

# TOPICS IN EXERCISE SCIENCE AND KINESIOLOGY

## Establishing a Methodology for Conducting a Rapid Review on Wearable Technology Reliability and Validity in Applied Settings

### *Implementation Strategies*

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### Abstract

- Wearable technology is becoming increasingly popular with new devices entering the market frequently, but with disproportionality less research being conducted on the reliability and validity in field settings, outside of the laboratory.
- This paper details the methodology of gathering research based on the principals of a rapid review, using these points of application: inclusion criteria of studies (databases), search terms (data to be extracted), and how research will be conducted (narrowing articles and assessing bias).
- Point of application #1: Inclusion criteria are described well as potential databases used, allowing a means of not only systematically gathering information, but also the ability to check the status of the literature regarding wearable technology.
- Point of application #2: Specific search terms are outlined, and the data fields to be extracted are described.
- Point of application #3: Mechanism of the rapid review search explained, how articles are to be included and excluded, and how bias will be assessed.
- Key Words: Outdoor, Field, Exercise, Wearables, Fitness Trackers, Activity Trackers, Validation, Reliability, Research Design

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## Introduction

Wearable technology devices have become prevalent in exercise and fitness tracking, being ranked among the top fitness trends for the past several years (1). The wearable technology industry is currently releasing devices faster than researchers can test for validity and reliability (2). This information is important for both consumers and researchers, and while the volume of published literature has increased each year there is still a lag when compared to industry offerings (2). The use of wearable technology devices allows for tracking in applied and outdoor settings, and accordingly, there is a need to determine validity and reliability in these environments. Our research group has identified that difficulty exists when comparing devices across studies due to variations in methodology, as no standardized protocol has been accepted (3), although some have been proposed (4). To address this issue, our group has been asked by the journal *Technologies* (5) to provide a review summarizing the state of the literature. The aim is to identify the most common types of protocols used, length of investigations, number of subjects, modes of exercise, wearables used specific to studies conducted in applied settings/outdoor environments. It is considered a best practice to establish and publish the methodology of one's systematic review prior to beginning the process (6). Thus, the purpose of this manuscript is to provide details on the rapid review methodology that will be utilized.

## Methods and Results

As we had a general topic (wearables) we first needed to narrow our focus to an area that had not already been assessed by previous systematic reviews (2, 7, 8). As our research group has experience with wearable technology validation and reliability studies in outdoor settings (9-11) we felt it would be appropriate to determine the state of the literature in applied environments. Early searches into conducting systematic reviews revealed processes including PICO (12), PRISMA (13), and STROBE (14). We also had discussions on how to determine the presence of bias during our review (15). As we had several questions on the mechanics of conducting a systematic review, we set up a meeting with our Health Sciences Librarian who, in addition to being a valuable resource herself, provided us with resources to consider during the early stages of the process. Next, we had several discussions regarding the type of systematic review to employ (for a review of types of review papers, see Sutton) (16). Owing to the timeline established by *Technologies*, we determined that a rapid review would be appropriate. Following these considerations, we decided on criterion and methodology provided in the following Points of Application.

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## 1. Point of Application: Inclusion Criteria of Studies, Databases

Our *a priori* criterion for studies to be included in the review are as follows: investigations must be completed in human subjects, include an exercise intervention (as opposed to physical activity or under free living situations), the wearable must measure or estimate a physiological variable (for example: heart rate, respiratory rate, lactate, energy expenditure, etc.), testing for the study must be completed in an outdoor environment, the publication year will be limited to 2010 and later, and the investigation must include a statistical measure of validity or reliability (see Table 1). Potential databases that were determined to yield the greatest number of manuscripts meeting our predetermined criteria include: PubMed (17), MEDLINE (18), SPORTDiscus (19), Google Scholar (20), and Scopus (21) (see Table 1).

**Table 1.** Set criterion for article search, and potential databases to utilize.

<b>Predetermined criterion</b>	<b>Databases</b>
2010 or later	Google Scholar
Exercise intervention	Medline
Human participants	PubMed
Outdoor environment	Scopus
Physiological variable	SPORTDiscus
Validity or reliability	

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## 2. Point of Application: Search Terms, Data to be Extracted

For an article to be included, it must satisfy each of the following items (as discussed earlier): 1) have an exercise component, 2) utilize wearable technology to provide physiological measures, 3) include a statistical measure of validity or reliability, and 4) be conducted in a natural environment. Toward this end, the following search combinations will be utilized: Running OR Walking OR Biking OR Cycling OR Swimming OR Rowing OR Hiking OR Triathlon OR Exercise + Activity Trackers OR Fitness Trackers OR Wearable Technology OR Wearables + Validity OR Reliability OR outdoors OR field (see Table 2). In line with the items above, the data to be extracted include: type of environment, type of wearable device, exercise protocol, length of exercise, type of validity tests, type of reliability tests, type of physiological variable, and whether the device was considered to be reliable or valid.

**Table 2.** Required components with accompanying search terms to be utilized.

<u>Exercise Component</u>	<u>Utilize Technology</u>	<u>Statistical Measure</u>	<u>Natural Environment</u>
Biking	Activity Trackers	Reliability	Field
Cycling	Fitness Trackers	Validity	Outdoors
Exercise	Wearables		
Hiking	<u>Wearable Technology</u>		
Rowing			
Running			
Swimming			
Triathlon			
Walking			

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## 3. Point of Application: How Search will be Conducted, Articles Narrowed, Bias Assessed

Two independent teams will perform searches utilizing databases and terms described in Point of Application 2. The articles will be compiled, and articles screened by two teams based on the title (see figure 1). Common articles will progress to the next stage, and an independent investigator will decide on the remaining articles. Eligibility for articles to be included will be determined by two teams based on the abstract. Common articles will progress to the next stage, and an independent investigator will decide on the remaining articles. The final determination of articles to include will be completed using full-text documents by two teams. Bias will be evaluated using the Cochrane Collaboration's tool for assessing risk of bias in randomized trials (22). This tool will help to determine if included investigations were at risk for reporting results that could be underestimated or overestimated within the context of the Rapid Review.

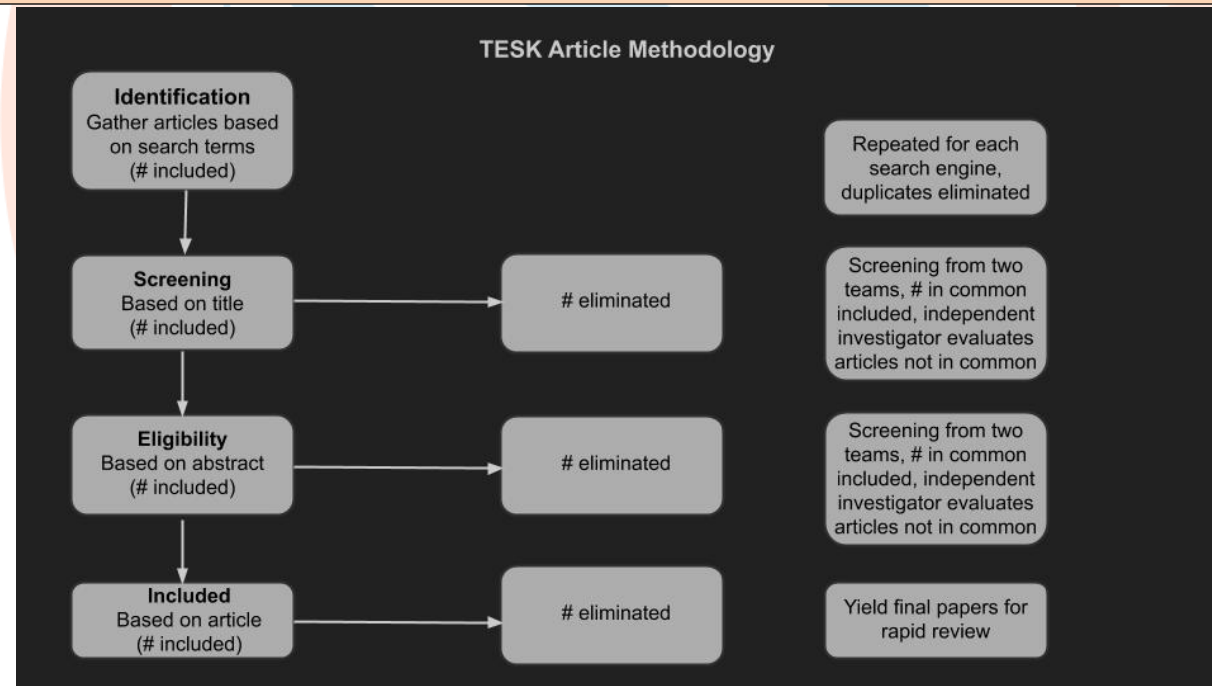


Figure 1. Methodology for determining inclusion of rapid review articles.

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## Equipment Utilized

- None

