

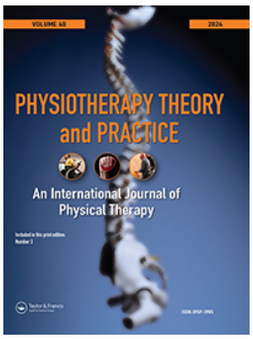
https://dspace.org/

Perceptions of human movement researchers and clinicians on the barriers and facilitators to health research data sharing in Africa

Oluchukwu Obiora; Dorothy Shead; Benita Olivier

INFORMA HEALTHCARE
https://hdl.handle.net/10539/41197
WOS

Downloaded from a DSpace repository. https://dspace.org/



Taylor & Francis
Taylor & Francis Group

Physiotherapy Theory and Practice
An International Journal of Physical Therapy

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/iptp20

Perceptions of human movement researchers and clinicians on the barriers and facilitators to health research data sharing in Africa

Oluchukwu Loveth Obiora, Dorothy Agnes Shead & Benita Olivier

To cite this article: Oluchukwu Loveth Obiora, Dorothy Agnes Shead & Benita Olivier (2024) Perceptions of human movement researchers and clinicians on the barriers and facilitators to health research data sharing in Africa, Physiotherapy Theory and Practice, 40:3, 516-527, DOI: 10.1080/09593985.2022.2127138

To link to this article: https://doi.org/10.1080/09593985.2022.2127138

Published online: 24 Sep 2022.

Submit your article to this journal

Article views: 82

View related articles

View Crossmark data

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=iptp20

PHYSIOTHERAPY THEORY AND PRACTICE
2024, VOL. 40, NO. 3, 516–527
https://doi.org/10.1080/09593985.2022.2127138

Taylor & Francis
Taylor & Francis Group

Check for updates

Perceptions of human movement researchers and clinicians on the barriers and facilitators to health research data sharing in Africa

Oluchukwu Loveth Obiora[a,b], Dorothy Agnes Shead[a,c], and Benita Olivier[a,b]

[a]Department of Physiotherapy, School of Therapeutic Sciences, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa; [b]Wits Cricket Research Hub for Science, Medicine and Rehabilitation, Department of Physiotherapy, School of Therapeutic Sciences, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa; [c]School of Anatomy, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

ABSTRACT

Introduction: The benefits of research data sharing abound in the literature. However, some factors define how researchers and clinicians approach the challenges surrounding sharing human movement health research data.

Purpose: To describe the perceptions of human movement researchers and clinicians on the barriers and facilitators to research data sharing in Africa.

Method: A qualitative descriptive design with a purposive sampling method was used. In-depth interviews with human movement researchers and clinicians across Africa were conducted online via Microsoft Teams. Sixteen (n = 16) participants took part in this study. This sample size was representative of East, West, Northern, and Southern Africa. Efforts made to engage with participants in Central Africa were unsuccessful.

Result: Five themes emerged: 1) the researcher-clinician gap; 2) technological pros and cons in Africa; 3) cost matters; 4) bureaucracy and ethical factors; and 5) the unique African perspective. Mainly, barriers rather than facilitators to data sharing exist among African human movement researchers and clinicians.

Conclusion: There needs to be a societal and psychological shift through reorientation to encourage data sharing among African human movement researchers and clinicians.

ARTICLE HISTORY
Received 14 March 2022
Revised 14 Sep 2022
Accepted 14 September 2022

KEYWORDS
Data curation; database; research data; information dissemination; health information management; health information exchange

Introduction

Human movement research is the scientific study of the movement of the human body. It encompasses all aspects of physical, recreational, and sporting activities. The World Health Organization (2018) refers to physical activity as *"any bodily movement produced by skeletal muscles that require energy expenditure including activities undertaken while working, playing, carrying out household chores, traveling, and engaging in recreational pursuits."* Regular physical activity of moderate intensity has been associated with a marked reduction in the risk for premature mortality and is an established means of reducing the risk of more than 25 chronic medical conditions (Gledhill et al., 2016; Warburton and Bredin, 2016, 2017).

There is a multitude of factors that can adversely impact human movement patterns rendering the need for appropriate rehabilitation and treatment mechanisms to be implemented. Significant advances in motion capture equipment, research methodologies, and data analysis techniques have enabled a host of research that has advanced an understanding of human movement (Ferber, Osis, and Hicks, 2016). Data from these studies can dictate the rehabilitation approach that will afford the most effective treatment outcomes especially in Africa where resources for health rehabilitation and treatment are limited.

The urban-rural population divide differs between some higher-income countries and those in Africa, where middle or lower-income countries are the norm. In 2021, the US Department of Agriculture (Dobis et al., 2021) reported that 14% of the US population lived in rural areas, while in the UK the Department for Environment, Food and Rural Affairs (2021) stated that 17% of the population were rural dwellers. In contrast, in Sub-Saharan Africa which comprises 48 of the 54 independent African countries the rural population averages 58% of the total population (World Bank, 2021).

According to the United Nations Economic Commission for Europe (2017) policy brief on aging rural areas experience health inequalities compared to

CONTACT Oluchukwu Loveth Obiora Lovethegboka@yahoo.com Department of Physiotherapy, School of Therapeutic Sciences, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown, Johannesburg, South Africa

© 2022 Taylor & Francis Group, LLC

urban areas due to weaker health systems, lack of access to health insurance schemes and social benefits, transportation difficulties limiting access to care and facilities, and the fact that younger family members leave for urban opportunities resulting in older persons being left behind without social support (World Health Organization, 2015). Similarly in the African context Igwesi-Chidobe, Odebiyi, and Okafor (2012) stated that rural dwellers are often poor and marginalized and have been reported to have a high level of disability and functional dependence.

The questions that pertain to human movement research need to encompass all elements related to optimal urban or rural rehabilitation and treatments regardless of locale; many are therefore universal. However, in the African diaspora unique questions also arise regarding language barriers, customary practices, and an increased economic burden associated with adjunct poverty that may differ from other global situations. Combating these challenges may result in innovative and unique African solutions to such problems. These might be extended to counteract similar global difficulties using data sharing.

Most human movement research investigates the varying factors associated with injury, pathology, and performance (Bae et al., 2017; Esposito, Stinner, Fergason, and Wilken, 2017; Hart and Achterman; Hart et al., 2020; Shaw et al., 2018; Uematsu et al., 2018; Williams, D'Andrea, and Herr, 2016) by focusing on a small number of variables and experiments performed on a few subjects (Ottenbacher, Graham, and Fisher, 2019). The sharing of discoveries has been at the heart of science since the scientific method was first described by Aristotle (Barnes, 1995). However, historically neither scientific reports nor the data upon which these reports were based has been easily accessible as databases were considered the private and intellectual property of those who developed them (Huston, Edge, and Bernier, 2019).

Clinicians and researchers into human movement in Africa have continued to operate separately from one another and analyze each patient in isolation. They lack the resources, infrastructure, tools, or time to statistically compare new patients to the thousands of patients seen in the same laboratory over the years nor gather new research data. One might argue that research and treating human movement performances and pathologies have not evolved at the same speed (Ferber, Osis, and Hicks, 2016).

A paradigm shift in health care has become the norm (Ottenbacher, Graham, and Fisher, 2019). Data sharing which refers to making research data available for other investigators when practiced in human movement research could be of immense benefit as it would increase opportunities for: scientific collaboration and partnerships; enrich research and analytical capacity; improve early detection of health threats and disabilities; improve option analysis and monitoring real-time response; inform interventions and policy decisions; improve evaluation capacity and performance indicators; increase capacity for public participation, transparency and accountability; merging data from smaller studies into larger datasets with greater statistical power; and practical opportunities for comparative effectiveness research (Ferber, Osis, and Hicks, 2016; Huston, Edge, and Bernier, 2019; Kalkman et al., 2019; Ottenbacher, Graham, and Fisher, 2019; Obiora, Olivier, Shead, and Withers, 2021). Having stated that the potential benefits of sharing are fascinating the challenges in making this happen are substantial and should not be underestimated. These challenges include creating a social, cultural, and technological shift that would enable data sharing, data management and storage, controlling access, and maintaining scientific integrity (Agency for Healthcare Research and Quality, 2015; Huston, Edge, and Bernier, 2019; National Institute of Health Office of Extramural Research, 2007).

In Africa some factors define how researchers approach human movement data collection challenges and unique circumstances in our urban and rural communities. These factors include: knowledge; beliefs; language barriers; time; and access to technologies related to collecting data for human movement research. It is possible that these do not vary significantly between rural and urban communities, although those in urban communities would likely have more access to technology. This point was borne out by a World Health Organization (2015) initiative where an android phone app can be used to obtain relevant data on community-based rehabilitation. Still this usage could be limited by poor technological infrastructure (World Health Organization, 2015). The reciprocal sharing of these data both locally and internationally can offer new perspectives on the testing and implementation of recently developed or adapted treatment techniques and may enhance the methods of gathering human movement research data and using it for evidence-based treatments. Therefore, this study aims to describe the perceptions of human movement researchers and clinicians on the barriers and facilitators to research data sharing in Africa. Human movement researchers and clinicians working with health data might have different concerns, challenges and experiences of data sharing. The triangulation of the findings from both clinicians and researchers provided insights that lead to an integrative approach to human movement research in Africa.

Methods

Design

A qualitative study with in-depth interviews was undertaken using a qualitative descriptive design. Qualitative description is especially amenable to obtaining straight and largely unadorned answers to questions of particular relevance to practitioners (Polit and Beck, 2014; Sandelowski, 2000).

Sampling and recruitment

Africa is the world's second-largest and most-populous continent, after Asia, with 54 sovereign states (countries) and five regions (United Nations, 2019). There are many human movement researchers and clinicians across Africa. In this context, researchers are individuals conducting human movement research, while clinicians attend to the health care needs of people in the field of human movement. The specific professions involved in human movement analysis and intervention are physiotherapists, biokineticists, sports scientists, podiatrists, chiropractors, and occupational therapists. A purposive sampling technique was employed. Purposive sampling is used when the researcher needs to select participants who are representative of the population under investigation because of their knowledge and experience of the particular phenomenon (LoBiondo-Wood, Haber, Berry, and Yost, 2013). LoBiondo-Wood, Haber, Berry, and Yost (2013) explained data saturation as the point where new data no longer arises during the data collection process. The sample size was therefore determined by data saturation (Fusch, Fusch, and Ness, 2018). It was possible to detect when data saturation and data good enough to answer the research question is attained because data analysis was commenced alongside data gathering (Varpio et al., 2017). Sixteen participants were therefore interviewed. The researchers obtained approval for the study from the University of the Witwatersrand's Human Research Ethics Committee. Aside from signing the electronic informed consent forms, participants were reassured of the confidentiality of their responses and that their participation was voluntary. Their verbal consent was also obtained before each interview was recorded.

Data collection

This study was conducted online via Microsoft Teams because the study targeted the principal researchers and clinicians across Africa. Microsoft Teams data is encrypted in transit and at rest. Microsoft uses industry-standard technologies such as TLS and SRTP to encrypt all data in transit between users' devices and Microsoft data centers and between Microsoft data centers. This includes messages, files, meetings, and other content.

We searched the websites of the African Academy of Science, the Physiotherapy Boards of different African countries, and ResearchGate. Snowball sampling was also employed where participants were encouraged to recommend other potential participants in their country. E-Mail invitations were sent to the human movement researchers and clinicians. During the outreach drive to recruit possible participants e-mails were sent in English language. Some e-mails were also sent in French language to engage with possible participants in countries where French was the first language, but no interest was forthcoming from these countries. Recruitment efforts began in January 2021 and were continued alongside data collection and analysis. Potential participants who indicated a willingness to participate signed an electronic informed consent form, after which the online interview was conducted at an agreed date and time via Microsoft Teams. The first two authors conducted the first two interviews, after which the first author went on to conduct the remaining interviews.

A semi-structured interview guide was used to guide the interviews while still allowing the discussions to flow naturally from the participants. Also paraphrasing, passive, and indirect probes were used where necessary to seek more details and get clarifications to the participant's responses during the interview. The interviews were conducted in English. Despite the multi-linguistic nature of Africa, researchers in Africa are in general familiar with the English language and are required to write in English for publication purposes even when data is collected in an African language. English is used globally in 98% of publications (Gordin, 2015). In most cases African languages are not used for academic, secondary, tertiary scientific, or educational purposes in Africa (Madzimbamuto, 2015). Therefore, healthcare workers may be proficient in a home language that is not English, but most also have a good understanding of English and communicate in it. Participants also had postgraduate qualifications and were therefore subjected to added exposure to English during their academic training. Each interview lasted between 45 to 60 minutes, and interviews were held between March and July 2021. Interviews were conducted with video to allow for a personal feel to the interview for both the interviewer and interviewee. Also, having the video activated helped the interviewer to take notice of non-verbal cues from the interviewee and these were recorded in the field notes. Data was anonymized and stored in a password-protected computer.

Data analysis

The participants' preferred names were replaced with pseudonyms. The interviews were transcribed verbatim. Demographic information of the participants was entered into a spreadsheet. A qualitative content analysis which is the analysis strategy of choice in qualitative descriptive studies (Sandelowski, 2000) was used to analyze the data from the interviews. According to Sandelowski (2000) qualitative content analysis is similarly reflexive and iterative as researchers continuously modify their treatment of data to accommodate new data and new insights about those data. It involved developing significant phrases or sentences from each interview transcript (Creswell and Poth, 2016). Codes were formulated from significant phrases and statements. The formulated codes were clustered into sub-themes, and similar sub-themes were grouped under themes common to participants' transcripts. The researchers discussed their findings with each other so that they contributed to the development of analytic questions for the discussions. Iterative checks were ensured throughout the study, and the results were integrated into an in-depth exhaustive description of the collected data.

Trustworthiness and rigor were assured by the implementation of methodological triangulation (i.e. use of field notes and recordings); analyst triangulation (i.e. use of two independent coders); and triangulation of sources (i.e. research and clinical human movement participants) (Krefting, 1991; Patton, 1999).

Results

Sixteen African researchers and clinicians involved in the field of human movement participated in the interviews. A third of the participants fulfilled both the roles of clinician and researcher. The mean age was 39.5 (SD = 9.3) years. The median years of experience were 10 years (range = 3–28 years). Participants were from South (44%), East (25%), West (25%), and North Africa (6%) (Table 1).

Themes and sub-themes

Five themes pertaining to barriers or facilitators to data sharing emerged: 1) The researcher-clinician gap; 2) Technological pros and cons to data sharing in Africa; 3) Cost matters; 4) Bureaucracy and ethical factors; and 5) The unique African perspective on data sharing. For each result, either one or more examples of interview quotes have been presented, and these are demarcated according to the participants' number, which is placed in brackets after the relevant quote. Table 2 illustrates the barriers and facilitators related to each theme.

Table 1. Characteristics of interview participants.

Characteristics		n
Age (years)	20–30	3
	30–40	5
	40–50	6
	50–60	2
Country/region	Nigeria/ West Africa	3
	Ghana/ West Africa	1
	South Africa/ Southern Africa	7
	Zambia/East Africa	1
	Kenya/ East Africa	1
	Zimbabwe/ East Africa	1
	Malawi/East Africa	1
	Sudan/North Africa	1
Field of human movement	Physiotherapy	6
	Sports physiotherapy	3
	Biokinetics/Sports science	3
	Sports coaching	1
	Medical engineering	1
	Exercise science	1
	Rehabilitation in HIV/AIDS	1
Clinician/researcher/both	Clinician	6
	Researcher	5
	Both	5
Qualification	PGD	1
	M.Sc.	8
	PhD	7
Experience (years)	0–5	3
	6–10	3
	10–20	7
	Over 20	3

PGD – postgraduate diploma; M.Sc – master of science; PhD – doctor of philosophy

The researcher-clinician gap

"There's no . . . connectivity . . . we have demarcations between our clinicians and our academics in Africa . . . in relation to human movement science . . . " (P2). Clinician-participants added: *"Clinicians are doing the real work while academics sit in the ivory tower . . . "* (P8), *"Researchers who don't practice as clinicians may suggest a clinician applies an intervention, but it is not practical and not easily implemented in reality"* (P12), *"Barriers for clinicians to use current research in their practice are . . . . time prioritization . . . understanding data collection methods used in papers . . . "* (P3), Researcher-participants added*: "Clinicians just believe in hands-on skills . . . feel academics are just book-warmers"* (P16), *"Many clinicians are stuck in their old ways of conducting practice and see no need to change . . . "* (P9) *" . . . the percentage of people (clinicians) really actively interested in research might be like 10%"* (P6). It was said that researchers are pro data sharing: *"Academics use research and publications to further their career,"* but clinicians need incentives: *"Clinicians will help with data collection if they are compensated for their work"* (P10), *"Need to consider . . . giving CPD points for accessing and listening to research"* (P12). It was noted that there is a: *"Lack of forums where researchers and clinicians can share their experiences . . . "* (P4). Suggestions were made to bridge the gap: *" . . . maybe more researchers and clinicians will start to work together . . . through an online platform system . . . ."*

Table 2. Themes and sub-themes.

		Sub-themes	
S/N	*Themes*	Barriers	Facilitators
1.	The researcher-clinician gap.	a. The perceived gap between researchers and clinicians, the ego factor between clinicians and researchers, clinicians rarely utilize research findings due to time b. Clinicians have no motivation to get involved in research, e.g., no CPD points awarded for involvement c. Time constraints may prohibit clinicians from reading, understanding, or conducting research d. Poor knowledge about data collection and data recording by clinicians	a. Researchers are in support of research data sharing b. Clinicians are in a prime position for research data collection due to ongoing access to patients c. Knowledge of the importance of research for optimal patient care in clinical practice and the unique African population. d. Basic degree parameters, e.g., including data sharing knowledge as part of undergraduate training with courses on data sharing for clinicians
2.	Technological pros and cons	a. Poor knowledge about data sharing rules and procedures to source data/use databases b. Dearth (or a paucity) of research databases c. Lack of standardization of data entry d. Technological challenges in African countries e. Age gap problems as younger researchers and clinicians are more technologically competent than their older colleagues	a. Cross-border mentorship by experienced researchers to educate other researchers and clinicians on how to share data effectively b. Availability of a secured database encourages researchers and clinicians to feel comfortable sharing and storing their data c. Enthusiasm of both researchers and clinicians about the idea of having a database for human movement research data in Africa
3.	Cost matters	a. Institutions are poorly resourced, thereby contributing to the scarcity of research funding b. Researchers and clinicians in many African countries are under-resourced with low salaries and lack of equipment to conduct research c. Research can be costly, prohibiting its conduction in poorly resourced settings d. Time costs money as clinicians have to balance time spent treating patients and earning a livelihood with time spent on research that actually costs them money e. Data and technology costs can be very expensive f. Lack of funding opportunities	a. Data sharing saves time and other resources b. Past and possible alleviation of funding issues (Facility research support, Covid-19 cost waivers, size of funding needs, funding access)
4.	Bureaucracy and ethical factors	a. The norm of keeping research data secured for only five years in many institutions can hinder long use of data and data sharing b. Institutional requirements for data collection and sharing are unclear and vary c. Bureaucracy delays data sharing as getting institutional/government approvals for data collection and sharing takes a prolonged time d. Worry of big companies using data unethically e. Currently used patient's informed consent does not include data sharing f. Plagiarism due to lack of security of intellectual property and patients' rights is a deterrent to data sharing.	a. Researchers and clinicians will share data once personal use is exhausted b. Recognition for the data sharer and protection of study data would encourage data sharing c. Institutional and national ethical control over collection and sharing of health data protect against misuse of health data
5.	The unique African perspective on data sharing	a. Current lack of African online research database b. The overseas published material does not align with the African situation c. Problems with language /consent for data collection and sharing, especially in the rural communities d. African research disparities within the continent and compared to overseas research conditions and outcomes e. Human movement studies are not encouraged f. Impact of low research settings	a. Africans live in a diaspora necessitating the recording and storage of African-specific data b. Africa's unique contribution to research c. Quality data collection facilitated by local expertise d. Database sharing would encourage the procurement, publication, and reading of African research papers e. Beneficial outcomes of African database, which include chances for research collaboration, access to funding opportunities, and increased exposure to African research

CPD – continuous professional development; IP – intellectual property

(P10). It was suggested that: *"There is a need for reorientation. Academics and clinicians should realize they are all on the same team and want to achieve the same goals. The mindset instilled for generations needs to be changed. An academic may have a Ph.D., but a clinician can have a portfolio of clinical acumen"* (P6).

Technological Pros and Cons in Africa

Regarding the existence of a human movement database in Africa: *"I'm not sure we have a platform like that"* (P2, P11), and *"There is currently nothing"* (P10). Still, there was much enthusiasm for the concept: *"I think it would be brilliant if one can log into a platform like that . . . if it's specifically for Africa"* (P11). To encourage: *"African usage of data"* and *"result in ease of producing papers without having to spend money on collecting data"* (P9). Database establishment was seen as: *"That's a big job"* (P11), and its use questioned: *"We are very entrenched in starting research projects from 'scratch' because we don't know how to source data from previous studies"* (P13). Also, for qualitative data storage: *"You're going to have*

hundreds of hours of interview data. What happens to all of that data?" (P8). For successful data sharing: *"the issue which is key to properly sharing data is quality. So, data sharing should be coupled with capacity building"* (P14). Technological cons raised included: *"In low economic countries (like Sudan) accessing data is very difficult and communication is of a low standard . . . electrical supply is intermittent . . . affects the use of technology . . . have little access to laptops . . . "* (P16). Other factors raised were: *"Age gap may present a challenge to the use of technology"* (P4) and a possible suggested solution: *"older practitioners should use younger physios to set up data collection"* (P10). Regarding data sharing: *"This sharing will allow for a broader perspective of the same condition and how it is being treated in different geographical locations . . . broadens the perspective on human movement . . . "* (P10). *"Postgraduate education benefits data sharing . . . "* (P4). Lack of standardization of data input was highlighted: *"Difficult to compare data that is recorded on different platforms . . . . Older practices may still use paper and this will have to be converted to digital"* (P12). *" . . . raw data is tricky in biomechanics . . . . You know if you've done 3D motion capture . . . most people don't often want the data that you've captured because there is so much processing to get to the usable point . . . "* (P3). However, positively, it was said that: *"Data sharing avoids research replication and speeds up the research process"* (P13).

Cost matters

Positive and negative research funding issues: *"Funding is the impetus for data collection. It is the 'conveyer belt' leading to finding out where data collection can happen"* (P5), *"To be candid . . . funding is almost non-existent here (Nigeria)"* (P2), *"Funding opportunities are growing and this is a promising development. Can now get funding as a principal investigator. Kenyan government supports research with funding"* (P13). The cost of using statistical software: *"Institutions may give access to statistical software such as SPSS, but sometimes they don't renew the license . . . serious researchers will have to buy their license . . . costs are prohibitive"* (P14). Concerning costs for processing large datasets: *"if you want to get it right on a large scale definitely requires funding"* (P3). A problem frequently raised was: *"Why should a clinician spend extra time collecting and uploading data?"* (P9). *"Private practice time is money, so to ask a clinician to put aside time to update data with . . . no real benefit is a problem"* (P8), *"There is a need for public institutions such as hospitals to 'invest' in their clinicians to enable the financial resources for the implementation of evidence-based research"* (P6). It was acknowledged that: *"It's tough as a clinician to engage with research . . . I'm in academia, so my library subscribes to . . . nice journals . . . other people don't . . . it's not open access. They're not going to pay $50 to read a paper"* (P10), *"There are many open access journals, you can share your result . . . but to share you need to pay article processing fees . . . a big amount of money. We don't have that"* (P11). Setting up a database: *" . . . that would require a large amount of funding for people and the infrastructure to set up the platform"* (P11), and its use: *"Will the African repository require that researchers pay for access and use? If researchers have to fund access themselves, you're not going to get a lot of takers. Maybe universities will fund software and access"* (P8). But this participant added: *"It would be more of a challenge here . . . institutions are under-resourced"* (P8). Cost of data: *"The challenge will be the cost of data . . . I pay 60 USD a month . . . so despite you have a powerful database . . . if you don't have means to access the Wi Fi then it is just like saying I want to go for lunch in London when I'm in Zimbabwe"* (P14).

Bureaucracy and ethical factors

Regarding data collection, it was said that: *"Approval from Ethics Committee assures the researcher that their methodology for data collection is secure and fully ethical. Ethical Committee . . . doesn't take too long for decision"* (P13). Still, participants from Nigeria and Zambia said: *"Ethical committees are slow to change their ideas. Ethical approval might be slow"* (P 8). Concerning data sharing: *"Institutional requirements are sometimes unclear and differ wildly . . . so it is difficult to find out how we do this properly"* (P3). Bureaucracy: *"Duplication of ethical procedures institutionally and governmentally resulting in extra delays in research approval. Accreditation process is very slow, and without it, a researcher cannot proceed with research"* (P5). Other challenges related to intellectual property rights: *"I would find it really difficult to share the raw data publicly without any security . . . I can only do that if I'm given a DOI number that would indicate I own the data"* (P2). *"I wouldn't want to start sharing data until I've personally made use of it . . . finished my degree, and I've published my findings"* (P4). *" . . . must weigh up the benefits versus the risks . . . will data be used by a bigger company to make a profit or used to help save lives?"* (P13). Ethical approval requires secure data storage by a researcher for a stipulated period. But how would this affect data being re-used by another researcher? *"Have to reverse thinking about destroying data after five years"* (P8). *"Patient must sign clause for their data to be used for future research . . . but must be specific with description of what data will be used for"* (P9).

The unique African perspective on data sharing

"Africa has a lot to contribute to research due to unique population and unique conditions" (P11). *" . . . in Africa can make understanding of certain population peculiarities more accessible"* (P6), *" . . . is value to public health in Africa"* (P1), *" . . . would facilitate collaboration with other African researchers to be able to share, explore, question methodology and compare data"* (P8). However: *" . . . need the local rural expertise in certain African communities to facilitate the data collection"* (P5). *"Ethics committees in Africa should include a community member, so it is not just scientists deciding on ethical matters affecting a community . . . get a more human perspective"* (P8). Research not valued in some African regions: *"So, when it comes to human movement in Kenya . . . biomechanics . . . they told me it is not necessary . . . but I think it's slowly creeping in . . . "* (P13), *"Sudan government are not interested in research. If they don't provide electricity for the people, how can one expect them to be interested in research"* (P16). On a positive note: *"I think in Africa, the whole idea is knowledge and support . . . so the repository, personally I think would be a good one to be embraced by most clinicians"* (P15), *"Expertise mentorship in data collection and sharing protocols between countries will enhance data collection"* (P5) leading to: *"Progress in an academic career driven by the production of data and research findings that may be replicated to some extent in other African countries so comparisons can be made. Researchers are working towards solutions for common problems"* (P15).

Discussion

This study is the first to report barriers and facilitators to data sharing perceived by human movement researchers and clinicians in Africa. However, although this study focused on the African perspective, many of the factors found also relate to the global situation regarding data sharing practices. Therefore, similarities will be shown and differences highlighted. Mostly barriers were shown: the researcher-clinician gap; the lack of adequate technological infrastructure; prohibitive data/internet costs; lack of adequate research funding, and ethical and bureaucratical bottlenecks. Identified facilitators were the establishment of researcher-clinician forums, cross-border research mentoring, and pre-clinical research methodology inclusion.

Africa consists of low and middle-income countries (LMICs). Over the last ten years, research output from LMICs has increased substantially (Bezuidenhout and Rappert, 2016), but Africa only generates one percent of global research (Duermeijer, Amir, and Schoombee, 2018). There is a predicted slow increase in data management and data sharing in Africa going forward (Abebe et al., 2021). However, studies are collecting data to guide database establishment to improve the continent's public health (Igumbor et al., 2021).

The researcher-clinician gap

A definitive gap between how researchers and clinicians viewed research data sharing was seen. Clinician-participants felt researchers produced outcomes that were difficult to implement in practice, were just immersed in books, and did not inform hands-on skills. Researcher-participants felt that clinicians simply treated patients, lacked good research methodology, and were slow to implement evidence-based practice (EBP). It was said that clinicians had little time to read relevant research and had difficulty understanding, interpreting, or using data. Similarly, Pravikoff, Pierce, and Tanner (2005) found nurses had trouble sourcing databases and collecting relevant data. Clinician-participants found that conducting research in/out of practice hours is challenging due to time constraints. However, Tenopir et al. (2011) showed that this phenomenon is not restricted to clinicians by reporting that 53% of researchers from North America (73%), Europe (15%), and Asia/Oceania (7.3%) listed insufficient time as a barrier to data sharing. It was raised that most clinicians obtained a basic degree and were not interested in postgraduate advancement. Only 10% of them showed a research interest, mirroring findings showing only 7% of the Australian medical workforce conducted research (Brandenburg et al., 2021). Furthermore in the USA, clinical researchers did not see uploading and sharing data, particularly in a repository as relevant to their work and 61% had never done so (Federer et al., 2015).

It was said that researchers face obstacles when trying to gather data while clinicians have easy access to rich data. However, researchers and clinicians do not engage with each other. It was suggested that establishing forums would help to bridge the gap with researchers spearheading the collection of data from clinicians. Furthermore, allocation of Continuing Professional Development (CPD) points to the forums might incentivize clinicians to attend and share data. Overall, a change in "mindset" is necessary for researchers and clinicians to realize that, as they work toward achieving the same goals, they need to recognize each other's skills and qualifications.

Technological Pros and Cons in Africa

The concept of 'Open Science" promotes data sharing and the re-use of data, but in many LMIC countries in Africa financial constraints and inadequate technological infrastructure: does not permit the free flow of research data (Bezuidenhout and Rappert, 2016); inhibits inter-African research collaboration (African Union, 2019); and governmental support for research is not prioritized, encouraged or funded (Mwelwa, Boulton, Wafula, and Loucoubar, 2020).

Comments by participants highlighted that poor internet access capability and reliability significantly inhibit efforts to collect, analyze, publish or share research data. This was also made apparent when internet difficulties disrupted interviews carried out in this study with participants in Nigeria, Sudan, Zambia, and Zimbabwe. Participants agreed that no human movement database currently exists in Africa, but there was palpable enthusiasm for the establishment of one. However, it was pointed out that lack of access to the internet could scuttle the use of such a database.

Dash, Shakyawar, Sharma, and Kaushik (2019) found that big data is significantly relevant to public health, a perspective also held by a participant who felt key human movement public health-related research questions could be answered by big data. The analysis of human movement encompasses the measuring of normal movement patterns or pathological movement (Lu and Chang, 2012). Biomechanical data are complex, heterogeneous, dependent on the data collection method, and therefore hard to share in large datasets (Ku et al., 2015). Participants echoed those findings and raised the need for data quality, standardization of data collection, data analysis, and presentation as impact factors for deciding which human movement data were shared. Participants felt that the standardization of the analysis of human movement data would be an enabler to easier data sharing. The issue of suitability of database storage for qualitative data was raised as qualitative data are not homogenous; data collection methodology varies considerably; datasets are bulky. The question arises as to whether 'big data' can answer qualitative researchers' fundamental questions effectively (Mills, 2018).

Many participants alluded to the need for some kind of mentorship to be established whereby researchers from countries in an African region where high-quality research is well-established should be invited to countries with less research experience linking this to capacity building. Barnes et al. (2019) stressed the importance of capacity building coupled with improvement in data science, data management skills, and database establishment.

Cost matters

In Africa, there are many low-resourced regions (Bezuidenhout and Rappert, 2016) and institutions offer few funding opportunities for researchers (Sawyerr, 2004). The ability to secure overseas funding is limited. Funding agencies require researchers to place their research data in open access repositories (Ross, Iguchi, and Panicker, 2018) and governments are requesting that researchers share data (Abebe et al., 2021). As pointed out by participants the high costs of acquiring data and gaining internet access prevent many African researchers from doing this. Furthermore, publishing costs and the cost of downloading articles are too high for researchers in many African countries. However, duplication of data achieved by using large database datasets could negate travel costs to gather data saving on research project costs.

It was felt that there is a need for public health institutions such as hospitals to "invest' in their clinicians to encourage research and data sharing. A reduced research financial burden might change a clinician's "mindset" positively toward undertaking research. In the clinical scenario, patients might benefit from implementing EBP regimens to lessen the time spent in hospital, decreasing treatment costs for the state and affording patients a quicker return to economic productivity. However, private practitioners, reliant on seeing as many patients as possible during practice hours to sustain their income, will still have to juggle financial concerns with time for research.

Bureaucracy and ethical factors

In colonial times unethical human research was carried out in Africa with the exploitation of vulnerable populations because safeguards were not in place to prevent such occurrences (Abebe et al., 2021). The development of ethical regulations in African countries has been continuous since establishing the first Research Ethics Committee in South Africa in 1966 (Ndebele et al., 2014). A participant suggested that it would be beneficial to include a community member on each ethics committee in the African context.

Ethical issues pertaining to the secure and de-identified keeping and sharing of human movement data have always been in place, but for some participants, the current slow grind of ethical approval and excessive bureaucratical controls are already delaying the carrying out of research resulting in it being shelved or carried out by others. In a Belgian study participants bemoaned the General Data Protection Regulation (GDPR) and ethical committees' requirements on

informed consent as challenges to data sharing (Devriendt, Borry, and Shabani, 2021).

In the formation of a database, developers must consider that patient data may be linked with research data collection, analysis, and outcomes (Kalkman et al., 2019). This linkage must prevent identified patient data from being leaked onto such a platform. Participants questioned how informed consent obtained to use participants' data in past research could be relevant for use in future studies (Barnes et al., 2019; Bull et al., 2015). Furthermore, factors such as building and sustaining trust, social justice, minimization of harm, and promotion of fairness would also have to be applied to data sharing in Africa (Barnes et al., 2019; Bull et al., 2015; Igumbor et al., 2021).

Researcher-participants throughout Africa concerned about intellectual property rights were wary of sharing research data collected as part of a masters or doctoral degree before publication or the ability to protect patents. In this regard Igumbor et al. (2021) reported that users of databases should have to declare to the custodians whether they had published or obtained a patent arising from the use of acquired data. Going forward some type of governance will have to be applied to storing data in a human movement research database. Mello et al. (2013) put forward four levels of governance for consideration ranging from an open access model to a model where conditions of use would be strictly controlled by a body independent of a research institution or sponsor.

The unique African perspective

Africa's kaleidoscope of different nationalities, languages, and cultural perspectives offers researchers opportunities to gather rich data unique to Africa. An imbalance exists in science, technology, and innovation development within the continent, and this impacts research integration (African Union, 2019) and the unique norms, traditions, and ways of collecting and sharing data in Africa present yet another hurdle to be traversed (Abebe et al., 2021). The variety of languages used on the continent also presents a barrier to easy data sharing (Mwelwa, Boulton, Wafula, and Loucoubar, 2020). These authors highlight that it is very difficult to share data between African countries using indigenous languages as these vary vastly. Therefore, English or French is often chosen to share information. Even so, English is the most acceptable language for scientific data sharing. Using English ensures that data from Africa can be easily shared with the wider global scientific community, and collaborations can be made, leading to capacity building.

It is essential that human movement data be collected in rural and urban settings, so it is fit for the purpose of being relevant and applicable to the whole population. More than one study participant pointed out that data collection in rural areas can be challenging, as consideration must be given to the use of research assistants that are familiar with the cultural nuances and the language of the population being sampled. The importance of exposure to research data collection and data sharing relevant to the African condition was mentioned by participants, emphasizing the need for such research to be directed toward clinical care. The implementation of research, therefore, has to be viewed in the culture within the context of the practice (McCormack et al., 2002). Data sharing in Africa presents researchers with unique challenges that to a large extent, remain understudied (Abebe et al., 2021). However, the recent identification of African health sciences research capacity and mapping of existing data has been carried out on the continent with the intention of highlighting areas where insufficient capacity exists, to encourage governments and international organizations to supply future funding and ultimately address the gaps and facilitate increased research (Wenham et al., 2021).

Limitations

The researchers tried to ensure fairness in recruiting participants from across the five regions of Africa by developing a sample grid. However, due to the lack of technological infrastructure and disrupted internet connections it was impossible to interview participants from Central Africa. Several invitation e-mails were sent to potential participants in these regions without response. One participant, a senior researcher from Central Africa replied that they would love to participate in the study except for the poor internet and electricity in their country. Efforts to have a direct telephone interview with them were not successful. The only participant from North Africa also made similar complaints but managed to grant a brief audio interview. The sample size was not large and perhaps not ideal for generalizing to an entire continent, but technological problems in some African countries made participant recruitment very difficult. However, the fact that data were collected from four African regions with very different cultures allows the unique African perspective of the sample to be appreciated. The lack of the use of primary African languages as opposed to the use of English in the conduction of the interviews may possibly be seen as a limitation of the study as perhaps some local nuances and specific details may have been missed. However, participants were researchers and clinicians with postgraduate degrees who were comfortable using English as it is the main language used by those educated to a postgraduate level in Africa.

Conclusions

Despite the fact that more barriers than facilitators to data sharing by human movement clinicians and researchers in Africa were identified by this study, there was a definite enthusiasm for the establishment of a secure human movement research database in Africa to enable data sharing within the continent and to promote better human movement-related public health. Moreso, there were some variations and similarities in the data sharing practices of the participants from various countries. Challenges due to technology and the cost of data sharing were reported to be intense in Sudan, Zimbabwe, and Nigeria. Also, participants from Zimbabwe, Kenya, Sudan, and Malawi mentioned poor knowledge about data sharing. Participants from Zambia and Nigeria mentioned bureaucracy and ethical factors as major barriers to data sharing. A potential participant from Cameroun and another from Zambia could not participate despite their willingness due to poor network connections in their countries. Therefore, although participants from South Africa reported having occasional technological challenges and cost issues, South Africa seemed to experience fewer of these barriers compared to other African countries. All the participants reported a perceived gap between researchers and clinicians in human movement research. Also, besides addressing technological, bureaucratic, and cost barriers, there needs to be a societal and psychological shift through reorientation to encourage data sharing among human movement researchers and clinicians in Africa. The sharing of the findings of this study with a global audience is crucial as it informs on similarities and identifies differences between nations' practices in relation to data sharing. It will also inform an initiative for a human movement database in Africa. An increased ability to share data within Africa and on the global stage will enable local and international collaborations, greatly enrich the global perspective on human movement research, and build worldwide capacity.

Acknowledgments

The authors are grateful to the human movement researchers and clinicians from various African countries who participated in this study despite the pandemic. This study was funded by the Hillel Friedland Postdoctoral Fellowship, University of the Witwatersrand, Johannesburg, South Africa.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Hillel Friedland Postdoctoral Fellowship, University of the Witwatersrand, Johannesburg, South Africa.

References

Abebe R, Aruleba K, Birhane A, Kingsley S, Obaido G, Remy SL, Sadagopan S 2021 Narratives and Counternarratives on Data Sharing in Africa. Proceedings of the 2021 ACM Conference on Fairness, Accountability and Transparency March 3 to 10 Canada, pp. 329–341.

African Union 2019 Contextualising science, technology and innovation strategy for Africa (STISA) - 2024. Africa's STI Implementation Report 2014-2019. Accessed 17 July 2022. https://au.int/sites/default/files/newsevents/workingdocuments/37841-wd-stisa-2024_report_en.pdf

Agency for Healthcare Research and Quality 2015 AHRQ public access to federally funded research. Accessed 17 July 2022. http://www.ahrq.gov/funding/policies/publicaccess/index.html.

Bae J, Awad L, Menard N, Rouleau M, Siviy C, O'Donnell K, Ellis T, Walsh C 2017 Exosuit-induced improvements in walking after stroke: comprehensive analysis on gait energetics and biomechanics. Paper presented at: 2017 International Symposium on Wearable Robotics and Rehabilitation (WeRob). Houston, Texas, USA. pp. 1–1. IEEE. doi: 10.1109/WEROB.2017.8383828.

Barnes J 1995 Complete Works of Aristotle 6th. Princeton, NJ: Princeton University Press.

Barnes KI, Canario JA, Vernekar SS, Goudar SS, Espinal R, Merson L, Cheah PY 2019 Equitable data sharing: Challenges and suggestions for ways forward. Wellcome Open Research 4: 172. 10.12688/wellcomeopenres.15425.1

Bezuidenhout L, Rappert B 2016 What hinders data sharing in African science. Presentation and Paper at Fourth Codesria Conference on Electronic Publishing. Dakar, Senegal, pp. 1–13.

Brandenburg C, Noble C, Wenke R, Hughes I, Barrett A, Wellwood J, Mickan S 2021 Relationship between research culture and research activity of medical doctors: A survey and audit. Journal of Multidisciplinary Healthcare 14: 2137–2150. 10.2147/JMDH.S319191

Bull S, Cheah P, Denny S, Jao I, Marsh V, Merson L, Shah More N, Nhan L, Osrin D, Tangseefa D 2015 Best practices for ethical sharing of individual-level health research data from low-and middle-income settings. Journal of Empirical Research on Human Research Ethics 10: 302–313. 10.1177/1556264615594606

Creswell JW, Poth CN 2016 Qualitative inquiry and research design: Choosing among five approaches. Thousand Oaks: Sage publications.

Dash S, Shakyawar SK, Sharma M, Kaushik S 2019 Big data in healthcare: Management, analysis and future prospects. Journal of Big Data 6: 54. 10.1186/s40537-019-0217-0

Department for Environment, Food and Rural Affairs 2021 Rural population and migration. Accessed17 July 2022. https://www.gov.uk/government/statistics/rural-population-and-migration/rural-population-and-migration.

Devriendt T, Borry P, Shabani M 2021 Factors that influence data sharing through data sharing platforms: A qualitative study on the views and experiences of cohort holders and platform developers. PloS One 16: e0254202. 10.1371/journal.pone.0254202

Dobis EA, Krumel T, Cromartie J, Conley KL, Sanders A, Ortiz R 2021 Rural America at a Glance: 2021 Edition. Accessed 17 July 2022. http://www.ers.usda.gov/publications/pub-details/?pubid=102575.

Duermeijer C, Amir M, Schoombee L 2018 Africa generates less than 1% of the world's research; Data analytics can change that. Elsevier Connect. Accessed 17 July 2022. https://www.elsevier.com/connect/africa-generates-less-than-1-of-the-worlds-research-data-analytics-can-change-that.

Esposito ER, Stinner DJ, Fergason JR, Wilken JM 2017 Gait biomechanics following lower extremity trauma: Amputation vs. reconstruction. Gait and Posture 54: 167–173. 10.1016/j.gaitpost.2017.02.016

Federer LM, Lu YL, Joubert DJ, Welsh J, Brandys B 2015 Biomedical data sharing and reuse: Attitudes and practices of clinical and scientific research staff. PLoS One 10: e0129506. 10.1371/journal.pone.0129506

Ferber R, Osis ST, Hicks JL, Delp SL 2016 Gait biomechanics in the era of data science. Journal of Biomechanics 49: 3759–3761. 10.1016/j.jbiomech.2016.10.033

Fusch P, Fusch GE, Ness LR 2018 Denzin's paradigm shift: Revisiting triangulation in qualitative research. Journal of Social Change 10: 19–32. 10.5590/JOSC.2018.10.1.02

Gledhill N, Shephard RJ, Jamnik V, Bredin S, Warburton D 2016 Consensus on evidence-based pre-participation screening and risk stratification. Annual Review of Gerontology and Geriatrics 36: 53–102. 10.1891/0198-8794.36.53

Gordin MD 2015 Scientific babel: How science was done before and after global english. Chicago and London: University of Chicago Press.

Hart T, Achterman P 2020 Qualitative analysis software. In: Matthes J, Davis CS, Potter RF Eds The international encyclopedia of communication research methods, 20–28. Hoboken, NJ, USA: John Wiley and Sons, Inc.

Hart HF, Crossley KM, Bonacci J, Ackland DC, Pandy MG, Collins NJ 2020 Immediate effects of foot orthoses on gait biomechanics in individuals with persistent patellofemoral pain. Gait and Posture 77: 20–28. 10.1016/j.gaitpost.2019.12.012

Huston P, Edge V, Bernier E 2019 Reaping the benefits of open data in public health. Canada Communicable Disease Report 45: 252–256. 10.14745/ccdr.v45i10a01

Igumbor JO, Bosire EN, Vicente-Crespo M, Igumbor EU, Olalekan UA, Chirwa TF, Kinyanjui SM, Kyobutungi C, Fonn S 2021 Considerations for an integrated population health databank in Africa: Lessons from global best practices. Wellcome Open Research 6: 214. 10.12688/wellcomeopenres.17000.1

Igwesi-Chidobe CN, Odebiyi D, Okafor UA 2012 Characterisation of physiotherapy needs in a rural community in South Eastern Nigeria. Nigerian Quarterly Journal of Hospital Medicine 22: 168–176.

Kalkman S, Mostert M, Gerlinger C, van Delden JJ, van Thiel GJ 2019 Responsible data sharing in international health research: A systematic review of principles and norms. BMC Medical Ethics 20: 21. 10.1186/s12910-019-0359-9

Krefting L 1991 Rigor in qualitative research: The assessment of trustworthiness. American Journal of Occupational Therapy 45: 214–222. 10.5014/ajot.45.3.214

Ku JP, Hicks JL, Hastie T, Leskovec J, C R, Delp SL 2015 The mobilize center: An NIH big data to knowledge center to advance human movement research and improve mobility. Journal of the American Medical Informatics Association 22: 1120–1125. 10.1093/jamia/ocv071

LoBiondo-Wood G, Haber J, Berry C, Yost J 2013 Study guide for nursing research-E-Book: methods and critical appraisal for evidence-based practice. Mosby: Elsevier Health Sciences.

Lu TW, Chang CF 2012 Biomechanics of human movement and its clinical applications. Kaohsiung Journal of Medical Sciences 28: S13–S25. 10.1016/j.kjms.2011.08.004

Madzimbamuto FD 2015 Is it possible to write a scientific paper in an African language? East African Medical Journal 92: 297–304.

McCormack B, Kitson A, Harvey G, Rycroft-Malone J, Titchen A, Seers K 2002 Getting evidence into practice: The meaning of context'. Journal of Advanced Nursing 38: 94–104. 10.1046/j.1365-2648.2002.02150.x

Mello MM, Francer JK, Wilenzick M, Teden P, Bierer BE, Barnes M 2013 Preparing for responsible sharing of clinical trial data. New England Journal of Medicine 369: 1651–1658. 10.1056/NEJMhle1309073

Mills KA 2018 What are the threats and potentials of big data for qualitative research? Qualitative Research 18: 591–603. 10.1177/1468794117743465

Mwelwa J, Boulton G, Wafula JM, Loucoubar C 2020 Developing open science in Africa: Barriers, solutions and opportunities. Data Science Journal 19: 31. 10.5334/dsj-2020-031

National Institute of Health Office of Extramural Research 2007 Data sharing policy. https://grants.nih.gov/grants/policy/data_sharing/.

Ndebele P, Wassenaar D, Benatar S, Fleischer T, Kruger M, Adebamowo C, Kass N, Hyder AA, Meslin EM 2014 Research ethics capacity building in Sub-Saharan Africa: A review of NIH Fogarty-funded programs 2000-2012. Journal of Empirical Research on Human Research Ethics 9: 24–40. 10.1525/jer.2014.9.2.24

Obiora OL, Olivier B, Shead DA, Withers A 2021 Data sharing practices of health researchers in Africa: A scoping review protocol. JBI Evidence Synthesis 20: 681–688. 10.11124/JBIES-20-00502

Ottenbacher KJ, Graham J, Fisher S 2019 Data science in physical medicine and rehabilitation: Opportunities and challenges. Physical Medicine and Rehabilitation Clinics 30: 459–471. 10.1016/j.pmr.2018.12.003

Patton MQ 1999 Enhancing the quality and credibility of qualitative analysis. Health Services Research 34: 1189–1208.

Polit D, Beck C 2014 Essentials of nursing research: Appraising evidence for nursing practice. Philadelphia: Wolters Kluwer.

Pravikoff DS, Pierce ST, Tanner A 2005 Evidence-based practice readiness study supported by academy nursing informatics expert panel. Nursing Outlook 53: 49–50. 10.1016/j.outlook.2004.11.002

Ross MW, Iguchi MY, Panicker S 2018 Ethical aspects of data sharing and research participant protections. American Psychologist 73: 138–145. 10.1037/amp0000240

Sandelowski M 2000 Whatever happened to qualitative description? Research in Nursing and Health 23: 334–340. 10.1002/1098-240X(200008)23:4<334::AID-NUR9>3.0.CO;2-G

Sawyerr A 2004 African universities and the challenge of research capacity development. Journal of Higher Education in Africa 2: 213–242.

Shaw KE, Charlton JM, Perry CK, de VCM, Redekopp MJ, White JA, Hunt MA 2018 The effects of shoe-worn insoles on gait biomechanics in people with knee osteoarthritis: A systematic review and meta-analysis. British Journal of Sports Medicine 52: 238–253. 10.1136/bjsports-2016-097108

Tenopir C, Allard S, Douglass K, Aydinoglu AU, Wu L, Read E, Manoff M, Frame M 2011 Data sharing by scientists: Practices and perceptions. PLoS One 6: e21101. 10.1371/journal.pone.0021101

Uematsu A, Hortobágyi T, Tsuchiya K, Kadono N, Kobayashi H, Ogawa T, Suzuki S 2018 Lower extremity power training improves healthy old adults' gait biomechanics. Gait and Posture 62: 303–310. 10.1016/j.gaitpost.2018.03.036

United Nations 2019 World population prospects - population division. https://population.un.org/wpp/.

United Nations Economic Commission for Europe 2017 Policy Brief on Ageing No 18. https://unece.org/policy-briefs.

Varpio L, Ajjawi R, Monrouxe LV, O'Brien BC, Rees CE 2017 Shedding the cobra effect: Problematising thematic emergence, triangulation, saturation and member checking. Medical Education 51: 40–50. 10.1111/medu.13124

Warburton DE, Bredin SS 2016 Reflections on physical activity and health: What should we recommend? Canadian Journal of Cardiology 32: 495–504. 10.1016/j.cjca.2016.01.024

Warburton DE, Bredin SS 2017 Health benefits of physical activity: A systematic review of current systematic reviews. Current Opinion in Cardiology 32: 541–556. 10.1097/HCO.0000000000000437

Wenham C, Wouters O, Jones C, Juma PA, Mijumbi-Deve R, Sobngwi-Tambekou JL, Parkhurst J 2021 Measuring health science research and development in Africa: Mapping the available data. Health Research Policy and Systems 19: 142. 10.1186/s12961-021-00778-y

Williams MR, D'Andrea S, Herr HM 2016 Impact on gait biomechanics of using an active variable impedance prosthetic knee. Journal of Neuroengineering and Rehabilitation 13: 54. 10.1186/s12984-016-0159-0

World Bank 2021 Rural population (% of total population) - sub-Saharan Africa. https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=ZG.

World Health Organization 2015 Capturing the difference we make: community-based rehabilitation indicators manual. https://apps.who.int/iris/handle/10665/199524.

World Health Organization 2018 Physical activity. https://www.who.int/news-room/fact-sheets/detail/physical-activity.