



## Article

# The Colección Osteológica Subactual de Santiago: Origin and Current State of a Documented Skeletal Collection from Chile, Latin America

Ofelia Meza-Escobar <sup>1,\*</sup>, Jacqueline Galimany <sup>2</sup>, Rocío González-Oyarce <sup>3</sup> and Nicole Barreaux Höpfl <sup>4</sup>

<sup>1</sup> Department of Archaeology, The University of Sheffield, Sheffield S10 2TN, UK

<sup>2</sup> Department of Anthropology, University of Nevada, Reno, NV 89503, USA

<sup>3</sup> Department of Archaeology, University of Durham, Durham DH1 3LE, UK

<sup>4</sup> Department of Anthropology, University of Chile, Santiago 7750000, Chile

\* Correspondence: comezaescobar1@sheffield.ac.uk

**Abstract:** This manuscript aims to introduce the *Colección Osteológica Subactual de Santiago* (COSS), a documented skeletal collection from Santiago, Chile, consisting of 1635 individuals living in low socioeconomic areas of the capital during the late 19th and early 20th centuries. The origin and current state of this collection, as well as the process by which it came to be housed at the University of Chile, is described. As of today, after long efforts for further documentation and improvements on the physical conditions of the collection, biological sex and age-at-death has been documented through burial records for 1198 individuals. Largely studied by Chilean researchers and students, the COSS collection has enabled a great amount of research, while also serving as part of a thriving scholarly community from different disciplines. Finally, discussion around representativeness, legal status and ethical concerns are addressed, highlighting the specific issues faced when working and studying the COSS collection.

**Keywords:** human osteological collection; documented skeletal collection; ethics in anthropology



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## 1. Introduction

Documented skeletal collections (named also “identified” or “reference” collections) play a significant role in the advancement of the forensic anthropology and bioarchaeology fields. Identified osteological collections, curated by public or private institutions for research and teaching purposes, serve the field by allowing us the rare insight into known biographical data of human remains. Contrary to human skeletal remains from archaeological contexts, identified skeletal collections usually include known sex and age-at-death, and are often complemented by cemetery records and grave markers, among others, that inform about dates of birth and death, and even cause of death. These collections have been vital in the development of methodologies to generate biological profiles and have given researchers means to understand health and demographics in varied populations [1].

Identified osteological collections more frequently used in research have their origins in the United States and Europe, and usually represent modern individuals of European and African descent [2]. Methodologies arising from these collections are used all over the world by bioarchaeologists and forensic anthropologists, with more or less success. As it is well documented, factors such as biological affinity, nutritional status, physical activity patterns and/or socioeconomic status, among others, significantly impact skeletal growth and development, influencing anatomical variation that tends to be population specific [3]. The generalizability of much published research on the field is problematic because it does not take into account regional variability; hence the need for the evaluation, updating or even development of methods based on local skeletal collections [4].

In this context, the *Colección Osteológica Subactual de Santiago* (COSS), usually translated as Santiago Subactual Osteology Collection [5] and Modern Collection of Santiago [6,7],

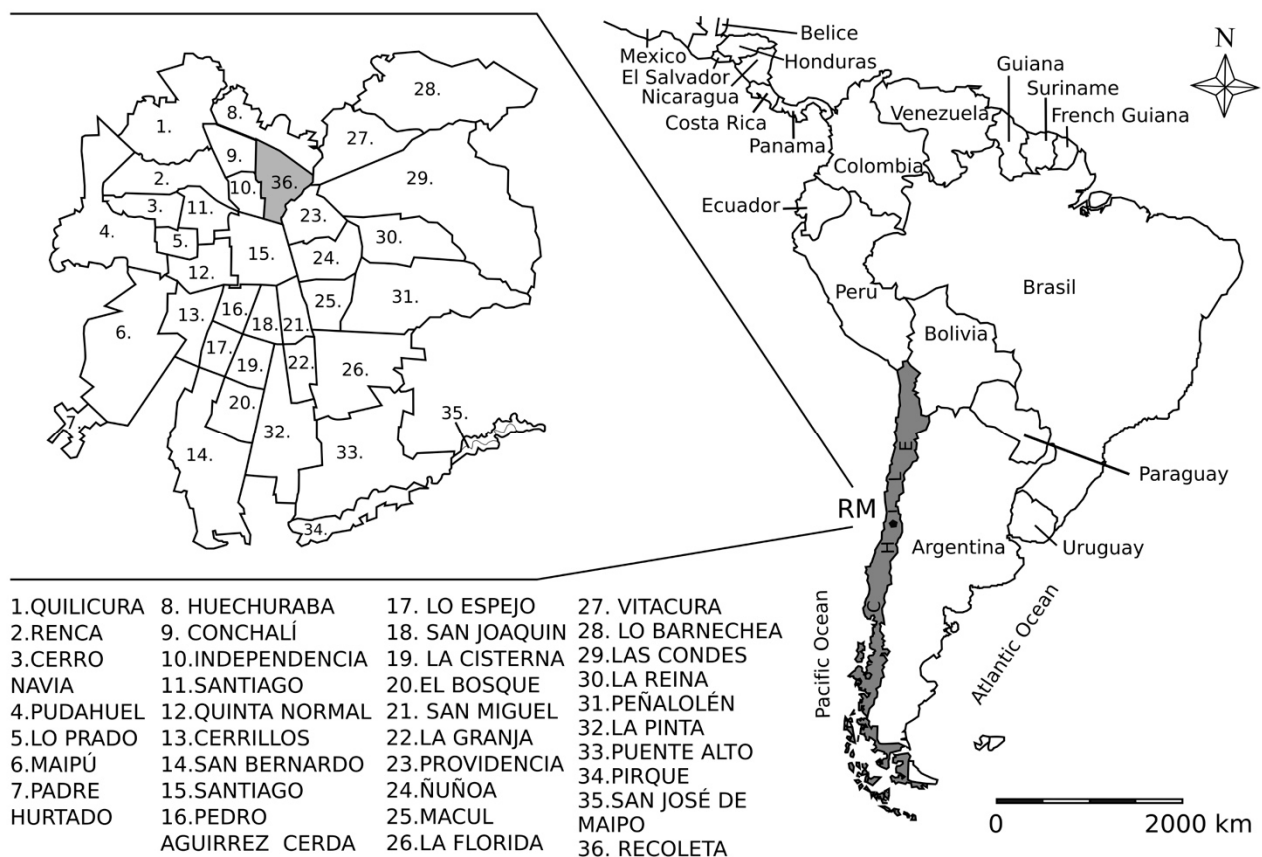
positions itself as an important identified skeletal collection within the South American context, providing insights into the lives and deaths of an urban population in the capital of Chile during the late 19th and early 20th centuries. The collection has also been known over the years as *Colección Cementerio General* [8–10] and *Colección subactual de Santiago* [11–14] in Spanish, and Subactual collection of Santiago [12–14], Cementerio general skeletal collection [15] and Subactual Skeletal Collection [16] in English.

This article describes the origin and current state of the COSS, its importance in bioarcheological and forensic research and training in Chile, and the ethical issues associated with the collection itself.

## 2. The Collection

### 2.1. Origin and Chilean Legislation

The Department of Anthropology at the University of Chile has housed bioanthropological collections since the 1950's, with Professor Juan Munizaga Villavicencio as the driving figure behind the idea of creating local reference osteological collections for teaching and research. Trained in medicine, Prof. Munizaga developed an early interest in anthropology while studying under the mentorship of Thomas Dale Stewart. His experience working with the world-renowned Terry and Hamann–Todd collections, inspired Munizaga in the need for an osteological collection with special focus in the forensic discipline. It was only twenty years later that modern human remains would join prehistoric osteological collections at the University of Chile, originating from the Santiago General Cemetery in Recoleta, a district in the north of Santiago Metropolitan Region (Figure 1).



**Figure 1.** Santiago Metropolitan Region (RM) within Chile in a map of South America. Highlighted is the Recoleta district, where Santiago General Cemetery is located (image by R.G.O.).

The human remains comprising the COSS collection were originally transferred from the Santiago General Cemetery to the University of Chile during the early 1970's, with a

smaller portion of them entering the Department of Anthropology in 1993. Collaboration efforts between the two institutions towards the further donation of human remains ceased between 1973 and 1990 during the military dictatorship of Chile, when the university, including the then Department of Anthropological and Archaeological Sciences (predecessor of today's Department of Anthropology), was heavily intervened by the military. During the 1970's, the subscription of an agreement between authorities at the University of Chile and the Santiago General Cemetery was sufficient to entrust the University with the donation of human remains from certain short-term graves. For context, Chilean legislation recognizes the existence of long- and short-term graves, that differ in burial duration and monetary value; short-term graves must be renewed at the end of their established period to maintain the burial plot. To allow higher education institutions to receive and curate human remains, two earlier Decrees issued by the Ministry of Health were modified by means of the Supreme Decree No. 254 [17]: the Decree 357 of 1970, Title III Of Graves, Article 33 states that "short-term temporary graves are those that give the right to the burial of a single corpse, for a minimum period of 5 years, with right to its renewal for equal and successive periods of up to 20 years [ . . . ]" [18].

If short-term graves are not renewed, paying the necessary fee, cemetery staff is entitled to reuse them, as stated in Article 38 of said decree: "once the term of occupation of a temporary burial has expired, the cemetery, if no one claims the remains existing in it, may remove them to transfer them to the common grave or to proceed with their incineration, in cases where the establishment has crematoria, without any responsibility for the Cemetery Management" [18]. The latter decree was modified to authorize for a third option: entrusting those unclaimed human remains to universities.

In Chile, all cemetery authorities must keep a record of burials, normally consisting of proof of fees payment (known as "exclusive right of burial") and a burial authorization certificate (*pase de sepultación* or *autorización de sepultación*) issued by the *Servicio de Registro Civil e Identificación* (Civil Registry and Identification Service of Chile). The latter, different from a death certificate and commonly known as "burial pass" in Chile, is the only documentation requested by cemetery authorities to proceed with a burial. It usually includes biographical information such as name and date of death, with other antemortem data (sex, age-at-death, and cause of death) not always recorded. Given the nature of the activities in most burial grounds, cemeteries are also subject to the *Código Sanitario de Chile* (Chilean Health Code), regulations related to the promotion and protection of health and safety among the inhabitants of the country. The Health Code's Ninth Book, Article 147, regulates the use of human remains of any kind for scientific research; it details that remains can be entrusted to scientific institutions "when the spouse or, in the absence of the latter, first-degree relatives of direct or collateral consanguinity do not express their opposition [to the exhumation and handing over] within the [agreed upon and paid] period and in the manner indicated in the regulations" [19]. The drafting of the code left space for ambiguity, thus Decree 240 of 1983 was published to regulate its application.

Through these legal modifications, the University of Chile and the Santiago General Cemetery agreed for unclaimed human remains of certain short-term burial areas to be exhumed by cemetery staff and relocated to the Department of Anthropology dependencies. Exhumations took place in two stages [20]: the first one during the 1970's with the exhumation of most of the graves, and later in 1993 under government funded project FONDECYT 1028-91, with the exhumation of *patio* (area) 134. Cemetery information submitted to the university alongside the human remains consisted of burial origin (location within cemetery grounds).

## 2.2. Curating the COSS Collection

During the last two decades, management of osteological collections worldwide has significantly changed in an effort to answer and satisfy new requirements regarding care, preservation and access claims for research [21,22]. The Department of Anthropology at the University of Chile has launched some initiatives to answer these issues. However,



constant physical relocation of the COSS collection meant that management plans were made at different times, for which documental referencing and skeletal systematization was in constant change and never concluded. In addition, segregation of bone elements for analysis and the absence of use and access protocols left the collection in a general state of disorganization. Unfortunately, most of the antemortem information recorded during the exhumation project was lost after Prof. Munizaga's death.

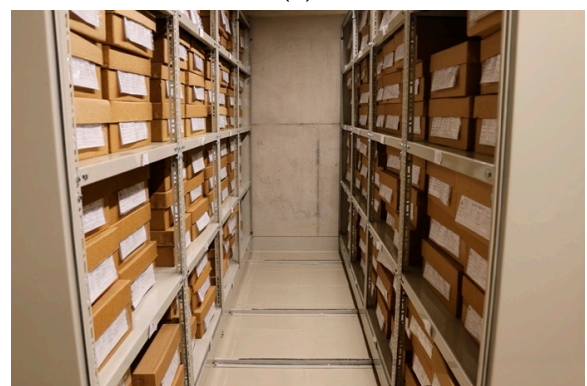
In response to these issues, different projects to improve the condition of the collection have been launched; a 2001 project, co-financed by the Andes Foundation, focused on conservation measures and chemical treatments to improve the condition of the remains [11]. It did not, however, add information in terms of osteological analyses. More recently, the “Bicentennial Project: Trajectories of Patrimonialization” (*Puesta en Valor de la Colección Osteológica Subactual de Santiago, Trayectorias de Patrimonialización, Proyecto Bicentenario*) was launched in 2014, and completed a year later by a group of academics and students from the University of Chile. The project sought to improve the overall preservation and integrity of the COSS collection, for its continued research and teaching purposes (Figure 2). Simultaneously, the project aimed to establish a standardized process to work with all osteological collections within the Department of Anthropology, helping in the ongoing management plans, while also questioning social and cultural dynamics surrounding archaeological objects and bioanthropology remains [23,24].



(a)



(b)



(c)

**Figure 2.** State of the COSS collection before (a) and after (b,c) the Bicentennial Project of 2014 (images by N.B.H and O.M.E.).

The Bicentennial Project involved major restructuring of the collection itself; during past decades, remains belonging to single individuals had been disassociated to create small collections of skeletal elements (such as skulls, long bones, vertebrae, mandibles, among others), in line with the idiosyncrasy of the time. Many bones were labeled directly with india ink on their surface, with *patio* (cemetery areas) and *sepultura* (burial number) information. These marks allowed the reassociation of dispersed bones with their respective skeleton involving an extensive and intensive manual labor task. To individualize each set of remains, the team adopted a protocol that included the (1) designation of an inventory number per individual, (2) dry mechanical cleaning of the remains, (3) extension of the skeleton in anatomical position, (4) inventory of bone presence and completeness, (5) evaluation of sex, age, pathologies and other individualizing traits, (6) photographic record, (7) entry into an Osteoware database [25], (8) repackaging in standardized full-size or half-size boxes depending on skeletal completeness, (9) collection management registration and (10) transfer to temporary storage and subsequent definitive location [26]. All information gathered during the reassociation of skeletal remains was recorded and is available for further study. Remains that were not possible to reassociate (no label or repeated labels associated) were grouped together by skeletal element and organized as ossuaries into a separate Teaching Collection.

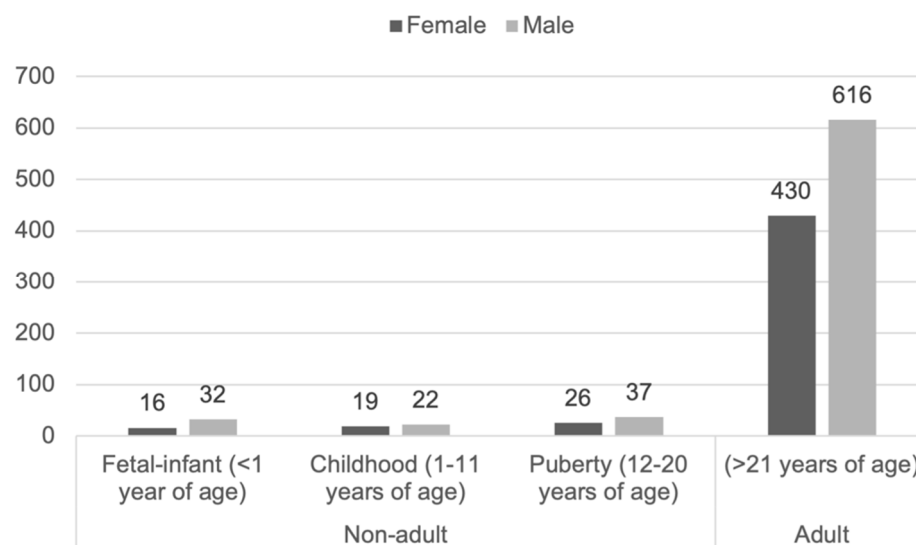
In addition, and as part of the Bicentennial project, antemortem data from cemetery records were collected following the work of Abarca [20]. In search of a correlation between skeletonized individuals and written records, administrative books and burial passes corresponding to the inhumation dates of the collection were examined between 2014 and 2016 at the Archive of Santiago General Cemetery. Individuals were considered “documented” if a match in sex, age and *patio* number was found, in which cases the burial pass were photographed and all individual information (name, sex, age, address of next of kin, civil registry, date of death and cause of death) recorded in spreadsheets. Additional antemortem information was added in 2021 as part of doctoral research efforts [27], using the same methodology previously stated but accessing cemetery archives previously not available. New antemortem data were found for reassociated but undocumented individuals, confirming biological sex and age-at-death, while it was also possible to corroborate information on the individuals identified during the Bicentennial project.

Among the achievements of the 2021 fieldwork on cemetery records was the documentation via burial passes of 31 previously undocumented non-adults, 19 of them corresponding to fetal–infant individuals (<1 year of age).

### 2.3. Current State of the COSS Collection

Today, the collection comprises 1635 individuals, of whom 1629 are skeletonized and eight are semi-mummified with presence of soft tissue in at least one anatomical segment. Completeness of the individuals varies, with a vast majority being semi-complete (50–85% of the skeleton present), followed by almost the same amount of complete (>85% present) and incomplete (<50% present) individuals. Information on completeness for each individual, including anatomical elements present and their overall preservation, was recorded. Age and sex were estimated for most skeletonized individuals, regardless of being documented or not, with adults being predominantly estimated to be male/probable male. The Teaching Collection includes 38 individuals without known *patio* and/or burial information, in addition to 107 boxes containing ossuaries; the existence of a separated Teaching Collection has allowed limiting the access of the COSS collection to research activities only.

Following documentation efforts, biological sex and age-at-death are known for 1198 individuals; of them, 954 have recorded cause of death, while years of birth and death are known in 1079 cases. Females ( $n = 491$ ) make up 40.98% of the documented individuals, with 12.4% ( $n = 61$ ) classified as non-adults (20 years of age or younger); males ( $n = 707$ ) amount to 59.02% of the documented individuals, with a larger number of non-adults ( $n = 91$ ) than female individuals (Figure 3).



**Figure 3.** Distribution of sex and age group for documented individuals in the COSS collection.

Additional documentation efforts are subject to the event of finding new records and field annotations regarding the exhumation and transportation to the university, as well as further examination of official records in the Archive of the Santiago General Cemetery.

Territorial affiliation was inferred based on the informant's address, recorded in cemetery documentation such as burial passes and/or proof of payment for the grave. Although usually the next of kin (e.g., wife, husband, parent), informants are also listed as neighbors or hospice representatives (in case of individuals sent to the cemetery directly from a hospice or hospital and granted burial free of charge). This makes the informant's address an important piece of information as it points to the place where the individual lived in the time prior to their death. Of the 1198 documented individuals, 903 burial passes listed addresses, and 84% ( $n = 759$ ) came from residential areas of low income status, such as Santiago Centro (where addresses point to conventillos, urban housing where each family rented one room, usually without running water or electricity, and shared bathroom facilities), Barrancas (known as Pudahuel after 1975, a settlement in the northwest of Santiago, created and inhabited by rural–urban migrants during the 19th century) and Renca (an eminently agricultural area at the time). Even though residential information is not available for all 1198 documented individuals, it is likely that the individuals in the COSS collection came from poverty-stricken communities [20,27], considering they were occupying the cheapest short-lasting burial sites within the Santiago General Cemetery.

Currently, the entire collection is housed in a separate underground storage inaugurated in 2016 and equipped with full-space, modular, self-supporting shelving that maximizes storage space. The space was specially designed to house archaeological and bioanthropological collections, with a restricted access system, and mechanical air conditioning that controls temperature and relative humidity. Improved physical conditions in addition to complete inventory and storage location records contribute to a general improvement in COSS's collection care and management.

#### 2.4. Published Work over the Years

Scholarly work using the COSS collection, either as main resource or as comparative sample, spans from bioarcheology to forensic anthropology, and includes dissertations/theses, peer-reviewed articles and book chapters. Data based on this collection have furthered our understanding of the modern Chilean population and has helped address issues related to biological sex estimation [6,8,9,13,14,16,28–30], age estimation and growth [10,15,31–35], stature and body size [20,33,36], dental pathologies [37], bilateral asymmetry of the appendicular skeleton [12,38], nutrition-related changes to the skele-



tal anatomy [20,39], growth disruption and mortality [40], shape variation in modern populations [41,42] and trauma and violence [43,44].

### 3. Discussion

#### 3.1. *The Collection in Context*

Over the years, the COSS collection has faced many challenges. Issues such as the detrimental exposure to cemetery burial environment, damage during transportation (including the forced relocation of the entire collection following Pinochet's coup), poor storage conditions and inadequate handling in research and teaching contexts, were not dealt with until recent years. In addition, common difficulties in the documentation process of skeletal collections worldwide were also faced during the process of standardization and further management of the COSS collection: incomplete or inexistent information about burial context [45], disparities between the biological profile of skeletonized individuals and documented individuals, as well as the association of more than one individual to the same grave [46]. These issues resulted in incomplete antemortem data for the COSS individuals. Although the collection has attracted researchers interested in its large number of skeletonized individuals, its potential as a reference osteological collection had been limited until recently [47,48]. Efforts such as the Bicentennial project have vastly improved the collection; the more antemortem data are available for each individual, the more useful the collection becomes, not only for research on new methods for biological profile estimation but to explore issues regarding health, pathologies, biological variation and lifeways [49]. Through the years, the collection has awakened the interest of other disciplines such as anatomy, medicine, odontology, physical therapy, forensic sciences and visual arts, benefiting from new perspectives and new research questions [50].

Although most skeletal collections suffer from sampling bias and are not representative of the population from which they originated [48], knowing contextual information of an osteological collection, such as biological sex and age-at-death, can enhance scientific research and collection management. It is, however, important to consider ethical standards needed when working with documented human remains. As stated by Rankin-Hill [51], all information "generated from skeletal biological analyses must be placed within the context of a population's lifeways and history to explain the conditions that produced the disruptions." Awareness about the contextual information for individuals in the COSS collection, in the form of antemortem data, allows present and future researchers to contextualize their findings and better articulate their conclusions, while also acknowledging the individual's personhood and life experiences. Albeit formed more than 30 years ago, it has been only during the last decade that researchers have taken into account the socio-political context on which individuals within the COSS collection lived [20]; inhabiting low socioeconomic areas of the city, the individuals in the COSS collection do not represent the inhabitants of the entire city or the country, but only a small portion of the population that lived during the late 19th and early 20th century in Santiago. As part of low-income families, these individuals were most likely stricken by physiological and psychological stress that caused growth disruption and/or affected their health outcomes in adulthood [34,40]. Any study using the COSS collection should take into account the higher physiological stress the individuals probably experienced, when compared to other socioeconomic segments of the population of Santiago during the period [52].

Even though it benefits from the advantage of a large amount of documentation, the COSS collection faces issues in common with other osteological collections around the world [26]. Demographic patterns observed within the COSS collection, such as overrepresentation of males in relation to the number of female individuals and the underrepresentation of non-adults, are common in most collections [53–64]. Housing the remains of 169 individuals under 18 years of age, of which 132 have documented age and sex, non-adults are vastly underrepresented in relation to adults. However, this is in line with even world-renowned skeletal collections of similar completeness status, such as Hamman–Todd [65], Granada [2], Rómulo Lambre [48] and Scheuer [66], where subadult

individuals do not surpass 130. Although a small sample, the documented non-adult individuals in the COSS collection, having known biological sex, age-at-death and often cause of death, represent a unique opportunity to study childhood in the past.

### 3.2. Ethical Concerns

The curation of human remains has been put to the question for both bioarcheological [67–69] as well as identified or modern skeletal collections of medical and/or forensic interest [70] as the need for current and situated ethical standards becomes imperative. Although an important step in the treatment of bioarcheological remains, the widely cited Vermillion Accord on Human Remains, signed in 1989, presented contradictory indications. While it called for respecting the mortal remains of the dead, the dead's wishes, and the wishes of guardians or relatives of the dead and their community, at the same time it argued for respect towards the scientific research value of those same human remains [71]. This latter principle, known as preservation ethic and derived from the need to replicate and validate scientific studies [72,73], is still an important argument among researchers for the continued curation and amassment of skeletal collections and stands at the core of many debates. Moreover, the importance of studying real (not casts) human remains has also been highlighted [74] in reference to modern skeletal collections.

Following Vermillion's precepts, an important current of thought posits the ethical need to treat remains as subjects, not objects, applying the same or similar ethical standards as in the study of living persons [75,76]. These standards are guided by four ethical principles: (1) autonomy (the obligation to respect the right of self-determination), (2) non-maleficence (the obligation not to cause harm), (3) beneficence (the obligation to further the legitimate interests of others) and (4) justice (the obligation to ensure fair access to resources for all) [77]. However, the dead are usually regarded as "invulnerable" among researchers who view the body as a rationalized and universal object that can be fragmented and reused without being affected or harmed after death [75,76,78]. This objectification limits the prescribed respect to the descendants or the community of the descendants, not for the dead themselves or "for their own sake" [75], as a subjective view would entail.

Individuals in skeletal collections are not only subject to objectivation but also to structural violence. Marked by colonial conflict in America and by racial and socioeconomic factors throughout the world, the discussion concerning collections of the recently-deceased has been led by North American authors focusing on dissection-derived anatomical collections thought to represent mostly marginalized individuals [70,79–82]. While the concept of structural violence was originally proposed to define the unequal power structure that produces unequal life conditions and opportunities [83], structural violence in death is understood as a continuation of the conditions of inequality and social injustice after death [70,79,84]. In response, North America has seen a shift towards donation-based collections establishing informed consent of the donor and/or their family as a minimum ethical standard.

On the other hand, cemetery-based collections of unclaimed individuals from southern Europe and Latin America continue to be curated and amassed [85,86] without much debate. Cardoso [85] has highlighted how poorly understood cemetery-based skeletal collections are in the English-speaking world and proposed ways to approach the ethical challenges they entail. Although sharing many ethical concerns with anatomical-or donation-based collections (i.e., consent), the fact that their procurement involves removing and disturbing the dead from their burials results in a stewardship that is more akin to archeological collections [86]. Given this status, for example, the requirement of consent should be considered to rest in the community, as their representatives decide the disposal of the remains that are periodically exhumed to make room for new interments [85]; a practice that is naturalized by the Roman Catholic tradition and common to both southern European and Latin American countries where cemetery-based collections are prevalent. Regarding structural violence, the author argues that a variety of reasons other than socioeconomic marginalization (e.g., loss of family ties) are involved in the use of the temporary graves



these collections procure remains from. Moreover, Vanderbyl et al. [87] found structural violence to be largely absent in a cemetery-based collection from Portugal that displayed a diversity of socioeconomic origins among the unclaimed individuals.

In Chile, the ethical and legal considerations regarding cemetery-based collections are very limited. While the National Monuments Law N°17,288, promulgated in 1970 and still in force, despite its ambiguous and reifying nature, protects human bodies recovered from archeological contexts by declaring burials, cemeteries or other aboriginal remains to be national monuments under the custody and protection of the State [88], there is no legal protection, other than against the desecration of graves [89], awarded to the human remains recovered from post-colonial contexts such as those included in the COSS. As mentioned above, when dealing with the deceased from modern contexts, the General Regulation of Cemeteries [18] prescribes the transfer of unclaimed bodies to public and private universities that offer careers in health sciences for the purposes of teaching or research. Currently, Chilean legislation does not consider other legal or administrative norms that grant a new legal status to already entrusted human remains or those that might be donated in the future, which are legally deprived in formal terms. Moreover, a proposal prepared in 2019 by the Constitution, Legislation, Justice, and Regulation Commission of the Chamber of Deputies to modify the Penal Code (Boletín N° 12.575-07), defines corpses as movable goods [90]. This qualification undoubtedly has legal and ethical consequences that are expanded in the cases the inalienability of human remains is relativized, for example, when seeking to satisfy certain social goals, such as research and teaching [91].

In contrast to Argentina [92], the US [93–95] and the UK [96], Chile lacks an ethics code regulating the study, curation and management of skeletal remains. Moreover, the lack of legal definition of human remains in Chile directly impacts conservation efforts and collection management, as ethical guidelines usually refer to local law as a starting point to design and implement the care of collections protocols [96–98]. Furthermore, this void can mislead to the restrictive notion of the body as an object, sometimes (but rarely nowadays in the bioanthropological field) reflected in the use of terms such as ‘specimens’ instead of individuals [74], in an effort to achieve or demonstrate scientific impartiality and objectivity [99]. This conception can lead to prioritizing conservation treatments that to only ensure the body’s material integrity [100], resulting in the loss of the personhood associated with the remains as a consequence [101].

Major steps in the ethical treatment and management of the individuals on the COSS have taken place since the Bicentennial Project in 2014. Minimum standards such as the re-association of remains belonging to single individuals and their placement in storage that respects individual integrity, the isolation of human remains from non-mortuary collections, the use of appropriate storage materials, the search and association of personal documentation, and the restriction of unauthorized access, are important improvements in the care of the collection and the recognition of their personhood [102,103]. Furthermore, although not backed by law, the collection is currently managed with the same guidelines as those of bioarcheological collections defined as cultural heritage, with restriction of access, handling limitations and non-exhibition standards. Nevertheless, ethical concerns such as the continuation of structural violence after death, the issue of consent and the consideration of the wishes of the dead and/or their community remain pending and need to be addressed. The acknowledgement of the individuals’ identities, paired with increased community outreach that allows for possible reburial claims could be a good start.

#### 4. Conclusions

In summary, the experience of procurement, curation and management of the COSS collection is relevant for present and future studies. Its importance goes beyond the origin and current state of the COSS collection itself but pertains to any acquisition or constitution of new osteological collections in the country. There are still challenges to overcome, such as the retrieval of missing antemortem information and the standardization of terminology used in previous records to make the collection administration more manageable. Current

storage conditions and conservation improvements answer and promote the ethical imperative behind the tenancy of human remains [73]: dignity and respect in their afterlife. Finally, with access to the collection granted upon reasonable request, researchers and research teams can benefit from the analysis of a modern, documented Latin American osteological collection.

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