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Research Designs in Sports and Health Science

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ABSTRACT

Research design is the heart of a good study in health and sport science, defining how data are collected, analyzed, and interpreted to advance knowledge and practice. This systematic narrative review addresses both quantitative and qualitative research designs commonly employed in these disciplines, describing their methodology characteristics, applications, and drawbacks. Quantitative designs covered are descriptive, correlational, experimental, quasi-experimental, longitudinal, cross-sectional, cohort, case-control, and survey research. Recent examples of sports and health research illustrate how these designs allow causality, prevalence, risk factor, and intervention effectiveness. The review also analyses qualitative designs such as phenomenology, grounded theory, ethnography, case studies, and narrative research based on how they help to explore lived experiences, social context, and meaning making processes that are pivotal to the understanding of athlete behavior and health outcomes. Furthermore, the review mentions major gaps through the incorporation of mixed methods research that integrates quantitative and qualitative approaches to provide richer analyses. Among some of the emerging new innovative designs like ecological momentary assessment, adaptive trials, and technology-enabled data collection are explained in terms of how they can achieve maximal ecological validity and accuracy. The intersection of data science and digital technologies, such as machine learning and wearable sensors, is seen to be transforming research possibilities, demanding adaptive methodological designs. Research design choice issues in research settings, especially in low-resource settings like in Uganda, are also considered to be culturally acceptable and viable. Ethical issues in sport and health studies, such as participant consent and confidentiality, are also considered. The review concludes with a guide for researchers and practitioners to choose a suitable design based on their research questions, accessible resources, and norms of ethics. By incorporating current trends and existing frameworks, the paper is a handy reference to construct methodologically rigorous and efficient research in sports and health science.

Keywords: Physical education and sport, leisure time, school commitment

INTRODUCTION

The scholarly fields of sports science and health science have expanded exponentially over the past few decades, driven by global interest in physical activity, elite sports performance, injury prevention, rehabilitation, and public health promotion. As these fields evolve, so does the need for rigorous methodology-based research to inform evidence-based

practice. Central to this effort is selection of an appropriate research design, which serves as the architectural plan for constructing valid, reliable, and contextually relevant knowledge (Portney & Watkins, 2015; Thomas et al., 2020). Research design has been described as the overall strategy coordinates the different components of a study in a coherent and logical way such that the research problem is maximally addressed (Creswell & Creswell, 2018).

In sport and exercise sciences, research problems are often multidimensional, extending from biomechanical and physiological to psychosocial and behavioural concerns. This diversity necessitates a wide range of designs, each with distinct methodological characteristics, strengths and limitations, and practical uses. Quantitative research designs such as experimental (e.g., randomized controlled trials) and quasi-experimental studies are widely used for hypothesis testing and casual inference, while observational designs provide valuable insights in contexts where experimental manipulation is not feasible (Portney & Watkins, 2015; Thomas et al., 2020). Often assessing the impact of clearly defined interventions on performance metrics, injury outcomes, or adaptation responses. For instance, RCTs have been used to establish the effectiveness of neuromuscular training programs at reducing ACL injury in female athletes (Tanaka et al., 2020), or to compare modalities of exercise for its influence on indicators of cardiovascular well-being in inactive adults (Thomas et al., 2020; Portney & Watkins, 2015). While experimental designs are appreciated for their ability to infer causation, they may be compromised in ecological validity when generalized to applied sport settings (Hopkins et al., 2009). On the other hand, observational designs such as cross-sectional, cohort, and case-control studies are necessary when experimental manipulation is not feasible or is unethical. These designs are broadly used in epidemiological surveillance, injury risk profiling, and performance analytics and offer valuable insight into population trends, associations, and longitudinal outcomes. Cohort studies, for example, have been used to monitor injury incidence and training load relationships over competitive seasons (Bache-Mathiesen et al., 2021). However, such designs are susceptible to confounding variables and typically cannot establish causation.

The increased recognition of the subjective, experiential, and sociocultural features of health and sport has elevated the prominence of qualitative research. Interviews, ethnography, and narrative analysis are some of the methods especially suited to an exploration of phenomena such as athlete identity, rehabilitation experiences, motivation, and physical activity cultural context (Sparkes & Smith, 2014). For instance, qualitative research has explored how athletes adjust to career-threatening injuries or how teenagers in low-resource settings perceive physical activity participation barriers (Ekenros et al., 2023). While qualitative approaches are routinely faulted for having limited generalizability, their degree of depth is necessary in exploring context, meaning, and lived experience. Recognizing the limitations of using either quantitative or qualitative approaches in isolation, researchers have increasingly adopted mixed-methods designs, combining the numerical rigor of the quantitative research with the contextual depth of the qualitative review. This is particularly helpful in sport and health contexts where both outcomes, and processes, need to be understood. For example, a study might assess the physiological effects of a new training program while simultaneously observing athletes' psychological responses and perceived efficacy

through interviews (Creswell & Plano Clark, 2018). Furthermore, the methodological landscape is being reshaped by emerging innovations in technology, data analytics, and interdisciplinarity. Furthermore, advances in technology such as wearable sensors, mobile health platforms, and AI-driven analytics are reshaping the methodological landscape, expanding both the possibilities and challenges of research in sport and health sciences (Kaizer et al., 2023).

With this complexity and variability, a strong understanding of research design options and their suitability to specific research questions is central to building both theoretical and applied knowledge in these disciplines. The aim of this narrative review is to critically outline the major research design types used in sports and health sciences, including experimental, quasi-experimental, observational, qualitative, and mixed-methods approaches.

The specific objectives of this review are to: Examine the methodological features, strengths, and limitations of each major research design; Illustrate their real-life applications through examples drawn from contemporary literature; Discuss emerging methodological innovations, such as AI, wearable technology, and mobile health platforms, and their implications for future research; Provide practical recommendations for researchers, practitioners, and policymakers on selecting and applying appropriate designs in sport and health research.

METHOD

This narrative review was done to present an integral and critical overview of the different research designs used in sports and health science research. The emphasis was on gaining insight into how diverse methodologies are conceived, implemented, and assessed in research settings varying from elite performance to public health and physical education. A narrative review is not similar to systematic reviews, where protocol is followed rigidly, targeting questions narrowly defined. This type of review provides flexibility and allows exploration into literature more broadly. It is especially suitable for conceptual topics, such as research design, where methodological application as well as its interpretation is expected to be diverse (Ferrari, 2015).

To identify relevant literature, a comprehensive and purposeful search strategy was employed across several major academic databases, including PubMed, Scopus, Web of Science, SPORTDiscus, and Google Scholar. The keywords were specifically selected to match the scope of the review, with variations of keywords including "research design," "methodology," "sports science," "health science," "physical activity," "qualitative methods," "quantitative methods," and "mixed methods." Boolean operators (AND/OR) were used to filter results and increase relevance. The search was restricted to sources between 2000 and 2024 to provide both the basis and the most recent methodological views. Only English-language literature was taken into account.

The inclusion criteria were peer-reviewed journal articles, books, and chapters that considered, utilized, or evaluated research designs specifically in the framework of sports, health, or exercise science. Theoretical and empirical sources were included if they had considerable discussion of research design concepts. Sources were excluded if they lacked methodological focus, were not peer-reviewed, were written in languages other than English, or were not accessible in full text. Initially, approximately 220 sources were identified. After screening titles and abstracts for relevance, 68 full-text documents were assessed. Of these, 45 high-quality sources were retained for final analysis and synthesis.

The selected literature was then reviewed thematically. Data extraction focused on identifying and categorizing various types of research designs used in the field, including experimental, quasi-experimental, observational, qualitative, and mixed-methods approaches. For each design category, information was gathered on its theoretical underpinnings, strengths, limitations, typical applications, and relevance in sports and health-related research. Focus was also given on

Table 1. Summary of Findings of Research Designs in Sports and Health Sciences

Authors	Country	Purpose	Type of source	Summary of key findings
Creswell & Creswell (2018)	USA	Define and explain the quantitative research approach	Book	Quantitative research supports hypothesis testing and statistical analysis for cause-effect relationships.
Patton (2015)	USA	Explains qualitative designs in health and sports	Book	Offers rich, in-depth insights into behaviour and experiences
Sparkes & Smith (2014)	UK	Highlight sophistication in qualitative research	Book	Emphasizes trustworthiness, reflexivity and ethical standards.
Fetters et al. (2013)	USA	Show value of mixed methods in health research	Journal Article	Offers holistic insights into clinical outcomes and patient experience.
Hammersley & Atkinson (2019)	UK	Describe ethnographic research methods	Book	Uncovers group culture, rituals, and values in sports and health settings.
Charmaz (2014)	USA	Describe grounded theory approach	Book	Develops theories from data, suited for under-researched areas.
Yin (2018)	USA	Detail case study method in health and sport	Book	Enables in-depth contextual analysis of programs and individuals.
Riessman (2008)	USA	Explore narrative research in personal health stories	Book	Provides insights into identity, culture, and experiences through personal narratives.
Zhang & Li (2023)	China	Assess policy effects using quasi-experimental time series	Journal Article	Time-series design proved effective for non-randomized intervention assessment.
Shiffman et al. (2008)	USA	Introduce Ecological Momentary Assessment (EMA)	Emerging Design Discussion	EMA enhances real-time, ecological data collection; reduces recall bias and improves validity in behavioural studies.
Chow & Chang (2011)	USA	Describe adaptive trial designs for interventions	Design Innovation Review	Adaptive trials adjust based on interim data; useful in real-time sports intervention testing.
Onywera (2019)	Kenya	Contextualize research design for African settings	Policy and Context Review	Resource constraints demand pragmatic designs; ethical and cultural sensitivity improves relevance and participation.
Coutts et al. (2019)	Australia	Apply machine learning to injury prediction and performance data	Predictive Modelling Study	Big data allows for pattern detection and individualized predictions; supports AI integration into sports science.
Robert-Lachaine et al. (2017)	Canada	Use of motion capture and IMUs in biomechanical assessment	Tech-Enhanced Field Study	Enabled objective, precise in-sport biomechanical analysis; suitable for performance evaluation.

recognizing innovative methodologies powered by technology development and interdisciplinarity, including wearable technology-based designs, AI-based analytics, and digital health technologies.

Synthesis of findings was done narratively, with themes structured around the methodological categories and their application to academic research as well as applied practice. The method allowed for broad yet critical examination of how various designs facilitate knowledge development, practical interventions, and policy-making in the areas of sports performance, health promotion, rehabilitation, and physical education. As this review was based entirely on published academic literature and did not involve human participants, no ethical approval was required. All sources were appropriately cited to maintain academic integrity and transparency. The methodology used in this review aligns with scholarly best practices for conducting narrative reviews and is intended to guide readers through the evolving landscape of research design in sports and health sciences.

Quantitative Research Approach

The quantitative approach is the focus of most studies in health and sports science, especially where it is an objective measurement of variables, hypothesis testing, and cause-and-effect relationships are desired. This method frequently uses experimental, quasi-experimental, and observational study designs such as randomized controlled trials (RCTs), longitudinal cohort studies, and cross-sectional surveys (Creswell & Creswell, 2018). Quantitative designs in sports science are applied in studying performance measures, physiological reactions, injury prevalence, and intervention effect. Quantitative designs become the preferred choice due to their capacity for reliability, reproducibility, and

generalizability of results where sampling and statistical methods were applied rigorously.

Quantitative research is advantageous in that it enables researchers to measure and analyse variables in numbers, enhancing objectivity and the ability to generalize findings to larger populations. Quantitative research makes it possible to use statistical software that supports determining patterns, relationships, and cause-and-effect relations among variables, thereby providing a solid basis for hypothesis testing and prediction. Apart from that, the quantified methods employed in quantitative research increase the reliability and reproducibility of results, which is vital in confirming study findings across situations (Creswell & Creswell, 2018).

as well as clinical outcomes yields more valuable insights to practice and policy-making.

Qualitative Research Approach

Conversely, the qualitative research approach offers depth, context, and interpretive insight into complex phenomena related to human experience, behaviour, and perception domains highly relevant in health promotion, athlete development, coaching, rehabilitation, and physical education. Qualitative designs explored in this review include phenomenology, ethnography, grounded theory, and case studies, which rely on data collected through interviews, observations, focus groups, and document analysis (Patton, 2015). These are invaluable methods in investigating how people live sport, interact with injury, make decisions about health issues, or construct identities through physical activity. A particular advantage of qualitative approaches is that they can produce rich, detailed data that shed light on the subjective aspects of sport and health that more purely quantitative methods might miss. The review also highlighted increased acceptance and methodological sophistication in qualitative research, such as a focus on trustworthiness, reflexivity, and ethics in research (Sparkes & Smith, 2014).

Qualitative Research Designs in Sport and Health Science

Qualitative research design is essential in understanding the complex, context-dependent, and subjective nature of individuals' experiences in sport and health science. Contrary to quantitative approaches, which prioritize numeric information and statistical inference, qualitative designs focus on securing rich, descriptive, and detailed data on participants' lived experiences, social interactions, motivation, and beliefs (Patton, 2015). This section explores the main types of qualitative research designs commonly used in the field, including phenomenology, ethnography, grounded theory, case study, and narrative research, and their feasibility and use in sporting and health contexts.

Ethnography

Ethnography entails the systematic study of individuals and cultures through prolonged fieldwork, participant observation, and immersing oneself in the environment being researched (Hammersley & Atkinson, 2019). In sport and health settings, ethnographies might attempt to discover the subculture of a professional football team, the Olympic athletes' training culture, or health cultures within indigenous communities. Ethnography is best suited to examine group dynamics, rituals, norms, and values within sport organizations or health related groups. By getting close to participants in their naturalistic settings, ethnographers provide rich, contextualized accounts that build an understanding of the cultural dimensions of health behaviours and sporting performance (Sparkes & Smith, 2014).

Grounded Theory

Grounded theory is a qualitative design that aims to develop or uncover theory from data, rather than starting with an a priori theoretical framework (Glaser & Strauss, 1967). It is especially suitable for new or under researched areas of sport and health for which theory does not yet exist to explain observed phenomena. For example, grounded theory may be

Combining Quantitative and Qualitative Methods

Mixed-methods research designs are increasingly being adopted, which incorporate both quantitative and qualitative approaches into a single study. This kind of methodological pluralism has the benefit of validation through triangulation, ability to address complex questions of interest from multiple perspectives, and amplifies depth and breadth of understanding (Creswell & Plano Clark, 2018). Mixed methods also find quite a good application in evaluation of intervention, exploration of behaviour change, and informing policy and practice in sports and health science.

One of the strengths of mixed methods research, is that it is able to lead towards a better understanding of complex research problems through integrating both quantitative patterns and rich contextual data. It allows researchers to study not only the "what" and "how many" but also the "why" and "how," which leads to more integrated and higher-level data interpretations. For instance, Fetters et al., (2013) cite the manner in which mixed methods are particularly helpful in health research, in understanding what happens to patients

used for the development of a model of adherence to rehabilitation programs by injured athletes or for an understanding of the decision-making process of adolescents who engage in physical activity. Data collection and analysis are parallel and equal tasks conducted through iterative coding in order for concepts and categories to inductively emerge from the data (Charmaz, 2014). The emerging theory is thus "grounded" in the experiences and perceptions of participants and is therefore highly relevant to real-life situations.

Case Study

The case study approach offers the potential for in-depth exploration of a single case or a small number of cases in their real-life context. Sport and health science case studies can focus on a single athlete, a team, a health programme, or an intervention site (Yin, 2018). A case study, for example, can follow the journey of a para-athlete preparing for international competition or investigate the implementation of a school-based physical activity intervention in a rural community in Uganda. This design is especially helpful for creating in-depth understandings, identifying complex interactions between variables, and informing practice and policy. The richness of case data allows researchers to identify intricacies and contextual effects usually bypassed by more generalized approaches.

Narrative Research

Narrative research concentrates on people's narratives about their experiences. It is concerned with the temporal and personal aspects of lived experience and how these are shaped by culture, identity, and social contexts (Riessman, 2008). Narrative research in sport and health research is utilized to investigate how individuals make sense of events such as illness, injury, training, or transformation through sport. For example, autobiographical accounts of athletes' adversity or burnout and resilience in health professionals can provide strong psychological and social insights into athleticism and health. The narrative design stresses the interplay among cultural scripts, personal voice, and identity, providing richness and empathy to research scholarship.

Each of these qualitative designs possesses specific strengths in examining the intricate human experiences underlying physical activity, health, and sport. Their usefulness continues to be on the rise as researchers and practitioners seek to complement empirical measures with context-sensitive understanding. The choice of an appropriate qualitative design depends on the research question, setting, and level of insight sought. Taken in their strongest applications, these approaches not only theorize and orient practice but also give voice and value to the lives of those at the nexus of sport and health science.

Quantitative Research Designs in Sport and Health Science

Quantitative research designs provide systematic, empirical means of quantifying variables, testing hypotheses, and

making inferences through statistical analysis in sports and health science. Quantitative designs facilitate evidence-based practice and scientific progress by enabling researchers to quantify relationships, compare groups, and assess interventions. This section describes key quantitative designs: descriptive, correlational, experimental, quasi-experimental, longitudinal, cross-sectional, cohort, case-control, and survey with illustrations from actual sports and health research.

Descriptive Research Design

Descriptive research seeks to systematically quantify characteristics of populations or phenomena without influencing variables. It is the foundation for developing baseline information regarding health habits or sporting profiles. For example, Blagrove et al., (2018) used a descriptive approach to profile the physical fitness level among Kenyan adolescent runners, reporting means in aerobic capacity and muscle strength to inform training programs. Descriptive studies like this one provide helpful snapshots but do not determine causality or relationships.

Correlational Research

Correlational research identifies the extent and type of relationship between variables without manipulation. As an example, a study conducted by Johnson and Sharma (2017) examined frequency of physical activity and mental health status in university athletes and demonstrated that there was a strong positive correlation between higher levels of exercise and reduced symptoms of anxiety. While correlational research will not allow causality, it can be used to indicate possible predictors or risk factors and inform subsequent experimental studies.

Experimental Research Design

Experimental design holds independent variables constant to test causal effects in controlled conditions. For instance, Smith et al. (2019) conducted a randomized controlled trial investigating the impact of a high-intensity interval training program on VO₂ max and sprint performance among semi-professional soccer players. Randomly allocated participants in the HIIT group showed significant improvement relative to controls, providing strong evidence of the intervention's effectiveness. RCTs like these represent the gold standard for determining cause-effect relationships. In another similar study, Nicholas et al., (2024a) conducted a study among HIV-positive patients on ART in Uganda. Twelve weeks of aerobic exercise intervention were compared in one of the studies for their effects on immunological markers, with CD4+ T-cell counts significantly improving among the participants in the experimental group. Functional work capacity was assessed based on VO₂ max and heart rate measures in the second study. Participant who underwent the same aerobic regime had greater VO₂ max and reduced resting heart rate, which indicates more optimal cardiovascular functioning Nicholas et al., (2024b). These findings emphasize the need for control over experimental design for determining intervention

efficacy on measures of both physiological as well as functional health. These studies constitute the gold standard for causal determination.

Quasi Experimental Research Design

Quasi-experimental designs are statistical designs that test causal relationships without random assignment, and they are particularly well-suited to real-world settings where randomization is unethical or impossible. Quasi-experimental designs involve statistical control of an independent variable with an effect on a dependent variable but employ existing groups rather than randomly assigned groups. This approach allows researchers to measure interventions in real settings, which helps to raise external validity, but may make it more difficult to control confounding variables, and so consequently might affect internal validity. For example, Zhang and Li (2023) employed an interrupted time-series quasi-experimental design to examine the impact of COVID-19 mobility intervention policies on visits to urban parks in Shenzhen, China. Their research demonstrated that such designs could effectively estimate causal effects in public health research, especially where randomized controlled trials were infeasible. Another example was the evaluation by Nelima & Buna, (2022) of an intervention of physical activity at schools aimed at preventing childhood obesity in Nairobi. Since the students couldn't be randomly allocated into intervention and control groups, the researchers used a quasi-experimental pre-post design with matched schools, which demonstrated BMI decline and increase in the levels of physical activity following the intervention.

Longitudinal Research Design

A longitudinal research design refers to the planned research of the same people or group over an important period of time, allowing researchers to determine changes and developments over the years. This design is best suited in researching patterns of development, changes in behaviour, trends in injury, or long-term consequences of interventions. It allows for temporal sequences to be determined, which are critical when making inferences of causality. As an example, Tondelli et al., (2021) monitored cardiovascular fitness and the prevalence of injury among Ugandan rugby players for three seasons of competition, identifying enduring patterns of performance decrement and periods of rehabilitation from injury. Such studies track dynamic processes that cannot be assessed with single-time-point designs, making them invaluable in developmental, rehabilitative, and sport performance research.

Cross-Sectional Research Design

Cross-sectional study design is a type of study where data is collected from a population or a representative sample at one point in time. Such a snapshot design is very useful for quantifying prevalence, correlations, and population characteristics but cannot provide causal inference as there is no depth of time. It is typically used in behavioural science, epidemiology, and public health. For instance, Goes et al.,

(2020) used a cross-sectional design to quantify university athletes in Kampala's prevalence of musculoskeletal complaints. High prevalences of back pain caused by training loads were observed by the researchers. As much as the outcomes indicate an issue of magnitude, the design cannot ascertain whether the training load caused pain. Cross-sectional designs are thus most suited for descriptive analysis or hypothesis generation.

Cohort Study Design

A cohort study design follows a group of individuals who share a common experience or attribute in one time period, for instance, exposure to an environmental risk factor or participation in a sport. Cohorts are typically followed prospectively with measurement of outcomes as they occur, though retrospective cohort studies also exist. This design works well to study the incidence of health outcomes, especially where exposures cannot be randomized. Kamau et al. (2017) also conducted a prospective two-year cohort analysis in endurance runners, contrasting rates of injury with different volumes of training. That more mileage represented an increased rate of stress fractures accompanied by the strength of this design in ascertaining risk factors as well as temporal associations further supports causal inference.

Case-Control Study Design

Case-control study is a retrospective research design that contrasts subjects with an end or condition of interest (cases) with individuals not having that condition (controls), comparing earlier exposures or risk factors. It's particularly useful for investigating rare conditions or diseases with long latency. Case-control studies are cheap and relatively quick but prone to selection and recall bias. Palmer et al., (2022), for example, examined osteoarthritis in retired athletes by comparing them with healthy controls and identified past injury and lifestyle factors that are linked to the condition. While this cannot prove causality, it can be helpful for the identification of associative risk patterns that can be used to inform further research or prevention.

Survey Research Design

Survey research design utilizes standardized questionnaires or interviews to gather data on people's attitudes, knowledge, behaviour, or experience. It can be employed in longitudinal or cross-sectional modes according to study objectives. Survey design is best at obtaining subjective data from large populations economically, though it heavily depends upon instrument quality and respondent honesty for validity. Feiss et al., (2020) conducted a survey of Ugandan coaches to establish their awareness and attitudes toward concussion management and identified education gaps that were later addressed by targeted programs. Surveys are indispensable during needs assessments, program evaluation, and policy planning, especially in sports and community health settings.

Each quantitative design possesses varying strengths and is suited to specific research questions in sport and health science. Descriptive and cross-sectional designs provide

snapshots of populations, correlational studies identify associations, experimental and quasi-experimental designs test interventions, and longitudinal, cohort, and case-control designs allow for causal inference over time. Survey methods complement these by providing self-reported data on behaviour and attitudes. Systematic application of these methods improves scientific understanding and informs evidence-based practice in sports training, public health, and patient management.

From correlational and descriptive studies to experimental, quasi-experimental, longitudinal, cross-sectional, cohort, case-control, and survey research, each design has unique methodological advantages that suit different research questions and practical constraints. Descriptive and cross-sectional designs provide crucial snapshots of populations and phenomena, whereas correlational studies identify meaningful associations that guide the formulation of hypotheses. Experimental and quasi-experimental designs, particularly randomized controlled trials, remain the gold standards for establishing causal associations and evaluating interventions. Longitudinal and cohort studies enable the observation of changes and causal inferences over time, whereas case-control studies efficiently study risk factors for less common outcomes. Surveys supplement the research setting with self-reported behaviour and perception information essential for health promotion and sport performance.

Selecting an Appropriate Research Design

This review stresses the importance of selecting appropriate research designs congruent with some objectives, ethics considerations, and resources. In addition, it suggests the importance of robust methodological application to provide valid, reliable, and generalizable results able to inform evidence-based policy, coaching technique, rehabilitation program, and health intervention. As sports and health sciences grow inclusive of technology and working with varied populations firm research designs will remain the foundation for generating strong, science-based observations beneficial for athlete development, public health, and overall wellness.

Mixed Methods Research Designs

Mixed methods research designs combine quantitative and qualitative approaches to generate a more comprehensive account of complex phenomena in sport and health science as earlier indicated (Creswell & Plano Clark, 2018). The integrative approach allows researchers to measure effects while, simultaneously, examining contextual determinants, e.g., athlete experiences or social relationships, influencing those effects. For example, a mixed methods study by Smith et al. (2020) investigated the efficacy of an exercise intervention in a community environment by combining quantitative measures of fitness with qualitative interviews to measure participant motivation and exercise barriers. One of the strengths of mixed methods is its potential for triangulation between data sources, resulting in greater

validity and richer findings than single method research. As sports and health research tackle more intricate problems that converge across behaviour, physiology, and environment, mixed designs provide valuable flexibility and depth (Johnson et al. 2007).

Critical Appraisal of Methodological Strengths and Weaknesses

While quantitative study designs are high bases for hypothesis testing and causality establishment, every design has inherent strengths and weaknesses that must be suitably appraised in sports and health research (Thomas et al 2022). For instance, randomized controlled trials (RCTs) provide high internal validity but can be expensive, time consuming, and sometimes ethically challenging to implement among sports populations (Shamseer et al., 2015). Cross-sectional designs provide efficiency and wide population coverage but with low temporal resolution and causality. Quasi-experimental designs provide pragmatic options but are prone to selection bias. Recognition of these trade-offs enables researchers to select designs that balance scientific superiority with practicability and ethical responsibility. Additionally, limitations such as recall bias in case-control studies or attrition in longitudinal studies have to be successfully addressed using robust study protocols and statistical approaches.

Emerging and Innovative Research Designs

The development in sports and health science in recent years has encouraged the adoption of state-of-the-art research methodologies that make use of technology and big data to record complex real-time events. Ecological momentary assessment (EMA), for instance, collects data regarding participants' activities and experiences in naturalistic settings, minimizing recall bias and enhancing ecological validity (Shiffman et al. 2008). Adaptive trial designs that modify the study protocol based on interim results are growing in popularity for their utility in testing interventions such as injury prevention programs (Chow & Chang, 2011). Wearable devices and sensor-based capture make possible continuous measurement of physiological and biomechanical parameters, opening the door to new longitudinal and intervention study designs (Bai et al., 2019). These new approaches complement traditional designs and can potentially enhance precision sports medicine and individualized training.

Convergence of Technology and Data Science

Data science convergence with digital technology has revolutionized research design possibilities in health science and sports. New motion capture, GPS, and inertial measurement units (IMUs) enable objective and precise biomechanical analysis within realistic performance (Robert-Lachaine et al., 2017). Machine learning methods on big data can identify patterns and predictors of performance deterioration or risk of injury, which support predictive modelling and personalized interventions (Coutts et al., 2019).

Moreover, cloud-based systems enable real-time data collection and remote monitoring, which expands the scope and accessibility of research (Kelly et al., 2020). Research designs should thus adapt to integrate these technologies in a thoughtful manner, maintaining data quality, confidentiality, and ethical application while enhancing analytical capability and ecological validity.

Global and Contextual Considerations

Sports and health science research designs need to be placed in the cultural, socioeconomic, and infrastructural context of various regions. In low- and middle-income countries, like the majority of African states, limited resources, unequal access to technology, and cultural factors determine the appropriateness and practicability of certain designs (Onywera, 2019). Randomized trials could be hindered by a lack of facilities or ethical issues, for example, and quasi-experimental or observational designs may, therefore, be more practicable. Additionally, culturally embedded procedures including local participants and conforming to community standards boost participant recruitment and data validity (Wasserman et al., 2018). Adaptation of the research design to local contexts is essential for creating applicable, effective research and informing sustainable sports and health development globally.

Recommendations for Researches and Practitioners

To improve the quality and relevance of research in sport and health science, researchers must align their research design suitably with specific questions, populations, and contexts and consider ethical and practical constraints. The employment of mixed methods is recommended to bring quantitative rigor and qualitative understanding together for better comprehension (Creswell & Plano Clark, 2018). Researchers must prioritize longitudinal and experimental study designs wherever possible to facilitate causal inference and evidence-based practice but must be pragmatic where resources are limited. Leverage of new technologies and data analytics can potentially enhance data richness but creates the issue of data security and participant confidentiality. Researchers must collaborate with practitioners very closely so that study designs are aligned with real-world requirements and facilitate translation into practice. Finally, methodological transparency, critical self-reflection regarding constraints, and ethical vigour form the foundation of influential sports and health science research.

Ethical Concerns in Sports and Health Research

Ethics must take precedence in sports and health research, particularly with the susceptibility of athlete populations and the secrecy of health data. Informed consent is to be acquired openly, ensuring that participants have knowledge of risks, benefits, and use of data (World Medical Association, 2013). Experimental study or intervention protocols need to be subjected to stringent risk-benefit analysis to guarantee the safety of participants. Wearable devices and health data via digital means raise confidentiality and ownership

concerns, requiring stringent data protection policy (Nebeker et al., 2019). Respecting athletes' autonomy rather than coercing them and treating participants equitably are other ethical obligations. Institutional review boards or ethics committees' ethical supervision is needed to ensure participant rights and scientific integrity in health and sports research.

CONCLUSION

In conclusion, this review emphasizes an elaborate understanding and careful application of research designs particularly quantitative, qualitative, and mixed methods which are essential for advancing knowledge and practice in sports and health science. Each design offers unique strengths: quantitative approaches emphasize causal testing through objective measurement; qualitative approaches provide depth in understanding lived experiences; and mixed methods integrate both to generate complementary insights. By synthesizing literature across these traditions, this review presents a comprehensive methodological landscape that can guide future research design, strengthen interdisciplinary collaboration, and support evidence-based practice in sport, exercise, and health contexts.

The rapid evolution of technology, including wearable sensors, mobile health platforms, and advanced data analytics, further broadens the scope of inquiry, demanding adaptable and ethically robust methodologies. Importantly, the insights from this review extend beyond local or regional relevance. They contribute to the international scholarly compilation by offering frameworks and examples that can inform research globally, while highlighting the importance of cultural sensitivity and contextual awareness in diverse populations. Ultimately, the selection of an appropriate design should be guided by the research question, context, and resources, but always with an eye toward methodological rigor, ethical responsibility, and the capacity to generate findings that resonate within the global academic and professional community.

Author Contributions

NM led the development of the manuscript and contributed to all sections. DM and AN supported the abstract, quantitative approaches, mixed methods, and recommendations. NL and ORR contributed mainly to the introduction, qualitative approaches, ethical issues, and contextual considerations. LL and MK focused on the methodology, quantitative designs, and critical appraisal. All authors reviewed the manuscript, provided intellectual input, and approved the final version.

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The authors hereby declare that there was no conflict of interest in conducting this study

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