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COMPARATIVE ANALYSIS OF PHYSICAL ACTIVITY INDICATORS IN STUDENT JUDO ATHLETES

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Abstract: *Physical activity is an important determinant of health, physical development, and athletic performance among university students. In student judo athletes, physical activity encompasses not only structured training sessions but also everyday movement, educational activities, recovery, and sedentary behavior. A comprehensive assessment of these components is necessary to understand individual activity patterns and support evidence-based training decisions.*

Keywords: *physical activity; student athletes; judo; physical activity assessment; training load; sedentary behavior; university students; comparative analysis.*

1. Introduction

Physical activity is an essential component of health promotion, physical development, and athletic performance. Among university students, activity patterns are influenced by academic schedules, transportation, leisure-time behavior, structured exercise, and the availability of sports facilities. Students involved in competitive sport have an additional physical demand associated with training, technical preparation, and competition. However, participation

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in sport does not necessarily mean that all aspects of an athlete's daily physical activity are optimal.

Judo is a combat sport that requires a combination of technical proficiency, tactical awareness, muscular strength, explosive power, movement coordination, and the capacity to perform repeated high-intensity actions. During a contest, athletes perform gripping, pulling, pushing, throwing, defensive movements, and transitions between standing and ground positions. These activities produce variable physical demands and involve both high-intensity efforts and periods of lower-intensity movement or recovery.

Research on the physical and physiological characteristics of judo athletes has identified several important dimensions of performance, including body composition, aerobic capacity, anaerobic power, strength, and physiological responses to exercise [1, 2]. These characteristics are relevant to the interpretation of activity indicators, but physical fitness and physical activity should not be considered identical concepts. Physical fitness refers to a set of attributes related to the ability to perform physical tasks, whereas physical activity describes bodily movement produced by skeletal muscles that requires energy expenditure.

This distinction is important when evaluating student judoka. An athlete may demonstrate high physical fitness because of regular training while spending substantial time sitting during lectures, independent study, or transportation. Conversely, a student may accumulate considerable daily movement without having the sport-specific fitness required for competitive judo. Therefore, assessment should distinguish habitual physical activity, structured training exposure, physical fitness, and sedentary behavior.

2. Aim and Objectives

2.1. Aim

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The aim of this article is to analyze the principal indicators of physical activity in student judo athletes and propose a multidimensional approach to comparing activity patterns across different athlete characteristics and training contexts.

2.2. Objectives

The specific objectives are:

1. To identify the principal domains of physical activity relevant to student judo athletes.
2. To compare questionnaire-based, device-based, and training-specific assessment methods.
3. To examine the factors that may influence differences in activity indicators.
4. To propose a structured framework for collecting and interpreting physical activity data.
5. To formulate recommendations for future empirical research and university judo training programs.

3. Materials and Methods

3.1. Research design

The article uses a narrative literature review and comparative methodological analysis. Scientific publications concerning the physical and physiological characteristics of judo athletes, activity patterns during judo contests, seasonal changes in physical fitness, and physical activity measurement were considered in developing the framework.

The analysis focused on the meaning of the indicators, their measurement methods, their relevance to student judoka, and the limitations of comparing results across different populations. The proposed framework is conceptual and methodological; it does not report a newly conducted experiment or a dataset collected from university students.

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3.2. Main domains of physical activity

For the purposes of this analysis, physical activity in student judo athletes is divided into five domains:

- **Habitual physical activity:** movement accumulated during daily life, transportation, recreational activity, and other non-training activities.
- **Structured judo training:** the frequency, duration, and organization of technical, tactical, and conditioning sessions.
- **Movement intensity and duration:** the time spent in different intensity categories and the distribution of activity throughout the day.
- **Sedentary behavior and recovery:** prolonged sitting, sleep-related recovery information, and periods of reduced activity.
- **Physiological and perceived training response:** heart-rate response, perceived exertion, and related indicators that help contextualize training exposure.

These domains are related but not interchangeable. For example, training duration does not directly quantify total daily activity, and a high heart rate does not independently establish the amount of physical activity performed.

Table 1.

Principal domains and indicators for assessing physical activity in student judo athletes

Domain	Main indicators	Potential assessment method	Interpretation
Habitual activity	Minutes of moderate and vigorous activity; walking and transport activity	GPAQ or another validated questionnaire	Describes reported activity across daily-life domains

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Structured training	Sessions per week; session duration; training attendance	Training diary or attendance record	Describes organized training exposure
Movement intensity	Time spent in different activity-intensity categories; steps where appropriate	Accelerometer or activity monitor	Provides objective information about movement patterns
Sedentary behavior	Sitting time and prolonged sedentary periods	Questionnaire or suitable posture-sensitive device	Helps characterize non-active periods
Training response	Session rating of perceived exertion; heart-rate response	Training log and heart-rate monitor	Helps contextualize physiological demands
Judo-specific activity	Duration and structure of technical drills, randori, and conditioning	Session records and structured observation	Describes the content of judo training

Source: Compiled by the author based on the reviewed literature and the proposed methodological framework.

3.3. Questionnaire-based assessment

Questionnaires are practical tools for assessing physical activity in large student populations. The Global Physical Activity Questionnaire (GPAQ) was developed to collect information about physical activity in different domains, including activity associated with work, transportation, and recreation [4].

For student judoka, questionnaire data may help identify whether the participant's activity is concentrated mainly in organized training or distributed across daily life. The questionnaire should be administered using an appropriate validated version and standardized instructions.

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Self-reported data have limitations. Participants may overestimate or underestimate activity duration, misclassify intensity, or have difficulty recalling a typical week. During periods of examinations, competition preparation, illness, or holidays, the reported week may not represent usual behavior.

Questionnaire results should therefore be interpreted as estimates of reported activity rather than precise measurements of all movement. Where possible, the assessment should cover a clearly defined reference period and record unusual circumstances that may influence responses.

3.4. Device-based activity assessment

Accelerometers and other movement-monitoring devices can provide information about activity duration, movement intensity, and the distribution of movement throughout the day. Some devices also estimate step counts, sedentary time, or energy expenditure, although the validity of these outputs depends on the device, placement, processing method, and activity being performed.

A device-based protocol should specify:

1. The device model and placement.
2. The number of days monitored.
3. Daily wear-time requirements.
4. The criteria for valid monitoring days.
5. The method used to process and classify activity.
6. How missing data and non-wear time are handled.

For student judoka, monitoring should ideally include both training and non-training days. If data are collected only during scheduled practice, they cannot represent the participant's full daily activity pattern.

Movement monitors may also underestimate or misclassify certain judo activities. Gripping, isometric contractions, resisted pulling, and some upper-

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body actions may not be adequately represented by movement acceleration alone. Accordingly, device-based measurements should be supplemented with training logs or other context-specific records.

3.5. Training-specific indicators

Judo training exposure can be described through the number of sessions, duration of sessions, attendance, and the proportion of training devoted to technical drills, tactical practice, randori, and conditioning.

One practical method for monitoring internal training load is the session rating of perceived exertion (session-RPE) approach. In a standardized protocol, the athlete rates the overall perceived difficulty of a session, and the score is combined with session duration to estimate session load:

If session RPE is recorded on a scale with defined anchors and duration is recorded in minutes, the resulting value is commonly expressed in arbitrary units. The scale, timing of the rating, and recording procedure should be consistent across participants and sessions.

This indicator describes perceived internal load rather than total physical activity. Two athletes may complete the same session duration but experience different internal demands because of differences in fitness, technical proficiency, fatigue, or the intensity of their work.

The comparative methodological analysis demonstrates that physical activity in student judo athletes is a multidimensional concept that cannot be adequately described by training frequency or a single fitness indicator. Habitual physical activity, structured judo training, movement intensity, sedentary behavior, and physiological training response provide complementary information.

Questionnaire-based methods are useful for assessing activity across daily-life domains, while device-based monitoring can describe movement patterns over time. Training diaries, session-RPE, and heart-rate monitoring

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provide additional context for interpreting the demands of organized judo practice. Each method has limitations, particularly when applied to activities involving gripping, static muscular effort, and complex sport-specific movements.

Comparisons between student judoka should account for training experience, sex, weight category, academic workload, and the period in which measurements are collected. Findings from elite or sub-elite athletes should not automatically be generalized to university students without appropriate validation.

The proposed framework offers a practical basis for future research and university sports monitoring. Empirical studies involving actual student participants are needed to establish the reliability, validity, and usefulness of the framework and to determine which indicators best characterize physical activity patterns in different student judo populations.

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