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Priorities in Physiotherapy Research: Mapping Global Research Agendas and Funding Trends

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Abstract:

The significance of physiotherapy research has been changed significantly within the past decades turning into a science-based field that is influenced by experimental research, technological advancements, ethical regulations, and economic funding priorities. This review maps the worldwide research agendas and funding patterns in the field of physiotherapy and a particular focus on human-based research offers critical mechanistic data on the recovery processes in the fields of musculoskeletal and neurological, cardiorespiratory, pain, and regenerative rehabilitation. Using evidence in human systems that are well-established, the review points at how structured physical interventions affect tissue healing, neuromuscular adaptation, neural plasticity and functional restoration using well-established biological pathways. It has been established that global research priorities are highly shaped around high disease burden and translational potential areas, specifically neurological and musculoskeletal rehabilitation, with methodological rigor, ethical framework and funding policies being decisive in determining areas of research. Despite the high experiment control, reproducibility, and mechanistic clarity of human-based physiotherapy studies, there are still limitations associated with the external validity, ethical restriction, and translation issues. The review also outlines imperative research gaps such as lack of long-term outcome assessment, underrepresentation of comparative intervention studies and the fact that it requires a better translational integration. The general implications of the findings are that evidence-based human-based investigation can be advanced through ethical and methodologically sound and innovation-driven research that can be used to guide future research agendas worldwide.

Keywords: Rehabilitation Research Priorities; Translational Physiotherapy; Neurorehabilitation; Musculoskeletal Rehabilitation; Exercise Physiology; Ethical Frameworks; Research Funding Trends

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1. INTRODUCTION

The research in physiotherapy has changed considerably over the past few decades where practice-based approaches have yielded to scientifically-based research that is being fuelled by experimental research, technological advancement, and the interdisciplinary research approach[1]. This change has been influenced by the escalating health demands in the world, the heightened focus on functional recovery, and the need to generate affordable and non-pharmacological interventions. Consequently, today physiotherapy studies have a broad scope of application, namely musculoskeletal rehabilitation, neurological recovery, cardiorespiratory conditioning, pain modulation and regenerative rehabilitation. In this growing research environment, articulated research priorities and strategic funding distribution have emerged as the most crucial factors to determine direction, scope, and influence of the physiotherapy science in the global arena.

Figure 1: Physiotherapy Research[2]

National health policies, priorities of funding agencies, advancements in technology, and translational relevance are all becoming important research agenda drivers in the field of physiotherapy at the global level. The funding conditions of competitive research have triggered increased consideration of the impact of research, ethical rigor and innovation potential, which has in turn influenced the prioritization of research studies that solve multifaceted rehabilitation issues and come up with measurable results. Global research priorities and funding trends mapping is hence important in the understanding of how the physiotherapy research directions are formed, which are the areas that receive constant investments, and critical gaps in knowledge exist. This kind of analysis offers a useful

understanding of the correspondence between scientific investigation, social requirements and the policy-based research approaches[3].

1.1 Background Information and Context

Research in physiotherapy is key in the development of evidence-based rehabilitation through the creation of scientific knowledge concerning movement, functional performance, and recovery mechanisms. Although early studies on physiotherapy were mainly aimed at validating clinical methods and modes of treatment, modern research has been moved to more of a mechanistic insight, maximization of outcomes, and innovation-led practices. The development of biomechanics, neuroscience, exercise physiology, and biomedical technology has significantly expanded the methodological framework of the field and enabled a more accurate and objective study of the process of rehabilitation[4]. On an international scale, physiotherapy research agendas are becoming more governed by societal health requirements, demographic changes, and financial factors, such as aging, the escalating number of chronic diseases, and the increasing number of injuries. To this end, funding bodies, and research organizations focus on making research that has a demonstrated translational relevance, scaling, and sustained functional advantages, and it is therefore necessary to discern these contextual forces in the context of current research priorities and future directions in physiotherapy research interpretation.

1.2 Objectives of the Review

- To identify global priorities in human-based physiotherapy research across major rehabilitation domains.
- To review key methodologies used in human-based physiotherapy studies.
- To evaluate strengths and limitations of human models in physiotherapy research.
- To assess the translational relevance of human-based physiotherapy evidence.
- To examine the influence of ethics and funding trends on research agendas.

1.3 Importance of the Topic

Research priorities mapping and funding trends are essential concepts in the sustainable development and strategic planning of the field of physiotherapy since sharply outlined priorities can guide researchers to focus on high-impact topics, guarantee the effective use of scarce resources, and enhance compatibility between scientific research and the requirements of the community[5]. Appreciation of trends on funds also allows one to see underrepresented or neglected areas of research that can be in need of more academic and financial support. This review promotes strategic research planning, evidence-based decision-making, and interdisciplinary collaboration and enhances the scientific basis of physiotherapy research by analyzing the process of global research agenda formation and its change over time. Finally, this analysis is necessary to make sure that physiotherapy is still moving forward as a strong, innovative, and effective discipline in health science.

2. HUMAN-BASED PHYSIOTHERAPY RESEARCH: EVIDENCE, METHODOLOGICAL FRAMEWORKS, AND CRITICAL APPRAISAL

The human-based physiotherapy studies have led to significant knowledge of the recovery processes after musculoskeletal, neurological, and cardiorespiratory disabilities through the use of the well-established human models (rodents, rabbits, canines, and ovine species). The musculoskeletal research indicates that the programs of exercise training always increase muscle regeneration, joint mobility, and connective tissue healing by promoting the mechanisms such as enhanced collagen arrangement, vascularization, and satellite cell mobilization. Equally, it has been shown in neurological models that neuroplasticity, synaptic reorganization, and functional recovery of the motor functions through task-specific training, treadmill exercise, balance activities and sensory stimulation can be promoted with the aim of promoting the therapeutic use of activity-based physiotherapy in restoring movement and coordination[6].

The research is methodologically based on controlled experimental designs, induced injury models, objective biomechanical, electrophysiological, histological and molecular measurements which are typically assessed longitudinally to determine recovery between time points. These techniques have a high internal validity, reproducibility and mechanistic understanding of tissue repair and neuromuscular adaptation. Nevertheless, there are still some critical limitations, such as the lower levels of external validity because of the differences between species, limitations in study design by ethical reasons, and difficulties in applying complex motor behaviors of humans to human clinical settings. Therefore, although human research offers a powerful preclinical basis, the results of these studies should be critically combined with clinical research to make the results meaningful and useful in the rehabilitation of humans[7].

2.1 Overview of Key Human-Based Physiotherapy Studies

The study of human-based physiotherapy has been of central importance to the development of knowledge on the post-injury and post-disease recovery mechanisms. Most of the research has focused on musculoskeletal injuries, neurological and cardiorespiratory dysfunctions that are experimentally induced as they are more akin to the clinical situations that are met when conducting rehabilitation on human beings. The rodents, rabbits, canines and ovine species are the common models used because they are similar in anatomy, manageable in size and have been well characterized in terms of their physiological response to therapeutic intervention[8].

The musculoskeletal model of evidence continually proves that designed physical exercise programs, including controlled loading, resistance training, and passive mobilization, can effectively increase the rate of muscle fibre regeneration, increase the range of motion of the joints, and speed up the recovery of tendon and ligament tears. Improved collagen orientation, elevated vascularization, and muscle satellite cell activation are identified to be the reasons of these adaptations.

Human-based physiotherapy has also been important in providing important information about neuroplasticity and motor recovery in the neurological models. Tasks-specific training, treadmill-based locomotor activity, balance training, and sensory stimulation have also been depicted to induce synaptic reorganization, axonal sprouting and cortical remapping after spinal cord injury, stroke, or peripheral nerve injury. The therapeutic capacity of the exercise based on physiotherapy is highlighted by functional gains in gait, coordination and motor control reported in these studies[9].

2.2 Methodological Approaches

The methodology of human-based physiotherapy studies follows strict and highly-organized methods of study, to enact the impact of therapeutic interventions in controlled settings. These methods serve the purpose of isolating the effect of certain physiotherapy parameters and reduce the error of confounding factors with an aim of enhancing the reliability and reproducibility of results. Through standard protocols and objective measures of outcome, such studies are valuable in providing mechanistic understanding of the process in tissue repair, neuromuscular adaptation and functional recovery[10].

Typical research in physiotherapy of humans involves using humans:

- Controlled experimental designs, where random assignment of humans to the intervention and control groups was carried out to define distinct cause and effect relations and eliminate bias in the experimentations.
- Artificial musculoskeletal trauma, nerve trauma, stroke, cardiopulmonary dysfunction (induced injury or disease models) so as to more closely replicate clinical conditions as they occur when contemplated in human rehabilitation.
- Objective measures of functional performance by quantitative biomechanical measures such as gait, joint range of motion, force, and movement kinematics.
- Electrophysiological tests, including nerve conduction studies and electromyography, to examine neuromuscular activation, transmission of signals and motor functional recovery.
- Histological and molecular methods that allow direct study of tissue regeneration, inflammatory reactions, muscle fibre remodelling and neural plasticity on the cellular level.
- Longitudinal assessment of functional recovery, where repeated assessments are done through time in order to measure short term adaptations and long term therapeutic outcomes.
- Standardized intervention regimens, which enable the accurate manipulation of these variables: degree of exercise, length, frequency and time to establish dose-response associations.

Together, these methodologies have a high internal validity and enable the ability to explore the physiological mechanisms behind physiotherapy interventions in detail, and they also have a strong basis of translating the preclinical results to evidence-based clinical practice[11].

2.3 Critical Evaluation of Strengths and Weaknesses

Such experimental control and reproducibility allow human-based physiotherapy studies to investigate in detail the cellular, molecular, and tissue-level mechanisms underlying recovery that are hard to investigate in humans. But there is a species difference and ethical restriction in the extent of external validity and the difficulty in applying complex motor behaviors and outcomes in clinical rehabilitation[12].

- **Strengths**

The experimental control is very high in human-based research of physiotherapy, which provides the researcher with an opportunity to control environmental factors, intervention, and biological variables. This is due to the fact that in such a controlled environment, it is possible to isolate the effects of a particular set of physiotherapeutic intervention, thus creating clear relationships between causes and effects. One of the key advantages of using human models is that it is possible to study cellular and molecular processes involved in recovery, including muscle fiber regeneration, inflammatory processes, neural plasticity, and tissue remodeling, that are hard or impossible to examine human subjects. Also, the standardized models of injury and intervention improve the reproducibility of the results in the studies and laboratories. The observation of the tissue level change using the histological, biochemical, and imaging methods adds more weight to the mechanistic knowledge of how physiotherapy intervention changes healing and functional restoration[13].

- **Weaknesses**

Although these are the strengths, human-based physiotherapy studies have significant limitations. The first is low external validity, since anatomical, physiological, and behavioral variation in human species and humans may limit the applicability of research to clinical use. The species-specific variations in reacting to exercise intensity, neuromuscular training, and rehabilitation timing can be significant enough to produce an over- or underestimation of the therapeutic effect in humans. Study design is also affected by ethical constraints where the severity of induced injuries, duration of interventions, and sample sizes are restricted which may influence the extent and level of investigation. Also, it is still difficult to extrapolate the complex motor behaviors and functional outcomes found in humans, e.g. coordinated gait patterns or task-specific movements, to meaningful clinical rehabilitation interventions in human patients. These restrictions demonstrate the necessity to interpret findings carefully and underline the role of combining human-based evidence with clinical and translational research[14].

3. DOMAINS OF APPLICATION AND TRANSLATIONAL IMPACT OF HUMAN-BASED PHYSIOTHERAPY RESEARCH

The research on human-based physiotherapy has contributed significantly in various areas of rehabilitation using controlled, mechanistic evidence in understanding the effects of physical interventions on recovery. Mechanical loading and exercise in musculoskeletal rehabilitation has always been shown to increase collagen organization, tensile strength, vascularization and extracellular matrix remodelling thus promoting tissue healing and functional recovery. Human models, likewise, have been used to elucidate the effects of aerobic and respiratory training on cardiac efficiency, pulmonary function, mitochondrial capacity, and exercise tolerance comprising the physiological basis of approaches to endurance training and respiratory physiotherapy to be used in clinical practice[15].

There have also been equal breakthroughs in neurological rehabilitation, pain control and newer regenerative methods. In human models, task-specific training, locomotor therapy and enriched environments induce neuroplasticity by neurogenesis, synaptic remodelling and cortical-spinal reorganisation leading to functional recovery of significance. Meanwhile, literature on pain and sensorimotor integration brings attention to the effect of exercise and mechanical stimulation on nociceptive pathways and endogenous analgesic responses. The more recent synthesis of physiotherapy and regenerative and technology-assisted interventions also highlights the value of human models on translation, which is rapidly becoming a part of the innovative, evidence-based rehabilitation approaches.

3.1 Musculoskeletal Rehabilitation and Tissue Healing

There are strong indications of human research that controlled mechanical loading and therapeutic exercise are important in musculoskeletal tissue repair and functional restoration. Physiological models of muscle strain/tendon rupture/ligament rupture/joint degeneration invariably show that physical loading of proper dosage improves collagen fiber orientation, tensile strength, and maturation of newly formed connective tissue. The exercise interventions have been reported to increase the proliferation of fibroblasts, enhance the remodeling of the extracellular matrix, and increase vascularization, and as a consequence, accelerate tissue healing and decrease fibrosis. Moreover, human models provide a means to be able to control accurately loading parameters like intensity, frequency and length of duration thus optimizing rehabilitation protocols[16]. Accordingly, research and development priorities in this area focus on injury prevention, sports rehabilitation, post-surgical recovery, and treatment of degenerative musculoskeletal conditions which demonstrates the high translational generalizability of this information to clinical physiotherapy practice.

Figure 2: Musculoskeletal Rehabilitation[17]

3.2 Neurological Rehabilitation and Neural Plasticity

Neurological rehabilitation is one of the most widely funded and scientifically prioritized fields of research human-based physiotherapy research. Model based experimental analyses have shown that activity-based interventions such as repetitive task training, treadmill locomotion, balance activities as well as exposure to enriched environment have a great impact of improving neural plasticity. Such interventions enhance neurogenesis, stimulate synaptic reorganization and restructuring of the cortex and spinal cord which results in functional recovery and enhanced motor coordination. Human models facilitate the complexity examination of the mechanisms within the body, including modulation of the expression of neurotransmitters, growth factors, and neural circuit responses during activity. The powerful mechanistic and functional data obtained as a result of these investigations has informed the evolution of the evidence-based neurophysiotherapy techniques and is still drawing a huge amount of research funds across the globe[18].

3.3 Cardiorespiratory Conditioning and Exercise Physiology

The response of the cardiovascular and respiratory systems to structured levels of exercise training have been actively investigated using human models[19]. There are research papers on aerobic conditioning, respiratory muscle training, and endurance-based training, which show the increase of cardiac output, myocardial efficiency, capillary density, and pulmonary ventilation. Also, it has been found that exercise improves the density of the mitochondria, oxidative enzyme activities, and oxygen absorption in skeletal muscles, which results in enhanced exercise tolerance and fatigue resistance[20]. These results give a mechanistic basis of endurance training programs and respiratory physiotherapy methods employed in treatment of chronic cardiopulmonary disorders. Human experiments have a controlled experimental

environment that enables perfect assessment of training intensity, progression, and recovery, which enhance the scientific foundation of cardiorespiratory rehabilitation measures[21].

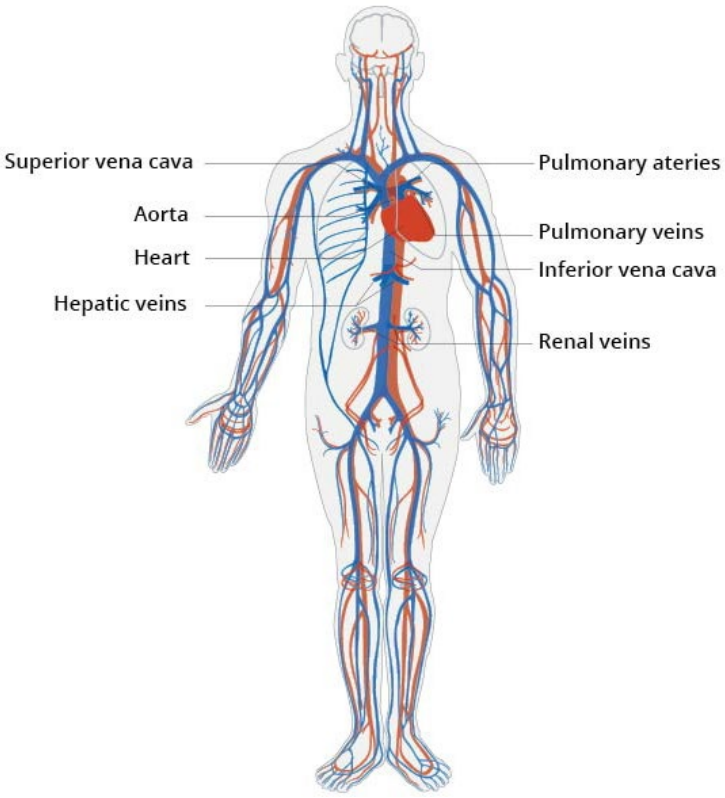

Figure 3: Cardiovascular Function[22]

3.4 Pain Modulation and Sensorimotor Integration

The research involving humans has contributed greatly to the study of pain modulation processes related to physiotherapeutic treatment. Studies have shown that the physical modalities (therapeutic exercise, mechanical stimulation and movement-based therapies) affect the peripheral, spinal and supraspinal nociceptive processing[23]. Exercise has also been found to decrease inflammatory mediators, control ion channel functions and stimulate endogenous analgesic mechanisms and systems such as opioid systems and serotonin systems. Moreover, sensorimotor training improves proprioceptive feedback and central integration, which are part of the better control of movements and lowering pain sensitivity[24]. The increasing focus on non-pharmacological modalities of pain management has led to an increase in funding agencies that support human studies in this field as it has the capacity to inform safe and effective physiotherapy modalities against chronic and neuropathic pain disorders.

3.5 Regenerative and Technology-Assisted Rehabilitation

The new tendencies in research in the field of physiotherapy are also moving toward the inclusion of traditional exercise-based interventions with regenerative and technology-based methods. Humans research is playing a critical role in assessment of the synergistic benefits of

therapeutic exercise in conjunction with stem cell stimulation, growth factor regulation, biomaterial scaffold and bioengineered tissue[25]. Other recent technologies, including robots aided training, neuromodulation and wearable technology, are also being evaluated on the human models to determine their safety, effectiveness and their influence on the biology. These researches are important in offering critical understanding of tissue regeneration, neuromuscular integration, and functional recovery on a cellular and system level. These innovative approaches have a high translational potential, and as such, human-based research has become a foundation of the future in the creation of more advanced rehabilitation technology due to the increasing investment by funding agencies[26].

4. ETHICAL CONSIDERATIONS AND POLICY FRAMEWORKS IN HUMAN-BASED PHYSIOTHERAPY RESEARCH

Research in human-based physiotherapy is carried out in the framework of broad ethical and regulatory rules that focus on ensuring a balance between the development of the sciences and the ethical duty to take care of the welfare of the humans[27]. These models are definitive in the priorities of research, design of experiments, methodology, and decision on funding. The ethical oversight committees, institutional human care and use committees and national regulatory bodies specify that all studies involving humans as far as physiotherapy is concerned give clear scientific justification of the use of humans, have demonstrated projected benefits, and that they do not have any non-human alternatives that are relevant. Consequently, mechanistic clarity and translational relevance are taking up a central role in physiotherapy research agendas to provide ethical approval and funding[28].

The main ethical governance principle in conducting human studies is the 3Rs principle of Replacement, Reduction and Refinement[29]. Replacement policies favor the adoption of alternative models, like in-vitro models or computer-based models, wherever feasible; nevertheless, numerous physiotherapy interventions will necessarily entail movement and loading and functional recovery, and therefore human models will be essential. Reduction strategies have an implication on physiotherapy research as they facilitate the best-designed studies, complex statistical design, and longitudinal designs that enable the acquisition of multiple outcomes measures using a single cohort of human. It is the refinement strategies that have most significantly influenced research in physiotherapy, leading to the creation of non-invasive rehabilitation regimes, graded exercise regimes, and functional behavioral assessments which have reduced the pain, stress and procedural burden on experimental humans[30].

Ethical requirements have also informed the development of intervention approaches in the human -based physiotherapy researches. The increased focus on non-invasive and low-stress rehabilitative methods like controlled treadmill training, voluntary exercise paradigms and environmental enrichment, which are highly ethical but still scientifically valid, has increased. Gait tests, endurance tests, motor coordination tests and longitudinal functional tests like these are now more popular than terminal or highly invasive endpoints. This change not only

increases human welfare, but also increases the topicality of results by recording changing recovery mechanisms over time[31].

Ethical compliance is now an issue of concern as a policy and funding requirement in the research evaluation and grant allocation process. There is a growing focus on human -based physiotherapy projects with strong ethical frameworks as well as a scientific rigor and translational potential in the funding agencies and international research councils[32]. Cross-modal experiments involving the use of cutting-edge imaging methods, behavioral analytics, and computational modeling are usually preferred because these methods have the highest data-gathering abilities and require fewer humans. These policy-based incentives have played a role in a methodological change to high-resolution, data-intensive, and ethically optimal research designs in the physiotherapy science.

Table: Summary of Key Studies on Physiotherapy Research Priorities and Trends[33]

Author(s) & Year	Study Title	Focus Area	Methodology	Key Findings
Silva et al., (2025)[34]	Establishing a Research Agenda for Physiotherapy in Portugal: A Delphi Study	National physiotherapy research priorities	Delphi consensus method involving expert panels	Identified priority research areas including musculoskeletal rehabilitation, neurological physiotherapy, service delivery, and implementation science to guide future national research agendas.
Souto-Miranda et al., (2024)[35]	Priorities in Physical Therapy Research: A Scoping Review	Global physiotherapy research priorities	Scoping review of published literature	Highlighted dominant research themes such as musculoskeletal pain, neurological rehabilitation, exercise therapy, and health services research, with gaps in implementation and equity-focused studies.

Sweileh, (2024)[36]	Research Trends and Patterns on International Migration of Health Workers (1950–2022)	Health workforce research trends	Bibliometric and trend analysis	Demonstrated increasing global research output on health workforce migration, emphasizing policy, workforce sustainability, and inequities relevant to rehabilitation and physiotherapy services.
Vaucher et al., (2025)[37]	European Research Priorities for Osteopathic Care (PROCare): A Sequential Exploratory Investigation and Survey	Manual therapy and osteopathic research priorities	Mixed-methods design (qualitative exploration followed by survey)	Identified research priorities focused on effectiveness, safety, patient-centered outcomes, and integration of manual therapies within healthcare systems, relevant to allied rehabilitation fields.
Vitorino Fandim et al., (2025)[38]	Telehealth in Physiotherapy Is Moving towards Equitable Authorship: A Bibliometric Study	Telehealth and digital physiotherapy research	Bibliometric analysis	Revealed rapid growth in telehealth physiotherapy research with improving global authorship equity, reflecting shifting research agendas toward digital and remote rehabilitation models.

Globalization of ethical standards has also contributed to human-based physiotherapy research in the world. Unified ethical standards are used in cross-border cooperation, data interoperability, and multicenter research, especially in musculoskeletal and neurological rehabilitation studies. Standardised policies also enable the emergence of a consensus-based outcome measures and uniform intervention protocols, enhance the global evidence base and ensure independent ethical practices across the research settings.

Although these have been achieved, there are some limits to experimental design due to ethical considerations, especially when the study uses long-term interventions, intense loading or modeling of chronic diseases. Limits in the duration of the intervention, repetition, or the severity of the intervention can limit the study of the long-term rehabilitation results or complicated recovery patterns. This means that scientists have a very delicate balancing act to undertake between the achievement of scientific innovation and moral accountability, whereby the complexity of the experimentation should not cause harm to the human life.

5. DISCUSSION

The discussion indicates that human -based research in physiotherapy is central in the development of world rehabilitation agendas due to provision of mechanistic, experimentally controlled evidence in musculoskeletal, neurological, cardiorespiratory, pain, and regenerative fields of studies. The emphasis on research in the areas of neurological and musculoskeletal rehabilitation is both representative of the disease burden on a global scale and the applicability of human models in the study of activity-dependent plasticity and tissue remodeling, and the funding priorities and ethical frameworks continues to drive research towards translationally relevant and non-invasive models. Despite the important perspectives that human research can provide towards evidenced physiotherapy practices and innovation, there are significant gaps in long-term outcome research, comparative intervention research, and translatability. Standardized outcomes, sophistication methodologies and ethically bothersome and technology aided research will be critical in filling these gaps to make progress in physiotherapy research in a sustainable and effective way[39].

5.1 Interpretation and Analysis of Findings

The results of this review reveal that human -based research in physiotherapy is in the center stage of defining the research agenda of rehabilitation research around the world because it offers mechanistic evidence that is experimentally controlled regarding recovery mechanisms. The human literature is consistent in its findings that structured physical interventions have effects on tissue healing, neuromuscular adaptation, and functional restoration via well-described biological mechanisms, across musculoskeletal, neurological, cardiorespiratory, pain and regenerative systems. The high level of research activity in the neurological and musculoskeletal rehabilitation fields is a consequence of the high burden of these disorders in the world as well as the aptness of the human models in the study of activity-dependent plasticity, mechanical loading, and tissue remodeling. The advantages of controlled experimental research, longitudinal evaluations, and the use of multiple outcome measures as indicators of internal validity, reproducibility, and mechanistic understanding have been viewed as priorities worldwide in the promotion of physiotherapy as a science-based field.

Meanwhile, the analysis shows that the priorities of funding have a strong impact on the focus of physiotherapy research, where there is a strong translational prospective and quantifiable outcomes of functions. Neurorehabilitation, exercise physiology, and technology-assisted rehabilitation are areas that are continuously being invested in because they meet policy goals,

innovation priorities and clinical relevance. Ethical paradigms also influence the direction of research by encouraging refinement-driven methodologies and intervention approaches that do not interfere with the subject, which strengthens a transition to research in ethically responsible and functional ways of rehabilitation.

5.2 Implications and Significance for Physiotherapy Research

These findings have profound implication in the development of physiotherapy research as well as practice. Human research yields a well-founded localized pathway of preclinical research, which enlightens the design of intervention, the most effective dosing regimen, and the timing of recovery plans. The mechanistic observations made on human models have had a direct impact on the formation of the modern-day physiotherapy methods, specifically neurophysiotherapy, musculoskeletal rehabilitation, and exercise prescription. Human studies enhance the scientific validity of physiotherapy by explaining the biological reactions to movement, loading, and training, and facilitates the incorporation of physiotherapy into multidisciplinary health systems.

Strategically, mapping of world research agendas and funding patterns can allow the researchers and institutes to translate the work to high impact priority areas without causing the duplication of efforts. The increased focus on translational relevance and ethical accountability makes it essential to conduct physiotherapy studies that are scientifically sound and ethically accountable. Furthermore, the growing role of physiotherapy research as an innovation-driven solution to healthcare is also reflected by the increasing collaboration between physiotherapy and regenerative medicine as well as in sophisticated technologies.

5.3 Research Gaps and Future Directions

Although significant, there are still some important gaps in the human -based physiotherapy research which will be considered in the future as identified in this review. A significant gap exists in the fact that little has been done to investigate the outcomes of long-term rehabilitation, especially in chronic and aging-related states where recovery periods are not constrained by short experimental time frames. Also, comparative research that has assessed various physiotherapy methods, dose regimens, and integrated therapies is comparatively low, which constrains the possibility of defining optimal rehabilitation regimes.

There are also still some challenges with translation, with species-specific differences and simplified in vitro settings potentially not fully recreating the complexity of functional recovery in clinical conditions. Future studies must aim at enhancing the translational applicability by use of standardized outcome measures, multimodal assessment paradigms, and combination of human results with and without accompanying preclinical and clinical studies. Increased investigations in underfunded fields like pain modulation, sensorimotor integration, and functional outcomes in regard to quality of movement can also enhance the evidence base. Lastly, further investment in ethically cleansed procedures, improved imaging, computer-based

modeling and technology-based rehabilitation will have to be in the direction of future healthy and effective global research agendas in physiotherapy[40].

6. CONCLUSION

This review shows that human -based physiotherapy studies are a fundamental basis in defining research agendas and funding priorities in the world by offering mechanistic, experimentally sound information in critical areas of rehabilitation such as musculoskeletal, neurological, cardiorespiratory, pain, and regenerative physiotherapy. The high focus on the neurological and musculoskeletal rehabilitation implies the global load of activity-related impairments as well as the appropriateness of the human models to study the activity-dependent plasticity, tissue remodeling, and recovery processes. Although human study is associated with a high level of internal validity, reproducibility, and translationally relevant information, there are still problems of external validity, ethical limitations, and long-term outcome assessment. To overcome these limitations, standardized methodologies, ethically advanced experimental designs and combining these with translational and clinical research will be necessary in order to maximize the research impact. In general, evidence-based rehabilitation practices and activities of strategically aligned, ethically responsible, and innovation-oriented human-based physiotherapy research are essential to inform future research and funding priorities of physiotherapy across the world.

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