

Acquisition of cadavers for anatomy education and research in Malawi

Arthur Tsalani Manjatika^{a,b,*}, Joshua Gabriel Davimes^{b,2}, Anthony Mwakikunga^a

^a School of Life Sciences and Allied Health Professions, Department of Biomedical Sciences, Anatomy Division, Kamuzu University of Health Sciences, Blantyre, Malawi

^b School of Anatomical Sciences, University of the Witwatersrand, Parktown, Johannesburg, South Africa

ARTICLE INFO

Keywords:

Anatomy education
Indigenous Malawian
Body donation program
Cadaver sources
Human Anatomy
Unclaimed body

ABSTRACT

Background: The use of human cadaveric dissection forms an essential part of teaching anatomy to health sciences students in Malawi. Despite worldwide struggles in acquiring sufficient human cadavers for anatomy education, the current recommendations on the best anatomy practices require the use of cadavers exclusively from the body donation programs. The current study aims to describe the sources of cadaveric bodies used for anatomy education in the Malawian context and reflect on the feasibility of using cadavers from the body donation program only.

Methods: A retrospective audit of the cadaveric records for the 2006–2022 academic years at the Kamuzu University of Health Sciences was done. The perceived challenges when sourcing the cadavers were identified and described based on the authors experiences in Malawi.

Results: The majority (97.3%) of the cadavers used between 2006 and 2022 were unclaimed bodies. The mean age of the cadavers was 45 years. Most (95.6%) of the unclaimed bodies were males. All the unclaimed bodies were sourced from hospitals. The body donation program in Malawi was patronized by populations of European descent only. Strongly held sociocultural and religious beliefs as well as economic reasons were perceived as significant barriers to acquiring cadavers of the indigenous Malawians through the body donation program.

Conclusion: Cadavers for anatomy education in Malawi are mainly from unclaimed bodies, similar to other African countries. The authors support the transition from using “mostly unclaimed bodies (and, less often, body donation)” to using “mostly body donation (and, less often, unclaimed bodies)” through awareness campaigns that are targeted to address the prevailing challenges.

1. Introduction

Human anatomy is known to form the basis of teaching and learning in clinical practice, specifically for healthcare professionals who handle patients (Estai and Bunt, 2016). Despite numerous criticisms (Nandi et al., 2000; Pawlina and Lachman, 2004; McMenamin et al., 2018; Emanuel, 2020), the use of cadaveric dissection is still considered a gold standard method for teaching and learning anatomy (Patel and Moxham, 2006; Kerby et al., 2011; Davis et al., 2014). Preferences for this method of teaching are well acknowledged for over the last 400 years (Azer and Eizenberg, 2007). The advantages of cadaveric dissection include enhancement of active and deep learning, improvements of manual skills in preparation for clinical practice, preparation for encounters with death and understanding of patient-physician

relationships (Azer and Eizenberg, 2007; Fruhstorfer et al., 2011). Globally, most health sciences institutions have registered a decline in the cadaveric-based teaching method over the years mainly due to the challenges in acquiring cadavers and due to the adoption of modular and more clinically oriented curricula (Estai and Bunt, 2016; Gürses et al., 2018).

Historically, human cadavers for anatomy education have been acquired through a variety of ways that include grave robbing, bodies of executed criminals, unclaimed bodies from hospitals and prisons, and most recently through well-established body donation programs (Gangata et al., 2010). The International Federation of Associations of Anatomists (IFAA), a body that advises global anatomy practices, recommends the use of donated bodies as the only way of acquiring cadavers for anatomy education in modern times based on ethical reasons

* Correspondence to: Anatomy Division, Department of Biomedical Sciences, School of Life Sciences and Allied Health Professions, Kamuzu University of Health Sciences, Private Bag 360, Chichiri, Blantyre, Malawi.

E-mail address: arthurmanjatika@gmail.com (A.T. Manjatika).

¹ ORCID:ATM: 0000-0003-0867-7123

² ORCID:JGD: 0000-0001-9808-5249

<https://doi.org/10.1016/j.aanat.2024.152212>

Received 20 July 2023; Received in revised form 27 November 2023; Accepted 16 January 2024

Available online 18 January 2024

0940-9602/© 2024 Elsevier GmbH. All rights reserved.

(IFAA, 2012). Globally, the modes of acquiring cadavers have been classified into five categories: (1) exclusively body donation, (2) mostly body donation (and, less often, unclaimed bodies), (3) mostly unclaimed bodies (and, less often, body donation), (4) exclusively unclaimed bodies, and (5) other sources (e.g., import of cadavers from abroad), either exclusively or in addition to another category (Habicht et al., 2018). While most Western European and North American health sciences institutions are believed to run successful body donation programs and have stopped the use of unclaimed bodies, most African health sciences institutions on the other hand, thrive through the use of unclaimed bodies (Gangata et al., 2010; Ihunwo, 2014; Mazyala et al., 2014; Riederer and Bueno-López, 2014; Mwachaka et al., 2016; Habicht et al., 2018). Notably, most health sciences institutions relying exclusively on cadavers from body donations are from developed countries (Gangata et al., 2010; Jones and Whitaker, 2012; Habicht et al., 2018; Štrkalj et al., 2020). Gangata et al. (2010) reported that body donation programs in African countries relied on donors of European descent, rather than the indigenous African population. Besides facing comparable challenges in obtaining cadavers from indigenous Africans, health science institutions in Africa have encountered difficulties in establishing effective body donation programs. The underlying sociocultural, economic and political reasons leading to limited success in running body donation programs utilizing indigenous African populations in developing countries like Malawi are unclear (Štrkalj et al., 2020). Recommendations may best be adopted and implemented if the specific environmental context is first understood.

Malawi is a sub-Saharan developing country located in the south-eastern part of Africa. Malawi has an estimated 19.8 million people, mainly (97%) constituted by indigenous African populations that are subdivided into ethnic groups, a small proportion of people of European descent (0.04%) and people of mixed ancestry (2.5%) (Statistics, 2018). The Malawian ethnic groups have distinct cultural and religious practices, though most of them overlap. The religious practices include Christianity (77.3%), Islam (13.8%), Ancestral worship and others (6.7%), with some (2.1%) who do not identify with any religion (Statistics, 2018; Demographics. 2023).

In Malawi, human anatomy is taught in many public and private health science colleges and training institutions, but Kamuzu University of Health Sciences (KUHeS) is the only institution in Malawi that uses cadaveric dissection in the teaching of anatomy. Three other public and private health science institutions that require the use of cadaveric and skeletal materials make use of the anatomy department of the KUHeS. At KUHeS alone, human anatomy is taught to around 1000 students each year across multiple courses, including Bachelor of Medicine Bachelor of Surgery, Bachelor of Dental Surgery, Bachelor of Biomedical Sciences, Allied Health Sciences (such as physiotherapy, pharmacy, and medical laboratory sciences), Bachelor of Nursing and Midwifery, and post-graduate biomedical sciences. To enhance their learning experience, medical, dental surgery, and biomedical sciences students are given the opportunity to perform in-depth full-body cadaveric dissections using a regional approach with approximately 12–15 students per dissection table. On the other hand, allied health profession teaching uses prosection, skeletal material, and plastic models.

KUHeS, formally known as the College of Medicine-University of Malawi, was opened in 1991 as the first medical school and became an independent university in 2021. At KUHeS, the (cadaveric) body donation program was implemented in 2006. Remarkably, considering over 17 years of existence of the body donation program, only a single study has investigated and reflected on their impact and mode of sourcing (Gangata et al., 2010). The current study aims to describe the sources of cadaveric bodies for anatomy education and research in the Malawian context, and critically reflect on the feasibility of implementing the IFAA recommendations.

2. Material and methods

To determine the sources of cadavers for anatomy education, a retrospective audit of the KUHeS Anatomy Department cadaveric records from 2006 (implementation of body donation program) to 2022 was done. This retrospective audit complies with the Anatomy Act 14 of 1990 of the Malawi Government (Act, 1990). The study ethical clearance was waived by the University of Malawi's College of Medicine Research Ethics Committee (P/02/10/872). In addition, permissions were obtained from the custodians of the cadaveric records. Information retrieved included the total number of cadavers used per academic year, the age and sex distribution of the cadavers, the sources of the cadavers (body donor program or unclaimed body), geographical sites/location from where the cadavers were sourced, and how the cadaveric remains were disposed of after completion of the dissections per academic year. For the donated cadavers, their sex and population affinity were also recorded. The '2018 Malawi Population and Housing Census' main report (Statistics, 2018) was used to ascertain the proportions of the Malawian population composition to determine their representations in the dissection halls. Additional details regarding the perceived challenges to sourcing cadavers and their possible solutions are described by the authors (A.T.M and A.M) in the results section, based on their experiences in handling (collecting/receiving cadavers from their respective sources, prosection, maceration and/ or cremation) cadavers in Malawi. These descriptions and perceptions were supplemented further by informal discussions with three other anatomy staff members (technical) of KUHeS. The authors describe and rank the perceived challenges from a list of common challenge themes found in the literature, such as 'sociocultural', 'political', 'economic', 'religious', and 'legislative', as described by Štrkalj et al. (2020).

2.1. Data analysis

The retrospective audit record data were managed in GraphPad Prism version 8.4.2. All the descriptive data were presented as frequencies and percentages. The perceived challenge themes (for example, "sociocultural" or "religious") were described based on the authors ranking. No statistical analysis was conducted based on the limited sample size.

3. Results

3.1. Sources of cadaveric bodies for anatomy education in Malawi

Between the 2006 – 2022 academic years, a total of 188 cadavers were used for dissections (Fig. 1), representing an average of 11 cadavers per academic year, and an approximation of 12–15 students per

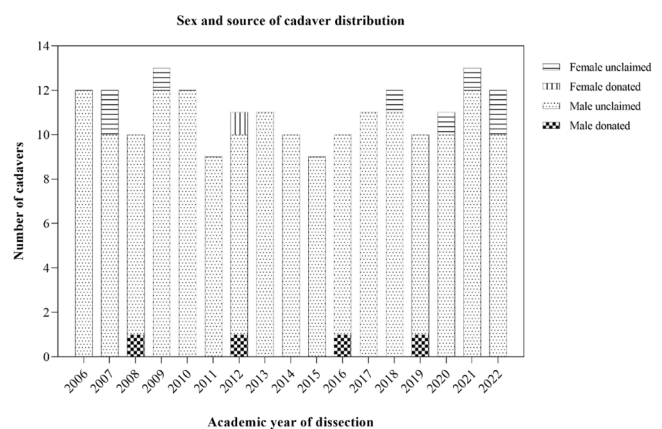


Fig. 1. A graph showing sex and source of cadaver distribution for the 2006 – 2022 period.

Please note that certain pages of this article have been removed in order to reduce the file size so that the PDF can be uploaded on the system (the system has a limit of 1MB for files and several PDF files are larger than this).

The first and last pages of each paper (with full bibliographic details and affiliations) are included.

If the entire unredacted paper is required, this can be emailed directly to whomever requires them by contacting Dr. Busisiwe Maseko on Busisiwe.Maseko@wits.ac.za

dissection table. Cadavers from the unclaimed bodies represented 97.3% while the cadavers from the body donation program represented 2.7% (5/188). The age at death ranged from 25 to 85 years (mean 45 years). The cadavers were predominantly males (95.2%) with very few females (4.8%). The unclaimed bodies were sourced from four main referral (central) hospitals: Mzuzu central hospital in the northern region (about 700 km away from the university), Kamuzu central hospital in the central region (about 400 km away), Zomba central hospital (about 70 km away) and Queen Elizabeth central hospital (about 0.5 km away) in the southern regions of Malawi (Fig. 2). The majority (90.2%) of the cadavers were from Zomba central hospital while few cadavers (1.0%) were sourced directly from district hospitals in the southern region (Table 1). The body donation program was implemented in Malawi in 2006 with the first cadaver being donated in 2008. One (1/5) of the donated cadavers was a female of European origin. Of the remaining male donated bodies, three were of European origin and one was a South African of European descent. Following completion of the dissections, the cadaveric remains of three (3/5) of the donated bodies were cremated, one (1/5) was returned to their family for burial (typical coffin burial) and one (1/5) was returned indefinitely to the Anatomy Department Skeletal repository. KUHes provided the burial and cremation-related costs. The skeletal remains from all the unclaimed bodies were retained indefinitely in the skeletal repository for teaching and potential research purposes.

3.2. Perceived challenges of body donation in Malawi and possible solutions

The perceived challenges during the sourcing of cadavers from the body donation program in Malawi, were ranked as follows: (1) socio-cultural, (2) religious, (3) unsubstantiated beliefs and (4) economical.

(1) Socioculturally, most indigenous Malawians practice unique burial ceremonies that vary in the length of time before the burial. Nearly all the burials occur within seven days after death and this depends on where death happened (for example in the home village, workplace in another district, or abroad/overseas) and the intended burial site. In cases where a Malawian national has died abroad or overseas, repatriation of the deceased is always facilitated to conform to cultural burial practices, for instance, paying their ‘last respect’. As such, Malawian traditional societies consider it inappropriate and unacceptable as per

Table 1
Cadaver source location for anatomy education over the past 17 years (2006–2022).

Location	Number of cadavers	
	Frequency (n)	Percentage of total(%)
Mzuzu central hospital	1	0.5
Kamuzu central hospital	5	2.8
Zomba central hospital*	165	90.2
Queen Elizabeth central hospital*	10	5.5
Mangochi district hospital*	1	0.5
Thyolo district hospital*	1	0.5
Total	183	100

* represents hospitals in the southern region of Malawi.

their customs to donate a body that may be retained after an academic year for burial. Possibly, the use of prominent traditional leaders as an initial point of contact to support body donation awareness campaigns may likely counter this challenge and lead to increased patronage of the body donation program by indigenous Malawians.

- (2) Religion: most religious practices (Christianity and Islam) in Malawi subscribe to the belief in life after death, and as such, a deceased body is not expected to be dissected in any way. In a few instances, the typical mortuary embalming, and post-mortem examination practices also raise religious concerns. The rationale behind these beliefs is rarely studied and, hence, poorly understood. Engaging with religious leaders in body donation awareness campaigns may subsequently eliminate or reduce this obstacle. This action, however, will best be implemented once the support from the traditional leaders has been obtained, as traditional leaders are more influential than religious leaders in the Malawian context.
- (3) Unsubstantiated beliefs regarding the use of deceased human body parts for ritual purposes were also perceived as a challenge that had contributed to the lack of patronization of the body donor program by indigenous Malawians. Numerous verbal and written claims in Malawian local newspapers have been made against mortuary attendants, suspecting them of removing some body parts during routine embalming and post-mortems. Another recent drawback to the body donation awareness campaigns came in around the 2014 and 2019 Malawi general elections period where claims of mass grave robberies were made nationwide. One possible way to overcome this challenge will be to engage the current and past students who have dissected previously to explain to the communities how the cadavers and human body parts are/were used as part of their training. This form of public outreach will likely improve the current view on body donation within local communities and families and in turn, increase public support of body donation.
- (4) Budgetary constraints also affect the mode of acquiring cadavers for anatomy education in Malawi. With ever-increasing costs of transportation due to the recurrent devaluation of the Malawian currency, it has been challenging to acquire cadavers from donors/unclaimed bodies residing outside the southern region of Malawi. A dedicated budget, for example, a grant for this purpose, may increase the number of cadaveric bodies available per year. Malawian anatomists will have to explore education-related grants to counter the financial challenges.

There were no perceived legal/legislative challenges as the Government of Malawi’s Anatomy Act 14 of 1990 (Act, 1990) allows the use of both donated and unclaimed bodies for anatomy education and research purposes. In addition to the legal provisions on the use of unclaimed bodies, hospitals regulate the maximum period before the burial of unclaimed bodies depending on the hospital’s storage capacity. Hospitals store unclaimed bodies for a maximum of 30 days. If the

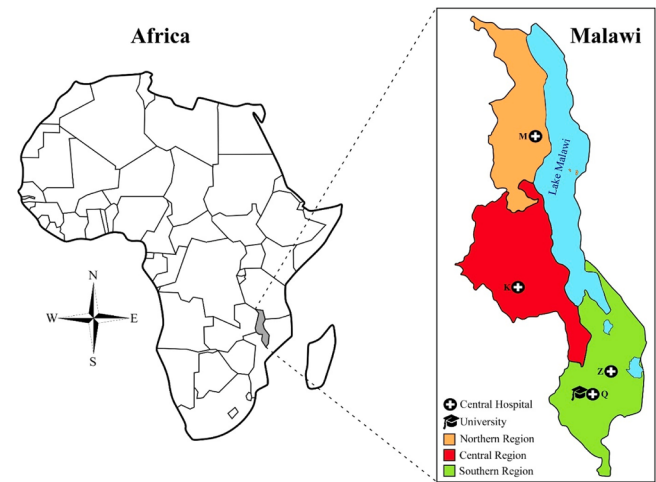


Fig. 2. A map of Africa showing the location of Malawi highlighted in grey. An inset detailed map of regional Malawi further shows the location of the main sources of unclaimed bodies and the location of the Kamuzu University of Health Sciences. K=Kamuzu central hospital, M=Mzuzu central hospital, Q=Queen Elizabeth central hospital, Z=Zomba central hospital.

bodies remain unclaimed after this time, they are referred to the medical schools for possible teaching and research purposes, or to the District or City Assemblies for disposal in mass graves at government cemeteries. The Malawi Police is involved in this process.

4. Discussion

This study aimed to describe the state of acquisition of cadavers for anatomy education in the Malawian context. The results show that the average number of eleven (11) cadavers per year is small as demonstrated by the high student-to-cadaver ratio (12–15 students per cadaver). With ever-increasing student enrolments, it may be recommended to increase the number of cadavers per year to achieve high levels of quality education and safety during dissections as per recommendations of the Basic Medical Education (BME) and Occupational Safety Health Administration (OSHA), (OSHA, 2005; BME, 2020). The current findings show that the mode of acquiring cadavers in Malawi is “mostly unclaimed bodies (and, less often, body donation)”, and this supports previous reports (Habicht et al., 2018). Similar to some other African countries, the concept of body donation is yet to be accepted by indigenous Malawians (Akinola, 2011). Despite legal provisions on the use of unclaimed bodies, the predominance of unclaimed bodies raises major ethical and moral concerns including loss of dignity of the deceased as no consent was sought, exploitation and social injustice as unclaimed bodies are often from low-income individuals (IFAA, 2012; Kramer and Hutchinson, 2015).

In the current study, most of the unclaimed bodies were younger adults, similar to the cadaveric profile of unclaimed bodies from other studies (Kramer and Hutchinson, 2015). The use of younger adults for dissections may be advantageous as most of the body organs are well preserved. Body donation programs may likely have more elderly people (Cornwall et al., 2012) and most of the structures may be affected by age-related changes. For a good representation of the young and elderly populations, the use of both unclaimed and donated bodies for anatomy education may be recommended. While most of the body donors may be from nursing homes/institutions for the elderly, there are limited nursing homes and elderly clinics in Malawi (Cornwall et al., 2012; Nyasa et al., 2019). This may be because living in extended families is a common practice in Malawi and most elderly people live together with their families. Possibly, this may be based on socioeconomic reasons considering the high cost of living associated with being at a nursing home.

Fewer female cadavers were utilized in our context. This is similar to the cadaveric composition of many countries where female cadavers form a minority percentage of both donated and unclaimed bodies (Labuschagne and Mathey, 2000; Hunt and Albanese, 2005; Techataweewan et al., 2018; Popoola et al., 2020). The sex of the cadaver becomes important when teaching reproductive and urinary systems (Hurren, 2004; Osuagwu et al., 2004). Difficulties may be experienced in demonstrating the female reproductive and urinary systems based on current cadaveric availability. It is believed that females are less likely to find themselves in situations that may result in an ‘unclaimed’ status of their bodies as they are mostly at home and do not travel extensively in many African settings. Males, on the other hand, are considered breadwinners and they may travel a lot to make ends meet for their families and may find themselves in unfamiliar environments (for example migrant workers), making it difficult to be traced by their relatives when they are deceased (Gugler, 1989).

The findings show that Zomba central hospital is the main source of unclaimed cadaveric bodies in Malawi. This may be because the maximum-security prison in the country is located in the Zomba district, just adjacent to the Zomba central hospital. Prisons are well-known sources of many unclaimed bodies in the literature (Gangata et al., 2010; Ghosh, 2015). The findings also show that the cadavers are sourced mostly from the southern region hospitals which share proximity and logistical advantage with the KUHeS. This study supports the

proposition that most of the cadavers may be easily sourced from areas in proximity to the university as this lessens the burden of transportation costs (Alblas et al., 2018). The unclaimed bodies may require specialized storage and preservation before they are transported to the health sciences institutions (Štrkalj et al., 2020). As such, most hospitals, especially those far from the university (over 300 km) may prefer the burial of the unclaimed bodies which is more cost-effective on their side. The advances in mass communication, for example, the use of social media, will lead to a decrease in the availability of unclaimed bodies. With better communication means, there will be fewer missing persons and therefore fewer unclaimed bodies. With logistical issues and fewer unclaimed bodies, a massive strain will ensue for anatomical education and body donor programs will be relied upon more heavily. This situation is a wake-up call for the Malawian anatomists to explore new ways to promote the body donation program beyond its current level.

Importantly, the body donor program in Malawi has been patronized only by people of European descent. The limited patronage by the indigenous African Malawians to donate their bodies to date may imply that the implementation of IFAA recommendations to use cadavers ‘exclusively from body donation’ is still far from being a reality (IFAA, 2012). With one body donation every 3–4 years, the number of cadavers from the body donation program alone is insufficient to meet the anatomy education needs per academic year (De Gama et al., 2020). Notably, some American and United Kingdom institutions that relied only on body donors as the sole source of cadavers following the introduction of the Human Tissue Act of 2004 (Human Tissue Act, 2004), had registered a significant decline in the number of cadavers available for dissection, and this potentially affected the quality of anatomy education (Buchanan, 1997; Renstrom, 1997; McLachlan, 2004; Stott, 2008). However, intense promotion of the existing body donation program in Malawi may make the transition from the use of ‘mostly unclaimed bodies (and, less often, body donation)’ to ‘mostly body donations (and, less often, unclaimed bodies)’ feasible (Štrkalj et al., 2020). From the educational point of view, it is important that students have access to high-quality education (OSHA, 2005; BME, 2020) through the availability of sufficient cadavers, acquired either through unclaimed bodies or body donation programs or both. Thus, a move towards the use of ‘mostly body donations (and, less often, unclaimed bodies)’ will ensure the availability of sufficient cadavers for teaching and learning purposes.

The procedure of acquiring cadavers through the body donation program in Malawi follows suit with that practiced by other countries (Kramer and Hutchinson, 2015; Techataweewan et al., 2018). During the early years of the implementation of the body donation program, Malawian anatomists faced challenges that led to decreased efforts in awareness campaigns to the general public (indigenous Malawians), and hence, an increased reliance on unclaimed bodies. As such, all the donated bodies used so far were purely by self/family initiative. There is a paucity of literature on African countries that run successful body donation programs involving indigenous African populations, with the exception of South Africa. Some institutions in South Africa have been successful in running body donation programs with donors of European descent (Kramer and Hutchinson, 2015). It is important to note that South Africa is a further developed country and has a different socio-economic status compared to Malawi.

The Malawian sociocultural context is similar to that of other African countries which have limited success with body donations programs utilizing indigenous African populations (Monteiro-Ferreira, 2005; Akinola, 2011; Ngubane, 2012). Notably, other South African cultures which also strongly opposed the use of the human body for dissections previously are now appreciating this as a way of advancing medical practice and education (Bhengu and Uys, 2004). While religion plays a significant role in the success of body donation programs in other countries outside Africa (Roach, 2004; Garment et al., 2007; Techataweewan et al., 2018), it acts as a barrier in the Malawian context, similar to other African countries (Akinola, 2011; Anyanwu et al., 2011; De

Gama et al., 2020). As opposed to the early years of cadaveric dissections globally where most religions opposed human dissection (Ghosh, 2015), there have been positive developments, for example, in Thailand, where mainstream religions are now accepting the use of human bodies for dissections and organ donations (Techataweewan et al., 2018). The support of religious leaders also played a significant role in promoting body donation programs in some American and United Kingdom institutions (Roach, 2004; Garment et al., 2007).

The request for body donors is mainly based on altruism and ethical reasons (Gunderman, 2008; Bolt et al., 2011; Techataweewan et al., 2018; Smith et al., 2022), however, such requests in the current Malawian political environment may likely raise more suspicions and solidify the existing unsubstantiated beliefs. Economical/budgetary constraints are well known to affect the mode of acquiring cadavers in many developing countries (Štrkalj et al., 2020). Relying on cadavers from an 'exclusively body donation program' requires dedicated funds for specialized transportation of the bodies, storage and maintenance, disposal and end-of-year commemoration services (Wingfield, 2018). Additional funds are also needed for the staff members involved in body donation awareness campaigns (Štrkalj et al., 2020). As such, most developing African countries rely on the relatively cost-effective means of sourcing cadavers (using unclaimed bodies) for anatomy education.

The small number of total cadavers sourced in Malawi appears to have affected cadaveric research output and explains the limited number of cadaveric studies done in the Malawian populations, with most studies instead focusing on osteology (Mwakikunga et al., 2016, 2021; Matundu et al., 2021; Nyasa et al., 2021a, 2021b; Kaledzera et al., 2022). The use of unclaimed bodies for research poses potential biases when interpreting the findings as some demographic data like population affinity, age, and associated data like occupational, medical and genetic history may not be available. Additionally, unclaimed bodies are not an accurate representation of the general population as factors like socioeconomic status, sex, age or cause of death may contribute to who becomes an 'unclaimed body', as such, the research findings from unclaimed bodies may not be generalizable to the general population. Limited population-specific literature may pose challenges in clinical and forensic anatomy as many anatomical variations are considered population-specific, and population-specific studies are recommended to substantiate the emerging new variation patterns.

5. Conclusion

Cadavers for anatomy education in Malawi are mainly sourced from unclaimed bodies, similar to other African countries. A combination of factors amongst indigenous Malawians including unwillingness to donate based on beliefs, misinterpretations, and limited public awareness are current challenges in strengthening the body donation program within Malawi. In addition, limited resources, logistical difficulties, and insufficient funding add to the challenge and require a different approach and effort. As student numbers increase, the most effective and feasible anatomical teaching methods will need to be adapted accordingly. Further promotion of the body donation program may lead to a more equitable balance between donated and unclaimed bodies and therefore not only improve anatomy education and research but may also ensure legally and ethically acceptable practices of anatomy education are maintained in the future.

Funding

None.

Ethical statement

This retrospective audit was conducted in compliance with the Anatomy Act 14 of 1990 of the Malawi Government. The study was waived by the University of Malawi's College of Medicine Research

Ethics Committee (P/02/10/872).

CRediT authorship contribution statement

Manjatika Arthur Tsalani: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Davimes Joshua Gabriel:** Writing – review & editing. **Mwakikunga Anthony:** Methodology, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors are grateful to Mr B. Matundu and Mr B. Ndoma for their help with access to the data. The authors also thank Dr B. Billings and Prof G. Štrkalj whose advice improved the quality of this work. We are also grateful to those whose bodies (donated or unclaimed) are being used for anatomy education.

References

- Act, A., 1990. Government of Malawi Anatomy Act 14 of 1990. 1-8.
- Akinola, O.B., 2011. Formal body bequest program in Nigerian medical schools: when do we start? *Anat. Sci. Educ.* 4, 239–242.
- Alblas, A., Greyling, L.M., Geldenhuys, E.M., 2018. Composition of the Kirsten skeletal collection at Stellenbosch University. *S. Afr. J. Sci.* 114, 1–6.
- Anyanwu, G., Udemazue, O.O., Obikili, E.N., 2011. Dark age of sourcing cadavers in developing countries: a Nigerian survey. *Clin. Anat.* 24, 831–836.
- Azer, S.A., Eizenberg, N., 2007. Do we need dissection in an integrated problem-based learning medical course? Perceptions of first-and second-year students. *Surg. Radiol. Anat.* 29, 173–180.
- Bhengu, B.R., Uys, H., 2004. Organ donation and transplantation within the Zulu culture. *Curationis* 27, 24–33.
- BME, 2020. Basic medical education WFME global standards for quality improvement. <https://wfme.org/wp-content/uploads/2020/12/WFME-BME-Standards>. Accessed on 19/06/2023.
- Bolt, S., Eisinga, R., Venbrux, E., Kuks, J.B., Gerrits, P.O., 2011. Personality and motivation for body donation. *Ann. Anat.* 193, 112–117.
- Buchanan, K., 1997. A difficult, valuable gift. *Pittsburgh Post-Gazette*.
- Cornwall, J., Perry, G.F., Louw, G., Stringer, M.D., 2012. Who donates their body to science? An international, multicenter, prospective study. *Anat. Sci. Educ.* 5, 208–216.
- Davis, C.R., Bates, A.S., Ellis, H., Roberts, A.M., 2014. Human anatomy: let the students tell us how to teach. *Anat. Sci. Educ.* 7, 262–272.
- De Gama, B.Z., Jones, D.G., Bhengu, T.T., Satyapal, K.S., 2020. Cultural practices of the Zulu ethnic group on the body and their influence on body donation. *Anat. Sci. Educ.* 13, 721–731.
- Demographics, 2023. Demographics of Malawi. (https://en.wikipedia.org/wiki/Demographics_of_Malawi). Accessed on 13/03/2023.
- Emanuel, E.J., 2020. The inevitable reimagining of medical education. *Jama* 323, 1127–1128.
- Estai, M., Bunt, S., 2016. Best teaching practices in anatomy education: a critical review. *Ann. Anat.* 208, 151–157.
- Fruhstorfer, B.H., Palmer, J., Brydges, S., Abrahams, P.H., 2011. The use of plastinated prosections for teaching anatomy—the view of medical students on the value of this learning resource. *Clin. Anat.* 24, 246–252.
- Gangata, H., Ntapa, P., Akol, P., Louw, G., 2010. The reliance on unclaimed cadavers for anatomical teaching by medical schools in Africa. *Anat. Sci. Educ.* 3, 174–183.
- Garment, A., Lederer, S., Rogers, N., Boulton, L., 2007. Let the dead teach the living: the rise of body bequeathal in 20th-century. *Am. Acad. Med.* 82, 1000–1005.
- Ghosh, S.K., 2015. Human cadaveric dissection: a historical account from ancient Greece to the modern era. *Anat. Cell. Biol.* 48, 153–169.
- Gugler, J., 1989. Women stay on the farm no more: changing patterns of rural–urban migration in Sub-Saharan Africa. *J. Mod. Afr. Stud.* 27, 347–352.
- Gunderman, R.B., 2008. Giving ourselves: the ethics of anatomical donation. *Anat. Sci. Educ.* 1, 217–219.
- Gürses, İ.A., Coşkun, O., Öztürk, A., 2018. Current status of cadaver sources in Turkey and a wake-up call for Turkish anatomists. *Anat. Sci. Educ.* 11, 155–165.
- Habicht, J.L., Kiessling, C., Winkelmann, A., 2018. Bodies for anatomy education in medical schools: an overview of the sources of cadavers worldwide. *Acad. Med.* 93, 1293–1300.
- Human Tissue Act, 2004. Human Tissue Act 2004 (Chapter 30). London, UK: Office of Public Sector Information. URL: (<http://www.opsi.gov.uk/ACTS/>). Accessed 25/11/2023].

- Hunt, D.R., Albanese, J., 2005. History and demographic composition of the Robert J. Terry anatomical collection. *Am. J. Phys. Anthropol.* 127, 406–417.
- Hurren, E.T., 2004. A pauper dead-house: the expansion of the Cambridge anatomical teaching school under the late-Victorian poor law, 1870–1914. *Med. Hist.* 48, 69–94.
- IFAA, 2012. International Federation of Associations of Anatomists. Federative International Committee for Ethics and Medical Humanities (FICEM). Recommendations of good practice for the donation and study of human bodies and tissues for anatomical examination. *Plexus* 4–5.
- Ihunwo, A., 2014. Body donation in Africa. *Ann. Anat.* 196, 8.
- Jones, D.G., Whitaker, M.I., 2012. Anatomy's use of unclaimed bodies: reasons against continued dependence on an ethically dubious practice. *Clin. Anat.* 25, 246–254.
- Kaledzera, T., Matundu, B., Adefolaju, G.A., Manda, J., Mwakikunga, A., 2022. Morphometric study of the suprascapular notch and scapular dimensions in adult Malawian cadavers and implications of completely ossified superior transverse scapular ligament. *Pan Afr. Med. J.* 41.
- Kerby, J., Shukur, Z.N., Shalhoub, J., 2011. The relationships between learning outcomes and methods of teaching anatomy as perceived by medical students. *Clin. Anat.* 24, 489–497.
- Kramer, B., Hutchinson, E.F., 2015. Transformation of a cadaver population: analysis of a South African cadaver program, 1921–2013. *Anat. Sci. Educ.* 8, 445–451.
- Labuschagne, B.C., Mathey, B., 2000. Cadaver profile at University of Stellenbosch Medical School, South Africa, 1956–1996. *Clin. Anat.* 13, 88–93.
- Matundu, B., Adefolaju, G.A., Manda, J., Mwakikunga, A., 2021. A morphometric study of the mandibular foramen in dry adult human mandibles in a black Malawian population. *Int. J. Morphol.* 39, 390–395.
- Mazyala, E.J., Revocatus, M., Manyama, M., Msuya, S., Rambau, P., Kimwaga, E., Magelle, N., Machimu, Y., Joshua, M., Magori, C.C., 2014. Human bodies bequest program: a wake-up call to Tanzanian medical schools. *Adv. Anat.* 1–6.
- McLachlan, J.C., 2004. New path for teaching anatomy: living anatomy and medical imaging vs. dissection. *Anat. Rec.* 281, 4–5.
- McMenamin, P., McLachlan, J., Wilson, A., McBride, J., Pickering, J., Evans, D.J., Winkelmann, A., 2018. Do we really need cadavers anymore to learn anatomy in undergraduate medicine? *Med. Teach.* 40, 1020–1029.
- Monteiro-Ferreira, A.M., 2005. Reevaluating Zulu religion: an Afrocentric analysis. *J. Black Stud.* 35, 347–363.
- Mwachaka, P.M., Mandela, P., Saidi, H., 2016. Repeated exposure to dissection does not influence students' attitudes towards human body donation for anatomy teaching. *Anat. Res. Int.* 1–5.
- Mwakikunga, A., Katundu, K., Msamati, B., Adefolaju, A.G., Schepartz, L., 2016. An anatomical and osteometric study of the femoral sulcus angle in adult Malawians. *Afr. Health Sci.* 16, 1182–1187.
- Mwakikunga, A., Manjatika, A., Mazengeny, P., 2021. Morphometric description of thoracic vertebral pedicles in adult malawian cadavers and implications for transpedicular spine fixation. *Int. J. Morphol.* 39, 1575–1580.
- Nandi, P., Chan, J., Chan, C., Chan, P., Chan, L., 2000. Undergraduate medical education: comparison of problem-based learning and conventional teaching. *Hong Kong Med. J.* 6, 301–306.
- Ngubane, S., 2012. Death and burial practices in contemporary Zulu culture. *Mank. Q* 53, 91.
- Nyasa, C., Mwakikunga, A., Chisati, E., 2019. Care for older people in Malawi: a situation analysis. *Soc. Innov. J.* 56.
- Nyasa, C., Mwakikunga, A., Tembo, L., Dzamalala, C., Ihunwo, A.O., 2021a. Distribution of variations in anatomy of the circle of Willis: results of a cadaveric study of the Malawian population and review of literature. *Pan Afr. Med. J.* 38.
- Nyasa, C., Mwakikunga, A., Tembo, L.H., Dzamalala, C., Ihunwo, A.O., 2021b. Anatomical variations and morphometric properties of the circulus arteriosus cerebri in a cadaveric Malawian population. *Folia Morphol.* 80, 820–826.
- OSHA, 2005. Occupational safety health administration. Health and safety recommendations for workers who handle human remains. (<https://www.osha.gov/sites/default/files/publications/mortuary/pdf>). Accessed on 19/06/2023.
- Osuagwu, F., Imosemi, I., Oladejo, O., 2004. Sources of cadaver used for dissection at the Ibadan medical school, Nigeria-Analysis of a three-year data. *Afr. J. Biomed. Res.* 7.
- Patel, K., Moxham, B., 2006. Attitudes of professional anatomists to curricular change. *Clin. Anat.* 19, 132–141.
- Pawlina, W., Lachman, N., 2004. Dissection in learning and teaching gross anatomy: rebuttal to McLachlan. *Anat. Rec.* 281, 9–11.
- Popoola, S.O., Omonisi, A., Odesanmi, W., 2020. Sources of cadaver for anatomic sciences in an evolving medical institution. *Afr. J. Biomed. Res.* 23, 293–296.
- Renstrom, J., 1997. Cadaver shortage faces medical students. *Ann Arbor, MI: University of Michigan The Michigan Daily* 9.
- Riederer, B.M., Bueno-López, J.L., 2014. Anatomy, respect for the body and body donation—a guide for good practice. *Eur. J. Anat.* 18, 361–368.
- Roach, M., 2004. *Stiff: The curious lives of human cadavers: WW Norton & Company.*
- Smith, C.F., Munro, R., Davies, D.C., Wilkinson, T., Shaw, H., Claridge, K., Llewellyn, S., Mc Ateer, P., Ward, S., Farsides, T., 2022. Understanding beliefs, preferences and actions amongst potential body donors. *Anat. Sci. Educ.* 16, 224–236.
- Statistics, N., 2018. Malawi population and housing census. ([http://www.nsomalawi.mw/images/stories/data_on_line/demography/census 2018/2018%20Malawi%20Population%20and%20Housing%20Census%20Main%20Report.pdf](http://www.nsomalawi.mw/images/stories/data_on_line/demography/census%202018%20Malawi%20Population%20and%20Housing%20Census%20Main%20Report.pdf)). Accessed on 10/04/2023.
- Stott, D., 2008. Not enough bodies. *BMJ* 336 (Suppl S1), 4.
- Štrkalj, G., El-Haddad, J., Hulme, A., 2020. A global geography of body acquisition for anatomy education: Issues, challenges and prospects. *Teach. Anat.: A Pract. Guide* 223–235.
- Techataweewan, N., Panthongviriyakul, C., Toomsan, Y., Mothong, W., Kanla, P., Chaichun, A., Amarttayakong, P., Tayles, N., 2018. Human body donation in Thailand: donors at Khon Kaen University. *Ann. Anat.* 216, 142–151.
- Wingfield, H.A., 2018. Body donation today: a critical comparison of two current practices, and moving into the future. *Clin. Anat.* 31, 86–89.