond, and it should not be neglected.

Influences on the learning of anatomy and physiology and clinical practice

Overall, students viewed PME as an essential component in their health professions journey. It is beneficial for students to see human internal organs at close range, differentiating them from book images. Furthermore, PME offers students an explicit chance to observe pathophysiological changes due to illnesses, as well as to gain a better view of where internal organs are located.

Cognitive influences

PME influenced the students' thought processes regarding knowledge acquisition and retention in anatomy and physiology. This was demonstrated by how deeply the students could reflect, remember and visualise what they saw during the PME. In this domain, reflection is a key feature, as it allows the student to reflect in action and after the PME, whether during their study time or in clinical practice. PME posed a disorientating dilemma, as students would go back and forth between what they were taught in class and what they observed during the PME. This resonates with the study's theoretical position relating to transformative learning theory. Mezirow[16] and Tsimane and Downing[17] state that for learning to occur, a disorientating dilemma is necessary to aid in unlearning, relearning and learning new knowledge. This study has illustrated that students learn differently, and being exposed to PME strengthened their knowledge acquisition and retention of anatomical and physiological parts. Students in this context were limited to textbooks only, which influenced their learning abilities. Being able to see the physical internal organs assisted students in consolidating what they learnt in theory, and they were therefore able to construct long-term memories of the body parts compared with using only textbooks as a learning tool.

The value of using PME is similar to what other scholars have found in their studies, such as helping students learn anatomy and physiology, exposing the hidden curriculum, making students empathetic, preparing them to handle death in clinical practice and influencing their outlook on life as professionals.[16-19] Enrolled nursing students were able to visualise what they were taught from textbooks, the latter possibly not being an accurate representation of the body parts. In agreement with the information processing model by Ausubel,[20] lack of visual stimuli may hinder information retention over an extended period. Therefore, to promote active learning as a means of knowledge construction, PME is necessary to help students to learn anatomy and physiology. However, for enrolled nursing students there is some evidence to suggest that they face challenges in class when they are taught something they have never seen; therefore, students experience difficulty when making associations between the different body parts, especially the internal organs. The enrolled nursing students had resource limitations, as they had been exposed only to textbook content with no access to a skills laboratory, and limited internet access during school hours, except those who had access to internet facilities from home. The only teaching aid is a skeleton and a mannequin of human internal organs, which are not sufficient to showcase the human organs and enhance anatomical and physiological knowledge among the enrolled nursing students.[18]

Disorientating dilemma

Based on the narratives of the students, they went through a disorientating dilemma, as they had to challenge their knowledge and understanding of anatomical and physiological concepts during the postmortem. Some students experienced an 'aha' moment when they saw what the real organs looked like compared with what they had initially imagined. According to Mezirow,[16,19] a disorientating dilemma is important, as it facilitates students to question their past understanding and beliefs, leading to the acquisition of new knowledge and skills. In addition, a disorientating dilemma may aid transformative learning. Transformative learning can be achieved as students acquire new information and become intentional in their day-to-day practice as reflective students.[19] However, transformative learning cannot take place without reflection and self-directed learning and PME enabled our students to become self-directed learners. Students expressed that they needed to study further to gain more understanding of what they saw.

Psychomotor influences

The psychomotor influences describe the effect of PME on the students' skills and abilities in clinical practice. Enrolled nursing students identified themselves as important cadres in caring for the sick. They desired to practise with knowledge and understanding, but practical limitations during their student years might affect how they practise their profession. Students shared how, during the practical allocations, they were often labelled as incompetent, but they related this to the lack of practical exposure to anatomy and physiology, which is one of the core subjects in nursing. Without fully understanding how the human body functions and the relationships between the different body systems, the students may struggle to provide effective clinical care.

During clinical practice, the students are expected to apply their anatomical and physiological knowledge when caring for the sick. PME helped them to reflect on how the body functions, how the internal organs are interrelated and how these affect one another. This finding is consistent with the findings of Cannon and Bauer,[1] where baccalaureate nursing students described how PME helped them to understand the interconnection between the body parts. Enrolled nursing students highlighted that they were able to connect subjective and objective patient data after PME. Moreover, they could take a patient's history with understanding and conduct physical examinations with confidence, knowing the location of the body parts and internal organs aided by visualisation. This finding is consistent with those in the studies by Cannon and Bauer,[1] Bamber and Quince,[2] and Keiser and Murray-Wright,[14] in which similar findings were highlighted.

Affective influences

The enrolled nursing students believed that PME prepared them to manage their feelings and emotions when faced with difficult situations such as death. This finding is in line with the findings in other studies that highlight the value of PME for both medical and nursing students.[1,2,14,21] However, the study participants who had been exposed to postmortems expressed surprise at how their behaviour changed when they were handling dying patients, and they attributed this behaviour to PME. The findings therefore show that, although PME may initially be perceived as traumatic or gruesome, this learning strategy might offer many benefits and determine how enrolled nursing students practise their profession.

Study limitations

The study involved enrolled nursing students, some of whom did not have biology as a foundational subject during their high school years. However, during the interviews, we did not explore this factor, which limits our ability to compare their responses based on prior biology knowledge. Moreover, the interviews were not conducted immediately after PME, and students therefore had to recall and reflect on the exposure. Memory decay and reinterpretation of the experience might have affected their responses, potentially introducing bias. The researcher was the subject lecturer and the interviewer, and due to power differentials it might have influenced the participants' responses based on their perception of the researcher's authority or expectations. Nonetheless, despite these limitations, the researcher remains optimistic about the trustworthiness of the study findings in comparison with similar educational contexts, as the insight gained could still offer a valuable perspective.

Conclusion

The study explored enrolled nursing students' perceptions and experiences of the learning of anatomy and physiology after PME in a resource-constrained setting in sub-Saharan Africa.The research suggests that PME has a valuable impact on the learning of anatomy and physiology for enrolled nursing students. PME provides students with unique opportunities to gain visual insights into the human body's internal structures, which may not be as effectively conveyed through textbook-based teaching alone. In addition, PME encourages enrolled nursing students to become reflective and self-directed learners. The outcomes of the study suggest that the experience stimulates critical thinking skills and independent learning, which are valuable qualities for healthcare professionals. Enrolled nursing students reported that PME allowed them to bridge the gap between theoretical knowledge and practical application. This incorporation of knowledge is crucial, as it enhances the ability of nursing students to provide effective patient care.

Furthermore, PME contributes to the development of empathy among enrolled nursing students. Understanding the physicality of internal organs and witnessing the reality of death may make students more empathetic in their interactions with patients, particularly those at the end of life. The students described changes in their behaviour in clinical practice, probably due to the awareness gained from PME. This indicates that the students' participation in PME has a practical impact on their ability to navigate sensitive situations involving dying patients and enables them to provide care with dignity and respect. The study highlights the initial difficulty that some students may face when exposed to PME. Therefore, the need for proper support and debriefing both before and after PME were emphasised. The support is crucial in helping students process their emotions and experiences healthily and constructively.

Overall, the potential benefits of incorporating PME into the education of enrolled nursing students, particularly in the context of anatomy and physiology, are highlighted in this study. The emphasis is on moving towards student-centred learning approaches and providing the necessary support to help students navigate challenging experiences such as PME effectively. However, the authors recommend that further comparative studies on students who had biology as a foundational subject and interviewing them immediately after the exposure should be conducted to determine if the impact of PME will vary among the participants.

Data availability. Data are available from the corresponding author on request.

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