Risks Posed by Wearables to Data Protection in Sports Science as Identified by User Studies

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Introduction

As a part of the Digitalisation and Transformation of Research (DiTraRe) project, Razum et al. [1] highlight that sports science research data is connected to various legal and ethical protections. These come to risk when wearables make stored data accessible to the manufacturer (i.e., "calling home") or to commercial monitoring [2]. Wearables are defined by Murata et al. [3] as worn non-medical technological devices for the monitoring and enhancement of physical activity (e.g., smart watches, GPS, sensor insoles etc.). The focus of this systematic literature review is on wearables' data protection risks during intended use under standard conditions. Therefore, this review does not address risks caused by human error or technological error. Also, there are additional risks that arise as a result of malicious external intervention (i.e., hacking), which are not the focus of this research.

Objective

The objective of this systematic literature review is to answer the research question (RQ): "What are the risks posed by wearables to data protection in sports science as identified by user studies?" The interest was in finding user studies where researchers directly identified the risks or where the risks could be inferred based on the information within sports science research on athletes.

Methods

The methods of Pickering et al. [4] were followed to ensure an empirical approach. The keywords were chosen to reflect the research question. Namely, the search query of "risks" AND "wearable" AND "data protection" AND "sports science" were used. Note, the singular form of "wearable", as opposed to the plural "wearables", was used during the keyword search. The singular form revealed articles connected to "wearable technology", which were otherwise excluded. The databases Google Scholar, Pro-Quest and ACM-DL were searched with Mozilla Firefox. Google Scholar was selected because it was found to be reliable by prior research [5] although there is evidence of bias too [6]. Pro-Quest was used due to its high interconnectedness with multiple other databases. ACM-DL was selected due to its close correspondence to computer science. The articles were selected by the author of this work.

During the literature search, there was no time interval selected.

- The *inclusion criteria* were that only user studies that provided information about *the risks* posed by wearables were retained. User studies were selected because it was assumed that if research prioritizes the concerns of users, then users may prioritize the recommendations of research.
- The *exclusion criteria* were that the articles were not user studies.

Google Scholar was searched from 12 August - 16 October 2025. The initial number (n) of relevant articles was $n = 387$, which was reduced to a total of $n = 11$ after the reading of titles and abstracts. After reading the full versions of the articles, 8 were retained. The reference sections of these articles were also scanned for related research, which resulted in the addition of a further 2 articles.

Pro-Quest was searched from 13 August - 16 October 2025. The initial number of relevant articles was $n = 87$. After the reading of titles and abstracts only $n = 2$ was retained. How-

ever, after the full versions were read, only 1 was included due to meeting the inclusion criteria.

ACM-DL was searched from 11 - 16 October 2025. The initial number of relevant articles (including conference proceedings) was $n = 74$. In the case of proceedings, these were scanned according to the same principles as articles. However, after the full versions were read, only 1 was included due to meeting the inclusion criteria.

Overall, 12 publications were included as a part of the research. Yet, there were no specific studies about "risk" per se. Instead, the studies were about different topics whilst touching on the subject of "risk perception." This is an acceptable result for a systematic literature review, which also aims to identify gaps in existing research rather than strictly articles that reflect the research question.

Results

The answer to the RQ is presented as a list of 10 perceived risks that were identified via user-studies with references to the corresponding papers attached.

1. The risk of data stored by commercial servers outside of national jurisdiction [3].
2. The risk of data ownership uncertainty [7].
3. The risk of *"being constantly watched [8]."*
4. The risk of third party sharing [9].
5. The risk of loss of control over personal data [10].
6. The risk of data being accessed by insurers (who could deny claims) [11].
7. The risk stemming from lack of awareness of relevant laws [12].
8. The risk of researchers collecting data with Apple devices that "call home [13, 14]."
9. The risk of researchers storing data on Google platforms [15–17].
10. The risk of data collection procedures being too complicated to understand for lay participants (as a result of which the participants cannot provide informed consent) [18].

It can be argued that some risks are synonymous (e.g., point 2. and 4.). However, this work aims to provide an initial list of the 10 perceived risks as identified within the user studies rather than a thematic grouping. The number 10 reflects the strict inclusion criteria rather than an a priori choice.

Discussion

The purpose of this systematic literature review was to identify the perceived risks posed by wearables to data protection in sports science as identified by user studies.

This literature review shows that even though researchers were perceiving risks posed by wearables to data protection in sports science [3, 18], it was often the athletes themselves that were perceiving the risks [7–12]. Moreover, none of the included articles were specifically about risks. This suggests that data protection is not a key priority for sports science research where wearables are concerned. This is an ethical problem because sports science data is sensitive data. This ethical problem is not going away on its own. To the contrary, the wearables global market size was USD 84.2 billion in 2024 and is projected to be USD 186.14 billion by 2030 [19]. If research does not urgently address the data protection risks posed by wearables to sports science research, then it will be more difficult to do so in a larger and unregulated market later on.

Future research should focus on a deeper collaboration between sports scientists and data protection researchers. Data protection researchers can use both qualitative and quantitative tools to gain focused insight into the extent to which personal data is protected from risk during sports science research. Data protection researchers must not forget to query practices of research towards minors (and the disabled) as some may not be able to provide informed consent. In all cases where sensitive data is collected with the use of wearables, data protection researchers and sports scientists should establish "best practice" guidelines for research to mitigate risks.

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