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REVIEW

History of occupational kineanthropometry in Cuba, current situation and perspectives

Historia de la cineantropometría ocupacional en Cuba, situación actual y perspectivas

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ABSTRACT

Introduction: occupational kinanthropometry is a specialized branch of kinanthropometry, which allows evaluations to be made with body measurements, on the body characteristics of the worker in relation to the physical activity that he/she performs.
Objective: to describe the use of kineanthropometry in Cuba for the evaluation of occupational health and safety.
Development: 64 articles related to occupational kinanthropometry were reviewed. Of these, 48 related to the history of anthropometry and other theoretical aspects related to this science were evaluated and referenced. Eleven nutritional, morphological and ergonomic evaluations of Cuban workers were taken into account. It was found that the use of anthropometric data in occupational health around the world has been fundamentally oriented towards making physical ergonomic determinations, to the detriment of other evaluations of body structure, composition and constitution. In Cuba, this type of study has been carried out in limited groups of workers, based on clinical-sports or ergonomic criteria and the absence of occupational variables.
Conclusions: occupational kinanthropometry contributes to a better understanding of the relationship between the worker's body measurements and the work activity performed. The generalization in Cuba of a holistic approach in the nutritional and morphological kinanthropometric evaluation of the worker can contribute to improving clinical, epidemiological and ergonomic assessments with minimally invasive, accessible and economical techniques, promoting safety, health, and greater labor productivity with a preventive vision.

Keywords: Occupational Kinesanthropometry; Kinesanthropometry; Kinesanthropometric Evaluation And High Physical Demand.

RESUMEN

Introducción: la cineantropometría ocupacional es una rama especializada de la cineantropometría, que permite realizar evaluaciones con medidas corporales, sobre las características corporales del trabajador en relación con la actividad física que este realiza.
Objetivo: describir el uso la cineantropometría en Cuba, para la evaluación de la seguridad y salud laboral.
Desarrollo: fueron revisados 64 artículos relacionados con la cineantropometría ocupacional. De ellos se evaluaron y referenciaron 48 relacionados con la historia de la antropometría y otros aspectos teóricos afines a esta ciencia. Se tuvieron en cuenta 11 evaluaciones nutricionales, morfológicas y ergonómicas realizadas a trabajadores cubanos. Se pudo conocer que en el mundo el uso de datos antropométricos en salud ocupacional, ha estado orientado fundamentalmente a realizar determinaciones ergonómicas físicas, en detrimento de otras evaluaciones de la estructura, composición y constitución corporal. En Cuba este tipo de estudios se han realizado en grupos limitados de trabajadores, segados por criterios de tipo clínico-deportivos o ergonómicos y la ausencia de variables ocupacionales.
Conclusiones: la cineantropometría ocupacional contribuye a una mejor comprensión de la relación que existe entre las medidas corporales del trabajador, y la actividad laboral que realiza. La generalización en Cuba, de un enfoque holístico en la evaluación cineantropométrica nutricional y morfológica del trabajador, puede contribuir a mejorar las valoraciones clínicas, epidemiológicas y ergonómicas con técnicas poco invasivas, accesibles y económicas, propiciando la seguridad, salud, y mayor productividad laboral con una visión preventiva.

Palabras clave: Cineantropometría Ocupacional; Cineantropometría; Evaluación Cineantropométrica Y Alta Demanda Física.

INTRODUCTION

Occupational kinanthropometry is a specialized branch of kinanthropometry, a relatively new science that allows for a better understanding of the relationship between human body measurements and physical activity. Despite its short existence, its historical background includes technical contributions, philosophical approaches, and methodological approaches that should allow for a better understanding and utilization of its potential.

To assess the physical condition of a subject, different methods that combine both physiological and anthropometric measurements of external areas of the body are recommended. The latter in particular make it possible, through indices and indicators, to evaluate the shape, composition, structure, dimensions, proportions, physical performance, and maturation of the human body.[1,2,3,4] In Cuba's current conditions, characterized by severe material limitations that hinder the execution of complementary studies during the Occupational Health Medical Examination (EMSO), kinanthropometry can be very useful in providing information on the physical and structural characteristics of workers.[5] This is why it is necessary to describe the use of kinanthropometry in Cuba for the assessment of occupational safety and health.[5]

METHOD

To write this article, a search was conducted on Google Scholar, PUBMED, SciELO Regional, SciELO Public Health, and SciELO Cuba. The search strategy also used the possibilities offered by the artificial intelligence programs DeepSeek and ChatGPT. The descriptors used for the search included the following terms: occupational kinanthropometry, history of kinanthropometry, nutritional assessment, and morphological evolution. A literature review was conducted of 64 articles related to the topic under investigation, including review articles, original works, and theses for scientific and specialty degrees.

After the references were analyzed, 56 articles related to the proposed objective were selected. Of these, 20 corresponded to the past five years and 36 to more than five years ago, given the relevance of their content to the research.

Of the total number of works evaluated and referenced, nine were related to the history of cineanthropometry, and 14 were related to concepts and theoretical aspects related to this science. Six studies related to worker evaluations were also referenced: six nutritional, ten morphological, and seven ergonomic. Thirteen published studies related to nutritional, morphological, and ergonomic evaluations of Cuban workers were also included.

Analysis of the data obtained from each reference and the professional experience of Cuban researchers who performed the described technique allowed us to obtain the results and conclusions of the research.

DEVELOPMENT

The term "kinanthropometry" (Kinantrhropometrie) was introduced by William Ross in 1976, gradually replacing the older terms anthropometry and biometrics.[1,2,3,6] It comes from the Greek roots knein-movement, anthropos-man, and meterin-measure.[3] Kinanthropometry has applications in the biomedical sciences, making it an indispensable tool for research related to physical activity, health, sports, anthropology, architecture, nutrition and dietetics, and industrial design.[1,7,8] Although their assessment methods are indirect or doubly indirect, they have the advantage of being well tolerated by the patient and easily accessible to the physician, providing valuable information on the individual's nutritional status, physical performance, motor and cardiorespiratory capacity, and overall health, depending on the physical activity they perform.[9]

In addition to anthropometry, various exploratory methods are currently used to evaluate the human body. These include plethysmography (Bod Pod), hydrodensitometry (HD), computed axial tomography (CAT), nuclear magnetic resonance (NMR), dual-energy X-ray absorptiometry (DEXA), ultrasound, and 3D scanning.[10,11,12] However, electrical bioimpedance (IB), in any of its variants, is the most widely used technique.[11,14] All these modern medical technologies allow for more accurate direct assessments, helping to avoid errors attributable to incorrect anthropometric measurement techniques, as well as theoretical, methodological, and conceptual errors related to the standardization of the technique used.[11] Nevertheless, measurements obtained by traditional anthropometric methods, properly standardized with the gold standard, are a viable alternative that is quick to perform, easy to generalize, minimally invasive, less expensive, and much better tolerated by the subject.[11,13,14]

The term occupational or work kinanthropometry, although rarely used in the scientific literature, is recognizable in the application of its principles and techniques in the assessment of the nutritional and morphological status of workers in relation to the work they perform in specific work contexts.[15] Countries with highly developed ergonomics, technology, and manufacturing, mainly in Europe, North America, and East Asia, make use of this science, adapting it to the specific characteristics of the population and industrial needs of each region.[15]

The study of the shapes, measurements, and proportions of the human body has accompanied humanity since its origins and has often been linked to work activities. Through body metrics, the most ancient civilizations sought the place that man occupied in nature and the essence of beauty. [16, 17] This endeavor, laden with a strong philosophical and esoteric component, was immortalized in Leonardo da Vinci's Vitruvian Man (1490), where human anatomical proportionality is governed by the "divine proportion" and the "golden ratio".[17,18,19]

The first applications of anthropometry in health can be traced back to the 17th century, with morphological studies carried out on humans by Elsholtz at the University of Padua. (3) During the 18th century, and generally on the basis of eugenic theories, height was used as a criterion for the selection of soldiers, slaves, and workers.[1,18] With similar approaches, 19th-century anthropometrists focused their efforts on studying cranial capacity, jaw structure, forehead angle, and other features, attempting to support neo-Darwinian theories about the racial degeneration of society and the need to apply "racial hygiene". [20]

However, the measurement of human beings using statistical criteria began in the 19th century with the work of Lambert

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Adolfphe Jacques Quetelet (1796-1874). A notable example is this scientist's creation of the body mass index (BMI), which, despite its recognized limitations, is still used today.[3,17,21]

Anthropometric studies became established in the early decades of the 20th century and were focused mainly on anthropological, criminalistic, biomechanical, sports, and health evaluations. These studies began to correlate these measurements with the environmental and social conditions and health history of the subject, with the aim of assessing their nutritional status, growth, and physical development.[1,17,22]

In the early 1920s, Nicola Pende established biotypology as a scientific discipline responsible for studying the variability of body structures and their relationships with the physiological, endocrine, and physical systems. He also proposed the use of anthropometric techniques to analyze the body structure of the subject or biotype, which he defined as "(...) personal individuality [...] resulting vitally, potentially, and currently from the entire complex of genetic and environmental factors and from the entire complex of structural, humoral–dynamic, and metapsychic particularities of the subject, linked together in the same way as the different elements on which the type, performance, and value of the living machine depend."[23]

William H. Sheldon's interest in understanding the relationship between physique and human behavior was reflected in his book The Varieties of Human Physique (1940), which gave rise to the American biotypological school and introduced the new term "somatotype" for the first time, replacing "biotype".[24] However, it was not until 1967, with the work of Heath and Carter, that the analysis of body composition or somatotype began. These researchers associated the variations in morphology with factors such as physical activity to which the subject was exposed throughout their life.[17,25,26]

With the first Symposium in Kinanthropometry and Ergometry held in Montreal in 1978 and the founding of the International Working Group in Kinanthropometry (IWGK) in Brasilia that same year, an arduous process of research, definition of concepts, standardization, and protocolization of measurements began.[3] These advances, promoted in recent decades by different working groups and scientific societies such as the ISAK (International Society for the Advancement of Kinanthropometry) and the IBP (International Biological Programme), have set standards for this specialty.[27,28,29]

The use of anthropometric data in occupational health has focused primarily on physical ergonomic assessments (biomechanical and geometric).[30,31,32] The determination of body measurements provides information that allows for the development of the appropriate design (or redesign) of interior spaces, furniture, safety and personal protection equipment, hand tools, and machinery used in production.[33,34] It also allows for the determination of aspects related to the appropriate selection of personnel, as well as the design and implementation of programs for the prevention and control of work-related illnesses.[35]

Anthropometric methods are extremely useful for creating comfortable and safe working environments. However, the authors of this study agree that kinanthropometry can also contribute to occupational health through assessment possibilities, which have already been explored by other medical specialties.[30,31] In this case, the use of anthropometric techniques to holistically evaluate and interpret human somato-functional variations related to body structure, composition, and constitution, which are in turn determined by genetic and environmental factors, is highlighted.[1] Thus, on the basis of anthropometric and physiological values such as blood pressure, serum cholesterol, and glucose, it is possible to calculate cardiovascular and metabolic risk profiles, as well as the nutritional and morphological status of both workers and individuals who perform different jobs with particular characteristics.

Kinanthropometric measurements are key to analyzing eating behavior in relation to the particular lifestyle of individuals or work groups and assessing the relationships among diet, physical activity, and predisposition to disease. Thus, the authors of this study believe that occupational physicians have at their disposal a powerful tool that will undoubtedly contribute to assessing the suitability of the type of work to be performed by workers, ensuring greater safety, effectiveness, and productivity. Physicians should also be able to recommend appropriate dietary treatments, physical exercise plans, medications, and changes that may occur in working populations over time or during an intervention.[3,4]

In Cuba, anthropometric studies have focused primarily on nutritional assessments, sports medicine, growth and development, and the design of school furniture and footwear.[36] With regard to workers, kinanthropometric assessments have been limited and carried out on small samples of individuals, with the possibility of establishing a source of anthropometric data for the Cuban working population still pending. [36,37] Among the studies carried out on workers, those focused on occupations with very high physical demands, such as divers and operators, stand out.[38,39,40] In some cases in these studies, despite the stated intention to evaluate health with a preventive approach, specific occupational variables were not taken into account, with priority given to clinical or sports criteria, or they were limited to the field of ergonomics.[41,42,43,44,45] In other cases, studies were conducted on the general working-age adult population, but the analyses did not include occupational factors.[46, 47]

Of particular interest to the authors of this paper are the studies conducted to determine the morphofunctional and proportional differences during the selection, training, and performance of elite Cuban professional dancers.[48,49] These studies made it possible to quantitatively validate these differences and similarities among dancers, which, until then, had been obtained by dance teachers empirically and qualitatively. In this way, cineanthropometric evaluation brought greater scientific rigor to the assessments traditionally made in classification exams. In the opinion of the authors of this study, these works highlight the importance of extending this type of quantitative assessment to other physically demanding occupations, such as construction workers, dockworkers, farmers, and tower workers.

Recent studies have focused on addressing occupational risks derived from nutritional and morphological factors among Cuban workers.[45,50,53] Noteworthy in this case are the studies carried out at the La Pradera International Health Center.[45,50] These studies provide an integrated view of occupational kriging assessment. The determination of the anthropometric profiles and body fractions of the subjects made it possible to evaluate their body composition, as well as their morphological and nutritional status, and to relate them to some values reported for the Cuban adult population.

In another study conducted on 2,688 people over the age of 18 who attended the aforementioned International Health Center, individual variables were associated with diseases resulting from atherosclerosis. Anthropometric indicators such as body mass index (BMI), waist circumference (WC), waist-to-height ratio (WHR), and conicity index (CI) were used in this study.[54]

In 2023, new studies addressed occupational risks through nutritional, morphological, and functional (physiological) kinanthropometric parameters. In these cases, these risks were associated with job and other factors, such as the age of the subjects and lifestyle changes caused by the COVID-19 pandemic.[55,56]

Finally, it is important to emphasize the great importance that kinanthropometry can have as a useful complementary tool in the assessment of the physical abilities and work performance of Cuban workers. However, the authors believe that the fragmented approach, limited mainly to the field of research, with which kinanthropometric assessments in occupational health have been developed, has reduced their potential for application in medical practice.

It is necessary to approach occupational kinanthropometry from a holistic, historical, and pragmatic perspective that allows its full potential to be exploited for the nutritional and morphological assessment of workers, thereby contributing to ensuring health, safety, and productivity at work.

CONCLUSIONS

Occupational kinanthropometry contributes to a better understanding of the relationship between workers' body measurements and the work they do. The use of kinanthropometry in Cuba for occupational health and safety assessment was described. The widespread use of a holistic approach to the nutritional and morphological kinanthropometric assessment of Cuban workers can contribute to improving clinical, epidemiological, and ergonomic assessments with minimally invasive, accessible, and economical techniques and promoting safety, health, and greater workplace productivity with a preventive approach.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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AUTHORSHIP CONTRIBUTION

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Writing – revision and editing: Pedro Irán Gort Iglesias, Yanet Ortega Dugrot, Georgina López Pumar.

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