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POSSIBILITIES OF USING ANTHROPOMETRIC INDICATORS FOR HUMAN IDENTIFICATION

Abstract. Identification of a person is one of the key tasks of investigative bodies, which includes the identification of persons about whom nothing is known, persons whose bodies have been destroyed as a result of decay, destruction by animals or other factors, such as the influence of fire, etc. Also, the question of identification arises when it comes to fragmented remains of the human body, skeletonized remains. In all these cases, the main role in solving this problem is played by the forensic medical expert, who applies the available knowledge and resources to the questions raised by the investigative bodies. The most common and reliable means for solving such a problem is identification by DNA profile. However, this method is not always possible to apply not only in view of the condition of the corpse (skeletonization, severe decay, etc.) but also the condition of the forensic medical service, which often does not have access to such equipment. In such cases, it is most appropriate to use the anthropometric indicators of the deceased for identification, which include hand and foot prints, features of the structure of the ear, and features of the size and structure of the bones. The purpose of this study was to find modern scientific literature related to anthropometric indicators for forensic identification of a person and organize its results. For this purpose, a search was conducted for publications no older than 10 years in the scientometric databases Scopus, Web of Science, and Google Scholar using keywords. As a result, 18 literary sources were identified and analyzed. The obtained data indicate the presence of significant progress in the creation and application of anthropometric indicators for the identification of a person, which includes the determination of gender, age, ethnicity, regional affiliation and even personality characteristics. The most impressive results in age identification have been achieved by analyzing osteometric indicators of ribs, while regional affiliation can be predicted using dermatoglyphic indicators. Both podometry and auriculometry, dermatoglyphics and osteometry make it possible to determine gender with high

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accuracy. In this way, it is possible to confidently assert the success and prospects of using anthropometric methods in forensic medicine for the purpose of solving the problems of personal identification. The development of new methods on specific populations (by age, regional affiliation, etc.) will allow to increase their accuracy and specificity.

Keywords: identification, forensic medicine, anthropometric parameters, dermatoglyphics, osteometry, auriculometry, podometry.

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МОЖЛИВОСТІ ЗАСТОСУВАННЯ АНТРОПОМЕТРИЧНИХ ПОКАЗНИКІВ ДЛЯ ІДЕНТИФІКАЦІЇ ЛЮДИНИ

Анотація. Ідентифікація особистості є однією з ключових задач органів дізнання, що включає в себе ідентифікацію осіб про яких нічого невідомо, особи, тіла яких зруйновані в результаті гниття, руйнування тваринами чи іншими факторами, як то вплив полум'я тощо. Також питання ідентифікації постає, коли мова йде про фрагментовані рештки людського тіла, скелетовані залишки. В усіх цих випадках головну роль в вирішення цієї задачі має судово-медичний експерт, який застосовує наявні знання та ресурси для поставлених органами дізнання питань. Найбільш поширеним та достовірним засобом для вирішення такої задачі є ідентифікація за профілем ДНК. Проте, даний метод не завжди є можливим для застосування не тільки з огляду на стан трупа (скелетизація, виражене гниття тощо) а і на стан судово-медичної служби, яка часто не має доступу до такого обладнання. В таких випадках найбільш доцільним є застосування для ідентифікації антропометричних показників померлого, що включають в себе відбитки рук та ніг, особливості будови вуха та особливості розмірів і будови кісток. Метою даного дослідження було знайти сучасну наукову літературу, що стосується антропометричних показників для судово-медичної ідентифікації особи та упорядкувати її результати. Для цього було проведено пошук публікацій віком не більше 10 років в наукометричних базах Scopus, Web of Science, Google Scholar за ключовими словами. В результаті було виявлено і проаналізовано 18 літературних джерел. Отримані дані свідчать про наявність значного прогресу у створенні та застосуванні антропометричних показників для ідентифікації особи, що включає в себе визначення статі, віку, етнічної, регіональної приналежності та навіть особливостей особистості. Найбільш вражаючі результати в ідентифікації віку досягнуто при аналізі остеометричних

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показників ребер, водночас регіональну приналежність можна передбачити, використовуючи дерматогліфічні показники. Як подометрія, так і аурікулометрія, дерматогліфіка та остеометрія дозволяють з високою точністю визначати статеву приналежність. Таким чином можна впевнено стверджувати про успішність і перспективність застосування антропометричних методик в судовій медицині з метою вирішення задач з ідентифікації особи. Розробка нових методик на специфічних популяціях (за віком, регіональною приналежністю тощо) дозволить збільшити їх точність і специфічність.

Ключові слова: ідентифікація, судова медицина, антропометричні параметри, дерматогліфіка, остеометрія, аурікулометрія, подометрія.

Statement of the problem. Identification of unknown persons remains one of the most complex and complex tasks of forensic medicine. The relevance of this topic is increasing over time, which is explained by a significant increase in the population and its settlement in various parts of the world, which are dangerous from the point of view of natural disasters. For example, the earthquake in Haiti in 2010 was estimated to have killed 122,000 to 167,000 people, making it one of the deadliest earthquakes in human history [1]. Analysis of data from 1991 to 2005 showed that 90% of all (approximately 1.3 million) deaths from natural disasters occurred in developing countries [2]. All these events lead to mass spontaneous burials, an increase in the number of missing persons and unidentified dead bodies [3].

In addition to natural disasters, mass burials and the need to identify individuals accompany military conflicts that do not subside in different parts of the world. In 2022, a large-scale Russian invasion of Ukraine began, which in just 162 days caused the death of almost 25 thousand civilians in Ukraine [4]. In the civil war in Syria from 2011 to 2016, about 143,000 people died, of which a little more than 100,000 were civilians, and more than 13,000 of them were children [5]. The numerous wars in which Iraq took part from 1980 to 2008 caused the death of about 2.5 million people [6].

The identification of deceased persons falls on the shoulders of forensic experts of various profiles - from forensic anthropologists to forensic criminologists. The main goal of such work is to try to reduce the number of missing persons and find out about their future fate, collecting physical evidence for international or local courts regarding war crimes, acts of genocide, etc. [7]. Often, in such cases, we are talking about working with already skeletonized remains, which must be carefully removed from burial sites and analyzed based on only one physical evidence available at the scene - bones [8].

Considering the increase in the number and lethality of conflicts and natural disasters, and the often limited resources of forensic experts, there is a need to analyze publications devoted to the identification of persons using anthropometric indicators, which allows working with the most primitive equipment and requires the least resources.

Connection of the publication with planned scientific research works. The article is a fragment of a research topic of the Department of Forensic medicine and Law of the National Pirogov Memorial Medical University, Vinnytsya "Peculiarities

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of osteometric parameters in representatives of Ukrainian nationality" state registration number 0124U003548**.**

The purpose of the article – researched and systematized data from the latest scientometric sources regarding the possibilities of using various anthropometric indicators for forensic identification of a person.

Research objects and methods. The analysis of scientific sources for the last 10 years was carried out using the scientometric databases of Scopus, Web of Science and Google Scholar. The search was carried out using keywords both individually and in combinations: “identification”, “forensic medicine”, “anthropometric parameters”, “dermatoglyphics”, “osteometry”, “auriculometry”, “podometry”, “sex”, “age”. The review included articles that met such criteria as: the presence of a review process in the journal (criterion 1), a representative sample of the study (criterion 2), statistical processing of the results (criterion 3). Of the 45 publications found, 18 were included in the review. PRISMA was used for organization and the PRISMA flow diagram for visualization of the process of selecting publications for review of literary sources in accordance with international standards for writing review articles [9].

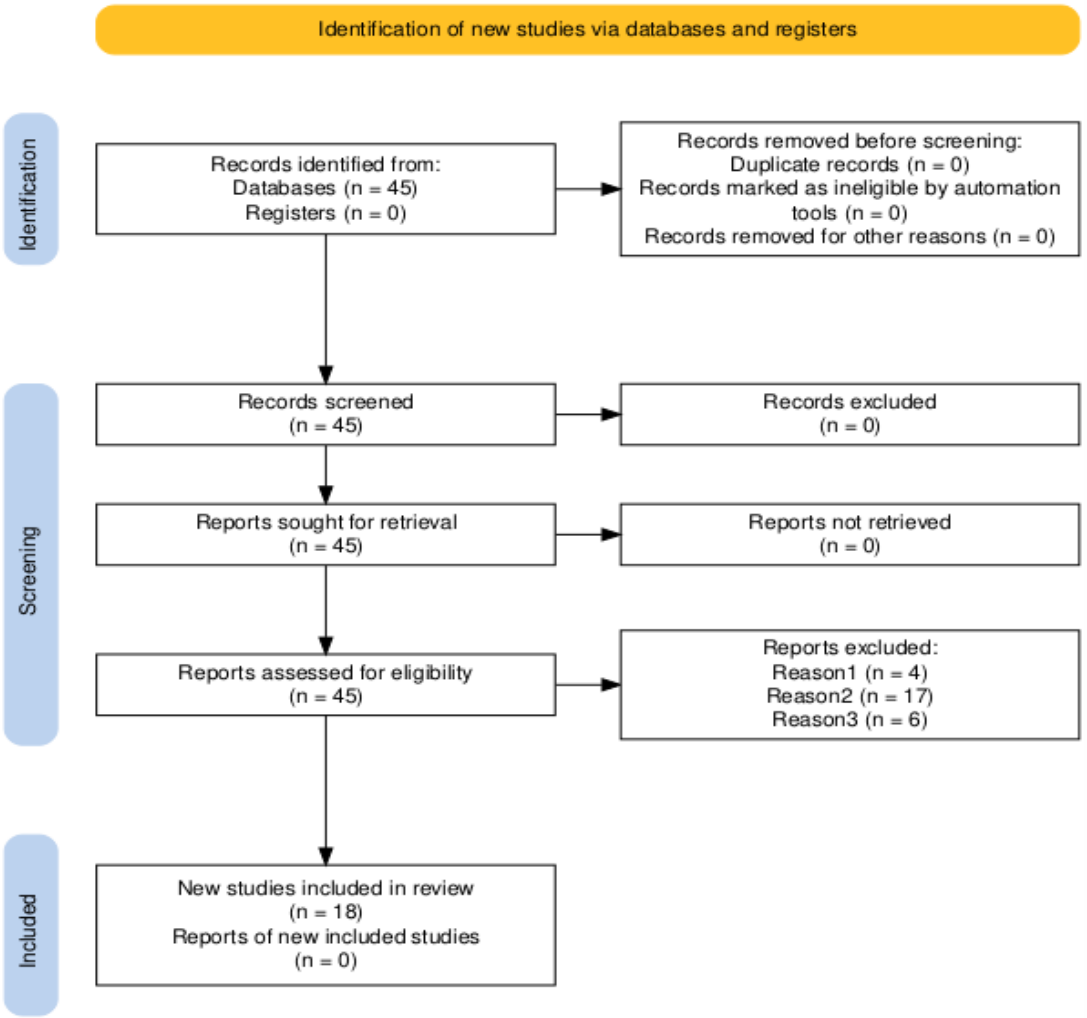

Fig. 1. The PRISMA flow diagram of literary sources search results.

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Presentation of the main material.
Research results and their discussion.

If we talk about the possibilities of dermatoglyphics for personal identification, then in a series of works carried out on representatives of Ukrainian nationality, males from different regions of Ukraine, aged 19-35 years, the team of authors revealed qualitative and quantitative signs of finger and palm dermatoglyphics, which are closely related to regional affiliation and personality characteristics. Ridge count of the fingers of the brushes and the value of the atd angle turned out to be key indicators that allowed predicting the features. The authors also built models for identifying the regional affiliation of individuals. The most frequently discriminating variables between men, residents of northern and other regions of Ukraine were the type of pattern on the fingers of the right hand and the asymmetry of the ridge count of lines a-b and c-d; for men living in southern and other regions of Ukraine, the type of pattern on the fingers of the right hand and the asymmetry of the ridge count of the palmar lines; and among male residents of the central, western or eastern regions of Ukraine, the type of pattern on the fingers of the left hand [10, 11, 12, 13, 14].

Auriculometry can be considered as another alternative option for personal identification. Over the years, this technique has developed significantly - new methods of measuring the ear, new distances, new means of fixation and analysis of the image of the ear have been created. [15]. The study of populations showed the presence of various morphologies of the shape of the ear in humans - from the most common oval (40% occurrence in men and 44.8% in women) to less common ones such as oblique, rectangular, round and triangular. Differences in the features of earlobe attachment were noted - in almost half of the examinees, both men and women, the earlobe was attached to the face [16]. An Indian population study of 300 individuals (150 men and women) aged 18-30 years showed that ear length, width and auricle base were greater in men than women, while earlobe length and width were greater in women compared with men (chi-square test, $p \leqslant 0.001$). The discriminant model built on the basis of the obtained data allows to obtain an accuracy of 68–71% in gender identification [17]. The length of the auricle can be used to identify a person's nationality - for example, Malaysians have been found to have higher values of this indicator than Indians [18].

Kozan N. M. [19, 20, 21] in a series of studies established the peculiarities of the sole pattern in representatives of the Ukrainian and Hutsul, Boyki and Lemki ethnic groups. Women of the Hutsul ethnic group compared to Ukrainian women from other regions of Ukraine had a high frequency of fibular loops and curl patterns on the third toe of the right foot, as well as complex patterns on the fourth toe of both feet. An increased frequency of tibial loops on the fifth toe of the right foot and significant repetition of patterns on the toes of the same name in one individual were also found. A high frequency of tibial loops on the first three toes of both feet was recorded in women of the Boyki ethnic group compared to Ukrainian women from

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other regions. In contrast, fibular loops, coiled loop-like patterns, and complex patterns on the toes of both feet were less common. In women of the Lemki ethnic group compared to Ukrainian women from other regions: a high frequency of tibial loops was observed on the second and third toes of both feet. In contrast, arc, loop, and complex patterns on the second and third toes were less common. In addition, a low frequency of fibular loops, loops, and complex patterns was observed on the first, fourth, and fifth toes of both feet. A high frequency of heterolateral symmetry of tibial loop and arch patterns on the first and third toes was also found.

Data from a review of literary sources regarding the main achievements of the use of podometry in forensic medicine shows that the accuracy of gender determination in some samples reaches 90-98%. At the same time, studies on the use of foot measurements to determine a person's physique or age do not show encouraging results [22].

The importance of osteometry is revealed most dynamically in forensic medicine. In the case of skeletonization of a corpse, it remains the only way to find out the answers to certain questions. However, this may concern not macroscopic but also microscopic indicators [23, 24]. In the study of García-Donas J. G. with co-authors, histomorphometric measurements of bones belonging to Greeks (inhabitants of the island of Crete) and Cypriots were carried out. Most of the indicators showed a statistically significant correlation with age, sex and sample. The created model for age identification included osteon population density, osteon perimeter and osteon roundness - this model had an error of 10.71 years without taking into account gender and nationality and 8.07 years with it [23].

The macroscopic examination of bones is no less important and includes the determination of such key questions as whether the object under study is a bone, whether the object belongs to human or animal bones, and if so, then questions arise as to who they belong to, which involves determining the sex, age and other parameters, which mostly requires performing osteometry [25]. For the answers to these questions and to carry out osteometry, the presence of almost any bone is sufficient, but the skull is usually considered the most classic for analysis. Analysis of the skull, and together with it the lower jaw, cervical vertebrae and teeth allows to determine the question of the article with an accuracy of more than 90% [26]. In particular, no less important in this case is the role of forensic dentistry, which includes not only the examination of teeth, but also chileometry and palatometry, which also show encouraging results for the identification of certain parameters of a person [27].

Conclusions. Both dermatoglyphics and osteometry, auriculometry and podometry are relevant methods in forensic medicine for the identification of an unknown person. The appropriateness of their use should be based on the degree of preservation of the body of the deceased and the information that potentially needs to be obtained. All of these methods are simple and cheap to use and do not require the use of special complex equipment or technologies, which makes them indispensable in case of limited resources or field conditions.

Dermatoglyphic, auriculometric and podometric methods can be used even with moderately pronounced putrefactive changes. These methods make it possible to determine the gender, ethnicity and regional affiliation of the deceased. At the same time, the osteometric method can be applied to the bodies of the dead in any condition, up to the fragmentation of bone remains. This method allows you to specify the gender, age and ethnicity of the deceased person.

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