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ORIGINAL ARTICLE

Experiences in teaching laboratory animals to residents of basic biomedical sciences

Experiencias en la impartición de animales de laboratorio en residentes de las ciencias básicas biomédicas

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ABSTRACT

Introduction: the Curriculum for Medical Residents in the various Basic Science Specialties includes Laboratory Animal Training as a complementary subject; this course must guarantee the development of the necessary skills in handling laboratory animals, based on the specific nature of each specialty.
Objective: to present the main impacts that this complementary training has had on the residents of Basic Biomedical Sciences at the University of Medical Sciences of Pinar del Río.
Methods: a qualitative and historical study was carried out using theoretical and empirical methods at the University of Medical Sciences of Pinar del Río in 2023.
Results: the course has currently been taught in the province for 11 years, training 151 residents in various areas of Basic Biomedical Sciences. Several animal biomodels used in the university's various basic research projects have been standardized. Those trained in this course have participated with their research results in the field of laboratory animals in various scientific events at different levels, published scientific articles in certified journals, and received several provincial awards from the Cuban Academy of Sciences and Annual Health Awards.
Conclusions: the training process in the use of laboratory animals at this University achieves positive impacts that are visualized through scientific results.

Keywords: Professional Training; Animals, Laboratory; Medicine.

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RESUMEN

Introducción: el Plan de Estudios para Médicos Residentes en las diferentes Especialidades de Ciencias Básicas incluye como Asignatura Complementaria a la Enseñanza de Animales de laboratorio; la misma debe garantizar el desarrollo de las habilidades necesarias en el manejo con animales de laboratorio que permita, desde la particularidad de cada Especialidad.
Objetivo: exponer los principales impactos que ha tenido esta formación complementaria en los residentes de las Ciencias Básicas Biomédicas de la Universidad de Ciencias Médicas de Pinar del Río.
Métodos: se realizó un estudio cualitativo y de corte histórico con el empleo de métodos teóricos y empíricos en la Universidad de Ciencias Médicas de Pinar del Río en el año 2023.
Resultados: La impartición de la asignatura en la provincia actualmente ha completado 11 versiones y formado a 151 residentes de las diferentes especialidades de las Ciencias Básicas Biomédicas. Se logra la estandarización de varios Biomodelos animales que se emplean en las diferentes investigaciones básicas de la universidad. Se ha logrado que los formados en esta asignatura participen con sus resultados de la labor investigativa del área de animales de laboratorio en varios eventos científicos a diferentes niveles, hayan publicado artículos científicos en revistas certificadas y obtenido varios premios provinciales de la Academia de Ciencias de Cuba y Anuales de la Salud.
Conclusiones: el proceso de formación en el uso de animales de laboratorio en esta Universidad logra impactos positivos que se visualizan a través de resultados científicos.

Palabras clave: Capacitación Profesional; Animales de Laboratorio; Medicina.

INTRODUCTION

The use of laboratory animals in teaching has been practiced for centuries and has led to significant educational advancements. Many teaching practices complement their academic training with laboratory animals, for example, in biology, microbiology, pharmacy, animal husbandry, anatomy, physiology, pharmacology, veterinary medicine, among others; even medical imaging and many more. This multidisciplinary need justifies the obligation to achieve quality standards or implement animal handling measures during such practices. These standards are already institutionalized in many countries in the Central American and Caribbean region through International Committees for the Care and Use of Animals [Comités Institucionales de Cuidado y Uso de Animales] (CICUAL or CICUA, for its acronym in Spanish). The function of these entities is to review and evaluate institutional testing, research, and education programs on animal care and use.[1,2,3,4]

The curriculum for medical residents in basic sciences incorporates the teaching of laboratory animals as a complementary subject, focused on developing practical skills adapted to each specialty for teaching and research roles. A methodology based on the Principles of Action Research is proposed to integrate technique and understanding of species used in biomedical research. The contents are organized in a spiral, with increasing complexity, addressing techniques such as handling, sample collection, and surgery. The course is taught over one semester, with a workload of four hours per week, totaling 64 hours excluding teaching consultations.[5]

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The location of this Subject is made taking into account the knowledge: Propaedeutic (those received in their training as a Doctor, Graduate in Nursing), Alternative (as this Subject contributes to the Subjects they are receiving) and Perspectives (as this Subject contributes to the future knowledge of the graduates, from the particularity of the Specialty).[5]

Since 2010, the University of Medical Sciences of Pinar del Río has been training specialists in basic biomedical sciences. This course has led to the training of several first-year residents in these specialties, achieving positive results in solving professional problems in the performance of their teaching and research duties. The present work aimed to present the main impacts of this complementary training on residents of Basic Biomedical Sciences at the University of Medical Sciences of Pinar del Río.

METHODS

A qualitative, historical study was conducted using theoretical and empirical methods. The guiding method was the materialist-dialectical method, which provided the analogy and, therefore, the way to explain and understand the development of the subject in the province, its essential features, and its characteristics at each stage. At the theoretical level, the historical-logical method was used. The historical method consisted of tracing the events related to the historical development of the subject in the province of Pinar del Río. The logical method focuses on specifying the background, beginning, and consolidation of the subject. Periodization was used to systematize the analysis, based on a previously published analysis of the experience with the application of this subject.

Theoretical methods used analysis-synthesis and induction-deduction to determine background information, interpret documentary information, and identify trends that have characterized the development of the subject in Pinar del Río. At the empirical level, documentary review was used. Documentary sources included a review of resident files at the University of Medical Sciences of Pinar del Río, as well as consultation of databases located in the departments of Basic Biomedical Sciences and Research and Postgraduate Studies at this university. The main indicators that characterize the main results of scientific production from a teaching, academic, and research perspective were processed and presented as relative frequencies using the statistical method.

RESULTS

The course has currently been offered in the province for 11 academic years, during which 11 versions have been taught, training 151 residents in the various specialties of Basic Biomedical Sciences. Table 1 shows the number of residents who have benefited from this training.

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Table 1. Residents trained in basic sciences by specialty and academic year.

Year	Specialty						
	Human Anatomy	Clinical Biochemistry	Embryology	Physiology	Histology	Immunology	Total
2012	2	0	2	2	3	0	9
2013	1	1	3	0	1	0	6
2014	2	1	3	2	1	0	9
2015	2	1	4	3	3	0	13
2016	3	-	3	3	3	0	12
2017	3	4	4	4	4	0	19
2018	3	3	2	3	2	4	17
2019	4	4	4	4	4	0	20
2021	2	1	1	1	2	4	11
2022	2	2	1	2	2	3	12
2023	7	2	1	5	3	5	23

In addition to these initial impacts on training, the standardization of several experimental biomodels across different research projects has also been achieved.

- Biomodel of hypervitaminosis A in Wistar rats.
- Biomodel of Diabetes mellitus in Wistar rats.
- Biomodel of leptospiral infection with different serotypes in Wistar rats.
- Biomodel of maternal food restriction in Wistar rats.
- Biomodel of prenatal alcohol intoxication in Wistar rats.
- Biomodel of arterial hypertension in Wistar rats.
- Biomodel of peptic ulcer caused by NSAIDs.

Of the research carried out as part of these residents' specialty completion theses, 26 had as their research topic the use of laboratory animals, applying the basic principles for their use and management.

Listed below are some of the publications resulting from the use of laboratory animals in the last five years.

- García-Otero M, García-Otero M, Corría-Martínez I, Mosquera-Escobar M, Armas-González E, Velázquez-Hernández Y. Kidney damage in Wistar rat fetuses infected with Leptospira canicola. Rev Inf Cient [Internet]. 2022 [cited 10 Apr 2022];101(1). Available from:http://www.revinfcientifica.sld.cu/index.php/ric/article/view/3829

- Monzón Tamargo M, Peterssen Sánchez M, Pérez Cardoso J, González García X, González Freije S. Heart and lung morphometry in Wistar rats infected with Leptospira canicola during pregnancy. Rev Cienc Méd Pinar del Río [Internet]. 2019 [cited 10 Apr 2022];23(4):542–52. Available from:http://www.revcmpinar.sld.cu/index.php/publicaciones/article/view/3944

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- Gómez García M, Linares Guerra E, Montier Iglesias A, Díaz González O. Protective role of folic acid in a biomodel of prenatal alcohol intoxication in Wistar rats. Rev Cienc Méd Pinar del Río [Internet]. 2019 [cited 10 Apr 2022];23(2):212–23. Available from:*http://www.revcmpinar.sld.cu/index.php/publicaciones/article/view/3772*

- Montier Iglesias A, Cabezas Alfonso I, Díaz Cabrera J, Linares Guerra E, Jerez Hernández E. Effect of vitamin E on endogenous antioxidants in diabetic Wistar rats. Rev Cienc Méd Pinar del Río [Internet]. 2018 [cited 10 Apr 2022];22(3):438–52. Available from:*http://www.revcmpinar.sld.cu/index.php/publicaciones/article/view/3476*

- Paredes Lazo D, Sanabria Negrín J, Zaldívar Garrit I, Crespo Dueñas A, Cruz Hernández I. Hypervitaminosis A and hepatic tissue lesions in newborn Sprague Dawley rats. Rev Cienc Méd Pinar del Río [Internet]. 2018 [cited 10 Apr 2022];22(2):316–25. Available from:*http://www.revcmpinar.sld.cu/index.php/publicaciones/article/view/3461*

- González Cordero A, Hernández Rodríguez Y, León García M, Vento Pérez R, Díaz Lorenzo H. Effects of calcium on body weight and blood pressure in spontaneously hypertensive rats. Rev Cienc Méd Pinar del Río [Internet]. 2019 [cited 10 Apr 2022];24(1):e4237. Available from:*http://www.revcmpinar.sld.cu/index.php/publicaciones/article/view/4237*

- Hernández Díaz R, Sanabria Negrín J, Zaldívar Garrit I, Llanuch Lara M, Paredes Lazo D. Histological alterations due to hypervitaminosis A in the long bones of newborn Sprague Dawley rats. Rev Cienc Méd Pinar del Río [Internet]. 2018 [cited 10 Apr 2022];22(2):208–15. Available from:*http://www.revcmpinar.sld.cu/index.php/publicaciones/article/view/3411*

- Lemus Quintana J, Cabezas Alfonso H, Zaldívar Garrit I, Armas González E, Ramos Chang Y. Clinicopathological observations in pregnant Wistar rats experimentally infected with leptospires. Rev Cienc Méd Pinar del Río [Internet]. 2017 [cited 10 Apr 2022];21(3):354–61. Available from:*http://www.revcmpinar.sld.cu/index.php/publicaciones/article/view/3020*

- León García M, Hernández Rodríguez Y, Vento Pérez RA. Maternal malnutrition. An animal model for its study. Saarbrücken: Spanish Academic Press; 2020. ISBN: 978-620-035884-4.

The trained specialists and residents have also participated in several scientific events at different levels, which are shown in Table 2.

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Table 2. Scientific events in which we have participated in recent years.

Events	Country	Date
Ibero-American Convention on Basic Biomedical Sciences.	Cuba	May 2016
International Congress of Youth Researchers.	Cuba	March 2016
Scientific conference of the National School of Public Health.	Cuba	October 21, 2016
VI Basic Sciences Research Workshop. Girón 2017.	Cuba	April 17-21, 2017
IV Provincial Conference of Residents of Basic Biomedical Sciences and I Provincial Conference of Basic Biomedical Sciences.	Cuba	April 13, 2017
10th Latin American Conference on Hematology, Immunology, and Transfusion Medicine. 5th International Workshop on Hemophilia, 3rd Workshop on Primary Immunodeficiencies, 8th Cuban Congress of Hematology.	Cuba	May 8-12, 2017
11th International Congress on Higher Education. Provincial event.	Cuba	June 2017
8th Congress on Clinical Nutrition and Metabolism. FELANPE Northern Region Congress.	Cuba	December 2017
10th National Congress of the Spanish Society of Pediatric Hematology and Oncology.	Spain	May 24-26, 2017
5th Provincial Conference of Residents in Basic Biomedical Sciences and 2nd Provincial Conference on Basic Biomedical Sciences.	Cuba	March 2018
20th Scientific Conference of Professors and Health Professionals. 6th Health Convention.	Cuba	May 2018
-III Provincial Conference on Basic Sciences and VI Provincial Conference on Residents of Basic Biomedical Sciences.	Cuba	March 2019
IX International Congress on Clinical Nutrition and Metabolism. Nutrisalud 2019	Cuba	November 2019
First virtual event on Basic Biomedical Sciences Granma 2020	Cuba	2020
Morfovirtual 2020	Cuba	2020
II Provincial Scientific Conference on Basic Biomedical Sciences. Artemisa Chapter	Cuba	June 7-11, 2021
Edumed Holguín 2021	Virtual	December 2021
IV INTERNATIONAL CONGRESS FeSAHANCCCAL "Building a Culture of Care"	Virtual	December 1-3, 2021
Provincial Conference of the Laboratory Animal Society, IV Provincial Virtual Conference of Basic Sciences and VII Provincial Conference of Residents of Basic Biomedical Sciences.	Virtual	March 28-April 2, 2022

The main awards and recognitions received by members in recent years are also illustrated.

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❖ Cuban Academy of Sciences Award at the Provincial Level

- 2017. Hypervitaminosis A in pregnancy and its effect on bone growth in offspring.
- 2018. Hypervitaminosis and hepatic tissue lesions in newborn Sprague Dawley rats.
- 2018. Histological alterations due to hypervitaminosis A in long bones of newborn Sprague Dawley rats.
- 2019. Effect of leptospiral infection on maternal and fetal well-being.
- 2019. Perinatal and morphometric alterations in newborn Wistar rats with congenital leptospirosis.
- 2019. Non-alcoholic fatty liver disease in adults from Pinar del Río.
- 2019. Leptospiral infection and its effect on internal genitalia in pregnant Wistar rats.
- 2020. Morbidity associated with overweight and obesity in adults from Pinar del Río.
- 2020. Kidney damage in fetuses of Wistar rats infected with Leptospira canicola.
- 2020. Effect of prenatal leptospiral infection on the liver of newborn Wistar rats.
- 2020. Effects of honey on spermatogonia in Wistar rats.
- 2020. Morphometry of Sertoli cells in Wistar rats treated with different doses of honey.
- 2021. Relationship of waist-to-height ratio with morbidity and cardiometabolic risk in adults from Pinar del Río.
- 2021. Standardization of a maternal food restriction model in Wistar rats.

❖ Annual provincial health awards in the specialty thesis category.

- 2016. Standardization of a maternal food restriction model in Wistar rats.
- 2017. Hypervitaminosis A in pregnancy and its effect on bone growth in offspring.
- 2017. Protective role of folic acid in a biomodel of prenatal alcohol intoxication in rats
- 2018. Effect of vitamin E on endogenous antioxidants in diabetic Wistar rats.
- 2018. Hypervitaminosis A and hepatic tissue lesions in newborn Sprague Dawley rats.
- 2018. Histological alterations due to hypervitaminosis A in long bones of newborn Sprague Dawley rats.
- 2019. Effects of calcium on body weight and blood pressure in spontaneously hypertensive rats.

DISCUSSION

Biomedical research on animals is justified because the information obtained from animal models in turn allows us to obtain truthful information to protect and improve human health and, ideally, also the animal's; this is the basis of the scientific validity of the research. In other words, we believe that physiologically, genetically, or anatomically we are sufficiently similar to make valid and useful inferences obtained from animal models, hence we greatly value biomedical research for its results. We believe, therefore, that these: a) are good; b) there is no other way to obtain them; and c) all seek a benefit for humanity.[6]

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Herrera Álvarez ME,[5] shows in his article the Cuban experience in Medical Sciences of the work of Veterinarians in the training of Residents in Biomedical specialties in Laboratory Animal Science and refers that this Subject is taught to Residents of Biomedical specialties since 1983 as a Complementary course and that since 2000 is that is included in the curriculum. The author reports that this course is taught nationwide to all faculties of Medical Sciences and that Doctors in Veterinary Medicine, Graduates in Veterinary Medicine, Zootechnicians and Biologists have brought this knowledge so that the graduate has the foundations, tools and knowledge necessary to face Teaching and Research with very positive results in the achievement of elementary skills related to the Laboratory Animals discipline. In addition to offering laboratory animal clubs for Latin American students, they discuss animal handling and techniques, experimental surgery, and cutting-edge technologies such as transgenesis and cloning. The author explains that Latin American residents and students participate in these events, participating in student and resident scientific conferences, where we advise and/or tutor projects.

Nicasio et al.,[7] in Argentina report in their article that since 2008, the Department of Biology, Biochemistry and Pharmacy of the National University of the South (DBByF-UNS) and endorsed by the General Secretariat of Postgraduate and Continuing Education, offers the course "Care and Use of Laboratory Animals: Applications in Biomedicine." This course is intended for postgraduate students who require training in the use of LA and provides updated concepts regarding the care and proper use of vertebrate animals for scientific research. The main practical aspects developed are animal handling, restraint and sexing. Administration protocols for substances and sample collection are carried out, participants participate in the application of sedation, anesthesia and analgesia protocols and finally they can witness the performance of euthanasia with the subsequent necropsy of the animal, all carried out under strict conditions of refinement. The authors report that the implementation of this course has substantially improved the skills of graduate students in the ethical handling of experimental animals, a situation that is evidenced by the continuous evolution of the experimental protocols presented by the different research groups for approval by the CICUAL of the BByF-UNS.

Castillo et al.,[8] report their experiences after implementing training actions on experimentation with laboratory animals to raise the competence in biomedical research of professionals and technicians of the Experimental Toxicology Unit in Villa Clara, Cuba and explain that the learning needs of professionals and technicians of Utex were identified and training actions were designed to raise the competence of professionals and technicians in experimentation with laboratory animals, which were considered by experts as a useful, relevant, feasible and original product.

CONCLUSIONS

After introducing laboratory animals to residents in basic biomedical sciences, the training process in the use of laboratory animals achieved positive impacts, as evidenced by the scientific results presented. Particularly important was the accreditation of a diploma program, as there is no other similar program, as well as the provision of several teaching manuals as support materials for the postgraduate activities designed.

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