EDUCATIONAL PRACTICES in Kinesiology

Teaching and Learning Resource

What to Wear? A Lab Using Activity Monitors for Exercise Programming

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ABSTRACT

Educational Practices in Kinesiology 4(1): Article 4, 2024. One responsibility of exercise professionals involves offering clients current information about contemporary fitness trends and technology. The purpose of this lab activity is to enhance experience and understanding of different Physical Activity (PA) Monitors. In this lab, the accuracy and usability of different PA monitors are assessed by comparing data on step count, calories, and distance walked. Objectives include understanding the importance of exercise documentation, computing metabolic calculations for exercise intensity and caloric expenditure, and analyzing the utility of PA monitors. This lab is intended to be conducted in person and can be completed in a class time of 75 minutes. The estimated time commitment to this lab is about 3 hours, including prep time and class time, and intended for 15-25 undergraduate students. Students participating in this lab should have background knowledge of exercise physiology and instruction. Conducting a walking lab with PA monitors and comparing them with manual step counts is unique because it provides a hands-on approach to understanding the accuracy and usability of PA monitors in real-world settings. By directly comparing data gathered manually with data from the monitors during a walking activity, students can gain insights into the effectiveness and reliability of the technology. This lab offers students a practical understanding of how PA monitors function, their potential impact on exercise monitoring and adherence, and the benefits for clients during exercise prescription.

KEY WORDS: Wearables, step count, heart rate, calculations

INTRODUCTION

An exercise professional should be current with information on fitness trends and technology. Knowledge of these trends can allow exercise professionals to improve their skills and have a deeper understanding to educate their clients on current fitness trends. American College of Sports Medicine (ACSM) has identified wearable devices as a top fitness trend. In 2024, wearable technology continues to be the #1 trend in ACSM's Worldwide Survey of Fitness Trends (Newsome et al., 2024). Wearable technology has been #1 every year since 2016, except for 2018 and 2021, where it was ranked 3rd and 2nd, respectively (Newsome et al., 2024). With wearables being the top fitness trend, it is important for exercise professionals to understand the utility and benefits of wearable technology.

The term consumer wearable devices, also known as wearables or physical activity (PA) Monitors, is any device that can be worn and provide user feedback on PA to address behavioral and physiological characteristics (Mercer et al., 2016; Strain et al., 2022). Physical activity monitors are commonly wrist-worn devices and utilize accelerometer sensors to detect movement. Almost all wearable technology can be connected to smartphone devices (Newsome et al., 2024). Consumer wearable devices or PA monitors use accelerometer sensors to detect movement. Yet, it is the combination of gyroscopes, magnetometers, barometers, global positioning systems, and optical sensors included in the devices that measure physical activity levels and provide additional metrics (Strain et al., 2022).

The PA monitors or wearables technology offers real-time data collection and biometric information such as heart rate, step count, minutes of activity, and some can collect sleep time (Newsome et al., 2024). Wearable technology advancements have allowed for accessible health and fitness tracking while offering users convenience and personalization regarding their daily PA and exercise patterns over long periods (Liguori et al., 2018).

One common feature of PA monitors is the estimated total or energy expenditure in absolute units (e.g., kcal/d) or indices expressed relative to body mass (Matthews et al., 2012). Another common feature of wrist-worn PA monitors is heart rate monitoring (Hammond-Haley et al., 2021; Kettunen et al., 2022; Matthews et al., 2012; Strain et al., 2022). Data may initially be stored on the device, with most offering Bluetooth connectivity to phone or tablet apps (Strain et al., 2022). Despite most people having access to PA monitors, one common issue is that people focus on the numerical information PA monitors provide rather than the instructional information given by the trainer (Kettunen et al., 2022). Practitioners and instructors must provide instructional and personal feedback that can enhance the use of PA monitors, help implement goal-oriented exercises, and subsequently lead to increased PA (Kettunen et al., 2022).

Undergraduate kinesiology students need to understand PA monitors since many clients will ask about their own wearable device. Physical activity monitors are also a tool to promote PA (Böhm et al., 2019). These monitors offer real-time feedback to clients and clinicians (Heizmann et al., 2023). Data from PA monitors allow clinicians to utilize the PA data metrics and prescribe physical activity and exercise. This classroom activity aims to offer students experience and knowledge related to various PA Monitors. This lab will educate students on the different types of PA monitors and the various features used during exercise. Students will also learn how technology can be used when prescribing exercise for the general population.

Learning Objectives

This lab compares various PA monitors' accuracy and ease of use. The students will gather information on steps, kcals, and distance. Data are gathered through manual counting and calculations. These data are then compared to those reported by the PA monitors.

The following objectives are used in the lab:

1. Identify the importance of exercise session documentation.
2. Compute metabolic calculations to determine exercise intensity, duration, and caloric expenditure.
3. Analyze the utility of wearable PA monitors.

Intended Audience

This laboratory activity is part of the Exercise Programming course in the core curriculum of the Kinesiology major. It is a 300-level course. Before taking this course, students will have taken anatomy and physiology, exercise physiology, and exercise instruction. This lab activity would be appropriate for kinesiology and exercise science students and students in pre-professional programs such as athletic training, physical therapy, medical school, and other allied healthcare programs. This lab may also be appropriate for high school students in a sports medicine, exercise science, or physical education class with modifications for understanding PA and the benefits of using wearable monitors. A class size of 15-25 students working together in small groups is suggested. However, a larger class could complete the activity if the class is split, and each group performs the lab on alternate days.

METHODS

Classroom Management

This lab will take 45-75 minutes, depending on the number of students who complete the lab. Students will need about 20 minutes to complete the lab before switching with their partners. This lab requires 1-2 hours of prep time to ensure all equipment is functional and PA monitors are charged. All PA monitors should be checked and charged the day before the lab. Advanced coordination with the facility manager is recommended before the semester to reserve space and equipment needed for the class. This will help the instructor prepare the lab with adequate space and teach students. The instructor should also give themselves time to create the track if needed.

Equipment

- A track or space to create a track to conduct the walking exercises.
- Handheld mechanical clicker counters
- Treadmill(s)
- Open reel tape measure for creating a track for indoors/outdoors *if necessary*
- Any PA monitor that includes a pedometer:
    - Garmin Vivosport Fitness Activity Tracker
    - Polar A370 Fitness Tracker
    - AnyCARE TAP 2 Smart Health Watch
    - i6 HR C Fitness Tracker
    - Note that other commercially used wearables, such as Apple, Google, and Samsung, can be used if available. Any wearable with a heart rate monitor could expand the objectives of this lab but is not necessary.

Student Instructions

1. Students should be informed to arrive for the class with appropriate clothing for PA.
2. Students will be educated on the purpose of the lab at the beginning of the lab and will be instructed on the lab rules.
3. All students should disclose any potential physical limitations that may exclude them from participating but still observe and be a part of the calculations and reflection.
4. The instructor will provide a brief overview of the PA monitors and inform the students that all equipment needs to be used carefully and returned at the end of the lab.
5. If using an indoor facility or gymnasium with shared spaces and equipment, students will also be instructed to respect the space and people outside of class who are also present.

Part I: Pre-laboratory introduction, initial measurements, and description of PA monitors

- Introduce and state the purpose of the lab.
- Discuss the learning goals.
- Instruct them on the functions of the PA monitors.
- Explain the conversions and procedures.
- Take students through calculations in the following order (see lab below), as each sheet has calculations.
- Create groups of 2-3 students.
- Provide the students with a manual clicker and one PA monitor.
- Designate one person to be the walker and one person to be the counter:
    - One person will be walking 0.5 miles on the track.
    - One person will be responsible for the manual counting using the clicker.
    - *Note: If there are groups of three due to an uneven number of students, have student one in the group designated as the walker, student two as the counter, and student three as the data recorder.*
- This process will be completed once on the track and once on the treadmill.
    - Partners will take turns being the participant and the counter.
    - Depending on access and resources of space and treadmills, half of the class starts on treadmills, and the other half on the track.
- For calculations using body mass at the end of the lab, students will be instructed to estimate their weight in pounds and convert it to body mass in kilograms.

Part II: Exercise selection and manual comparison.

Track Exercise

- Make note of start and end time to determine the speed in miles per hour (mph).
- Make note of the PA monitor's initial and end step total, as most will not be set at zero and cannot be reset.
- A manual count will be every right (R) step or one full stride.
    - At the end, the number will be doubled to (# of clicks x 2 = total steps). This is for convenience and easier tracking.
- Walking half a mile should take about 10 minutes.

Treadmill Exercise

- Partners will switch as the person walking will now be the manual step counter, and the counter from the track workout will now be the walker.
- The students will follow the same protocol for the treadmill as they would for the track.
- The participant will walk at 3.5 mph at 0% grade for 5 minutes.

Assessment

Students will be assessed on their attendance and participation in this lab. Additionally, the learning objectives will be assessed using data collection and calculations. In addition, the students will complete a post-lab reflection. The point value for this lab is 25 and will be assessed based on answering the questions thoroughly, meeting the 250-word count, and using appropriate grammar and sentence structure. Students will be given a rubric before the lab and will submit the lab report one week after the lab is conducted (See Resources for rubric).

Assessment

- Students return PA Monitors and equipment after the lab.
- Review the calculations to determine the accuracy of students' work.
- Discuss with students what they found and learned.
- Guided questions for them to consider in addition to the lab reflection:
    1. How could PA Monitors be helpful for the general population?
    2. What surprised you about the PA monitors that we used?

DISCUSSION

This lab activity allows students to determine the accuracy of PA monitors while gaining experience with their features and functions. The lab is paired directly with material from the lecture class examining the use of PA monitors as a tool to provide data on clients' biometrics during exercise. Physical activity monitors can increase clients' knowledge of their daily biometrics and movement. These monitors can be used as a form of self-monitoring to determine if clients are progressing toward their goals and provide documentation on mastery experiences. Student engagement in this lab is high due to the hands-on nature and skill application for PA and calculations. The lab offers a low-risk environment for students to practice using PA monitors, becoming familiar with the features and data before interacting with the public when completing their first internship in a general population fitness setting. Students will also be able to reflect on their data in the lab reflection and provide their thoughts on the PA monitors.

Students in this lab learn how results will vary based on the individual, which should be considered when creating exercise programs. In a previous study on one-mile step counts and walking/running speeds, it was suggested that male clients may meet the 10,000 daily step recommendation by accumulating 3,225 steps through activities of daily living and adding another 6,776 steps by walking 3.5 miles at a pace of 15 minutes per mile (e.g., 1,936 × 3.5) (Hoeger et al., 2008). Additionally, following the step count data for the walking pace (average of 1935 steps per mile), one could conclude that approximately 3800–4000 steps would be sufficient to satisfy the current activity guidelines of 30 min of moderate-intensity activity or walking two miles or walking at 4

mph (Physical Activity and Health, 1996; Welk, 2002). The average person takes between 2,000 and 2,500 walking steps per mile, as counted by a fitness band or phone motion sensor and walks between a speed of 3-4 mph (Bumgardner, 2022).

As with any device, PA monitors must be consistent and precise when recording and reporting biometric data. With dozens, if not hundreds, of different PA monitors available, discussing these devices' validity and reliability is important. This lab uses measures associated with validity and reliability studies to demonstrate how the accuracy of the PA monitors can be assessed by comparing manual step counts measured using mechanical clickers. Although this lab cannot validate the PA monitors, the students observe and learn about validity and reliability. In terms of reliability, this lab uses test-retest reliability by having students do multiple sessions with the PA monitors. Additionally, inter-rater reliability is utilized as multiple students must compare their step counts on the PA monitors with the mechanical clicker. This lab allows students to compare the collected data and analyze the PA monitors' reliability. In terms of validity, the mechanical clicker accounts for criterion validity, and the terrain (track and treadmill) assesses construct validity. Students and exercise professionals must be aware of PA monitors' reliability and validity, as some can be reliable but not valid for specific conditions such as walking or running. They can also differ based on free motion running or treadmill running (Montes et al., 2020).

In a recent scoping review, it was found that many studies utilize PA monitors that are more than 200 euros, which would currently equate to $216 USD (Huhn et al., 2022). It was reported that many of the articles that met the criteria of the scoping review found the authors of those studies to value the somewhat low price of the PA monitors (Huhn et al., 2022). The PA monitors for this lab include Garmin Vivosport Fitness Activity Tracker ($169), Polar A370 Fitness Tracker ($149), AnyCARE TAP 2 Smart Health Watch ($49), and i6 HR C Fitness Tracker ($40) models that were released before 2020. Although some of the PA monitors were older and less expensive models than the more common brands such as Apple, Samsung, or the newer models from Garmin, students still felt there were benefits to the utility of PA monitors in exercise prescription.

In past experiences, one student noted:

“I would recommend one of these watches, or any PA monitor, for my clients due to the simplicity for tracking general PA daily. Using these devices keep the client actively involved in improving their physical activity by allowing them to see their progression on a daily basis while also keeping them conscious of their health.”

While another student stated:

“I think if the client’s goal is to be more active and spend more time exercising, watches are an easy way to measure how much time they spend exercising.”

These responses show that students recognize the ease of documenting PA and analyzing the data for clinical use. As one of the most popular fitness trends, PA monitors are a great tool and resource for students to understand real-time PA data from clients. Analyzing personalized biometric data can further support exercise prescription and training programs suitable for clients and help exercise professionals.

It should be noted that this lab does come with a couple of limitations. Depending on the amount of time and class size, the professor may need to prepare this lab a few weeks in advance. The instructor should also ensure adequate PA monitors and time to conduct the lab. Not all students use a PA monitor when in a group. However, having all students wearing a monitor and comparing data plus individual differences is beneficial. An alternative for this lab could be to allow students to have PA monitors loaned out and worn throughout the week to get more data.

While some students may have a smartwatch and/or PA monitor of their own, the other goal of this lab is to expose them to different brands and cost points. Physical activity monitors can be affordable for many people, starting with some costs as little as $30, and they are often user-friendly (Degroote et al., 2020; Maher et al., 2017). Not all clients who students work with will be able to afford higher-end watches/devices. Exposing the students to lower-cost options and how they work will allow them to discuss PA monitors with clients from all socioeconomic classes. They will also be able to discuss the pros and cons of high cost versus low-cost devices. By allowing students to think critically about their own belief's as to why or why not they should recommend PA monitors for their clients, they can develop more informed and practical decision-making skills that enhance their clinical experience. Ultimately, this lab provides a basic understanding of PA monitors as an instrument for clinicians and how to use them for practical applications.

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RESOURCES

Physical Activity Monitors

Introduction

One of the jobs of the exercise professional is to provide up-to-date information to clients about current fitness trends and technology. Students in kinesiology must understand how and when to use wearable Physical Activity (PA) Monitors. Physical activity monitors can provide valuable biometric data on one's movement patterns, physical activity levels, and health outcomes. The purpose of this activity is for students to gain experience and knowledge related to various PA monitors. In this lab, students will be introduced to the functions of the PA monitors, which will allow them to document an exercise session. Then, students will use the recorded exercise session on the PA monitor to compute metabolic calculations and determine exercise intensity, duration, and caloric expenditure. Lastly, students will analyze and interpret their thoughts and opinions on the utility of wearing PA monitors for use and exercise prescription.

Points awarded for:

Attendance and Participation

Data Collection & Calculations

- Data tables complete with data collected during lab
- Calculations complete with work shown

Reflection

- Answer the questions thoroughly in the reflection
- Should be a minimum of 250 words

Proper Formatting

- Use of complete sentences
- Appropriate grammar
- Sentence structure
- Overall neatness

Part 1: Track

This portion of the activity compares the number of steps tracked by the PA monitor to the actual number of steps taken by the participant while walking on the track. Additionally, calculations will be completed to compare the estimated calories expended.

1. Using the indoor track, the participant will walk 0.5 miles.
2. While the participant walks, a group member will count the steps the participant takes to complete the 0.5 mile.
3. Another group member will record the time it takes for the participant to complete the 0.5 miles.
4. Finally, record the number of steps taken and the number of calories expended from the PA monitor.

- Make and model of PA monitor #1: _____
- Time to complete 0.5 miles: _____min
    - Convert to fraction of an hour = _____ min/ 60 = _____hour
- Speed = Distance/ Time = 0.5 miles/_____hour = _____ mph
    - (convert to m/min) = _____mph x 26.8m/min = _____m/min
- VO_2 (ml/kg/min) = 3.5 + (0.1 x speed in m/min)

  = 3.5 + (0.1 x _____ m/min)

  = _____ml/kg/min
- Kcal burned = [(VO_2 x participant mass) / 1000] x 5 x minutes of activity

  = [(_____ml/kg/min x _____ kg) / 1000] x 5 x _____ min

  = _____ kcal

PA Monitor: _____	Number of Steps	Calories Burned
PA Monitor		
Manual Tracking		

- Make and model of PA monitor #2: _____
- Time to complete 0.5 miles: _____min
    - Convert to fraction of an hour = _____ min/ 60 = _____hour
- Speed = Distance/ Time = 0.5 miles/_____hour = _____ mph
    - (convert to m/min) = _____mph x 26.8m/min = _____m/min
- VO_2 (ml/kg/min) = 3.5 + (0.1 x speed in m/min)

  = 3.5 + (0.1 x _____ m/min)

  = _____ml/kg/min
- Kcal burned = [(VO_2 x participant mass) / 1000] x 5 x minutes of activity

  = [(_____ml/kg/min x _____ kg) / 1000] x 5 x _____ min

  = _____ kcal

PA Monitor:_____	Number of Steps	Calories Burned
PA Monitor		
Manual Tracking		

Part 2: Treadmill

This portion of the activity compares the number of steps tracked by the PA monitor to the actual number of steps taken by the participant while walking on the treadmill. Additionally, calculations will be completed to compare the estimated calories burned.

1. Using the treadmill, the participant will walk at 3.5 mph at 0% grade for 5 minutes.
2. While the participant walks, a group member will count the steps the participant takes.
3. Another group member will record the distance walked (taken from the treadmill screen).
4. Finally, record the number of steps tracked, calories burned, and the distance walked (if applicable) from the PA monitor.

- Make and model of PA Monitor #1: _____
- Convert to mph to m/min = 3.5 mph x 26.8 m/min = _____m/min
- VO_2 (ml/kg/min) = 3.5 + (0.1 x speed in m/min)

  = 3.5 + (0.1 x _____ m/min)

  = _____ml/kg/min
- Kcal burned = [(VO_2 x participant mass) / 1000] x 5 x minutes of activity

  = [(_____ml/kg/min x _____ kg) / 1000] x 5 x _____ min

  = _____ kcal

PA Monitor: _____	Number of Steps	Calories Burned	Distance walked
PA Monitor			
Manual Tracking			

- Make and Model of PA Monitor #2: _____
- Convert to mph to m/min = 3.5 mph x 26.8 m/min = _____m/min
- VO_2 (ml/kg/min) = 3.5 + (0.1 x speed in m/min)

  = 3.5 + (0.1 x _____ m/min)

  = _____ml/kg/min
- Kcal burned = [(VO_2 x participant mass) / 1000] x 5 x minutes of activity

  = [(_____ml/kg/min x _____ kg) / 1000] x 5 x _____ min

  = _____ kcal

PA Monitor: _____	Number of Steps	Calories Burned	Distance walked
PA Monitor			
Manual Tracking			

Part 3: Lab Reflection

Compare and contrast the two PA monitors.

- How did the numbers compare for both watches and the manual counting/calculations?
- What are their features? (e.g., heart rate data, calories burned, wrist-worn)

Pros & Cons:

- What do you think are some of the pros & cons of using these watches with clients?
- Why would you or why would you not want to use them with clients?

Rubric

	Missing/No Submisson	Needs Improvement	Competent	Mastery
Attendance and Participation	**0** (0.00%) Student did not attend lab or no submission of work.	**1** (4.00%) Student did not finish the lab and was not engaging in during class.	**3** (12.00%) Student was actively engaged in in the class, but did not finish the lab.	**4** (16.00%) Student was actively engaged throughout the class and completed all steps of the lab.
Data Collection and Calculations	**0** (0.00%) No Submission	**1** (4.00%) Most data from lab is missing.	**3** (12.00%) Most data tables complete with data collected during lab. Calculations are complete but some work is not fully shown.	**5** (20.00%) Data tables complete with data collected during lab. Calculations complete with work shown.
Reflection	**0** (0.00%) No Submission	**5** (20.00%) Reflection is inadequate and does not answer all questions.	**9** (36.00%) Questions answered in the reflection. Detail is adequate but could be added to or is under 250 words.	**12** (48.00%) Answer the questions completely in the reflection. Should be a minimum of 250 words.
Grammar and Formatting	**0** (0.00%) No Submission	**1** (4.00%) Numerous grammar issues.	**3** (12.00%) A few grammar issues.	**4** (16.00%) Use complete sentences and appropriate grammar. Overall lab reflection is organized and document is formatted correctly.

Conflict of Interest Statement

This learning resource did not receive any specific grant from public, commercial, or not-for-profit funding agencies. This resource is not an endorsement of any products by the author. The author has no professional relationships with companies or manufacturers who would benefit from the results of the present study.