

Analysis of competition warm-up and re-warm-up practices of Portuguese basketball coaches

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ABSTRACT

Basketball is a dynamic team sport characterised by intense, strategic play that requires high-intensity activities such as sprinting, jumping, and changing direction. Proper warm-up (WU) routines are crucial for improving athletic performance and adapting to the game's physical demands. This study evaluates the WU practices of Portuguese basketball coaches and their adherence to evidence-based guidelines. A cross-sectional survey of 158 Portuguese basketball coaches was conducted to analyse the relationships between their WU and re-warm-up (RWU) strategies and the coached competition. Significant associations in WU were found among coaches of youth competitions and performance competitions, especially in WU volume, but no significant associations were found regarding in-game or halftime RWU strategies. This study shows that coaches in performance contexts tend to use more comprehensive WU strategies. However, there is a need for increased practice of RWU routines by the coaches of youth and performance competitions to optimise player performance.

KEYWORDS: sports performance; competition; basketball; warm-up; re-warm-up.

INTRODUCTION

Basketball is an intense, fast-paced team sport emphasising strategic territorial progress on the court. Players must master diverse movement patterns and continuously execute technical and tactical skills to achieve high performance levels (Petway et al., 2020). The intermittent nature of the gameplay requires players to switch dynamically between offence and defence, with or without the ball, maintaining performance against one or more opponents (Altavilla & Raiola, 2014). Frequent bursts of high-intensity activities, such as sprints, jumps, and quick directional changes, are interspersed with short active or passive recovery periods, all performed from various positions on the court (Ferioli et al., 2020). Success in basketball relies on the players' ability to rapidly accelerate, decelerate, jump, and shuffle, adapting these skills under continuous defensive pressure (Stojanović et al., 2018).

Pre-competition warm-up (WU) is a critical routine that enhances athletic performance and prepares players for the physical demands of the game. Evidence suggests that WU routines enhance explosive performance (e.g., sprints, jumps, and agility) by increasing muscle readiness (Silva et al., 2018)

and reducing injury risks (Ding et al., 2022). These routines typically include a general phase with low-intensity aerobic exercises, dynamic stretching, and sport-specific drills, lasting 15–20 minutes at 50–90% of maximal heart rate (Silva et al., 2018). The physiological benefits of WU include increased muscle temperature, increased fibre performance and conduction velocity, optimised oxygen uptake and psychological preparation (McGowan et al., 2015). However, these benefits are transient (Neiva et al., 2017) and can dissipate quickly if the athlete remains inactive for extended periods (Silva et al., 2022).

In basketball, where game substitutions often occur 9–23 minutes after play begins (Kapnia et al., 2023), maintaining physical readiness through WU strategies becomes critical. Declines of up to 15% in jump performance have been observed after only six minutes of inactivity (Crowther et al., 2017). Passive WU techniques during prolonged transitions to gameplay, including external methods to maintain core temperature, have shown promise in mitigating performance losses (Cowper et al., 2024). Also, re-warm-up (RWU) strategies during in-game (Koutsouridis et al., 2024) or in pauses, such as halftime (HT) have been proposed to counteract performance drops (González-Devesa et al., 2021).

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Although WU is widely recognised as crucial for performance optimisation and injury prevention, many coaches lack precise knowledge about its optimal duration, intensity and structure (Räsänen et al., 2021). This gap highlights the need for studies that align current WU practices with advancements in sports science. This study aims to analyse the WU and RWU practices of Portuguese basketball coaches in youth and senior competitions, assessing their adherence to scientific recommendations regarding duration, intensity, and structure.

It was hypothesised that Portuguese basketball coaches implement WU and RWU routines that adhere to recommended practices for duration, intensity, and structure.

METHODS

Participants

This study included 158 Portuguese basketball coaches who met specific eligibility criteria: i) possession of a valid Portuguese coaching license, divided into Portuguese coaching grade 1 ($n = 41$), grade 2 ($n = 59$), and grade 3 ($n = 58$); ii) at least one year of coaching experience, divided into 1–5 years ($n = 34$), 5–10 years ($n = 37$), 10–15 years ($n = 15$), and over 15 years ($n = 72$); and iii) participation in a formal national basketball competition, with coaches of youth teams ($n = 100$) and senior teams ($n = 58$). All participants were provided with detailed study information, gave written consent to participate, and were informed of their right to withdraw at any time. Ethical approval was granted by the Human Research Ethics Committee of the University of Beira Interior, and the study was conducted in accordance with the Declaration of Helsinki.

Measures and procedures

With an observational and descriptive study design, data were collected through a cross-sectional, self-administered questionnaire. The questionnaire was developed by the research team based on prior research (McGowan et al., 2016). Afterwards, to establish face validity and suitability, a prior pilot test was conducted with three basketball coaches. Feedback was used to refine questions, and data was not included. The first section of the questionnaire gathered demographic information about the coaches' competitive basketball background, coaching experience, formal basketball coaching qualifications, and the competition at which they regularly coached. In subsequent sections, detailed information was collected on the coaches' WU and RWU practices in competition. For further comparison, coaches were divided into youth coaches (youth competitions) and performance coaches (senior competitions).

The questionnaire was distributed to coaches during the 2023/24 basketball season. Coaches were contacted in person or via email sent to clubs registered with the Portuguese Basketball Federation, including a link to a Google Form. They received descriptions of the study, consent forms, and the questionnaire to complete independently.

Statistical analysis

All question data collected from the questionnaire were analysed using relative frequencies to determine the percentage response of coaches. Responses that were not conclusive were removed from consideration. The χ^2 test was used to verify the relationship between the answers of coaches (McHugh, 2013). Significance was set at $p = .05$. To quantify the degree of association between the variables, Cramer's association coefficient V was calculated, where values below 0.1 indicate a very weak association and values above 0.5 represent a strong association (Cohen, 2013). The statistical software IBM Statistical Package for Social Sciences (SPSS, version 27.0) for Microsoft Windows (Armonk, NY, EU: IBM Corp.) was used for the analyses.

RESULTS

Analysis of the WU volumes revealed significant associations based on the competition. Specifically, coaches managing youth competition programs WU with an average duration of 20 minutes. In contrast, coaches at performance competitions program longer WU, averaging 30 minutes or more. A moderate association between the type of competition and the volume of WU was found ($p = .001$; $V = 0.408$) (Figure 1).

Moreover, there was a moderate association between WU phases and the competition context among coaches ($p = .001$; $V = 0.398$) (Figure 1). Coaches in performance competitions predominantly structured their WU into three to five phases (94.8%), whereas those in youth competitions typically used fewer phases, with 79% implementing only two to three.

Despite the observed associations in the number of WU phases, a similarity was found in the tasks performed by coaches. In the general phase, coaches mostly included aerobic and stretching exercises, while during the specific phase, coaches mostly tended to use technical exercises (Table 1).

Regarding the WU intensity, no significant associations were found in the general phase between competitions ($p = .155$; $V = 0.160$), with coaches typically using moderate intensities (Table 2). Also, no significant associations were found on the WU intensity at the specific phase between competitions ($p = .636$; $V = 0.114$), with coaches mostly using moderate to vigorous intensities on their tasks (Table 2).

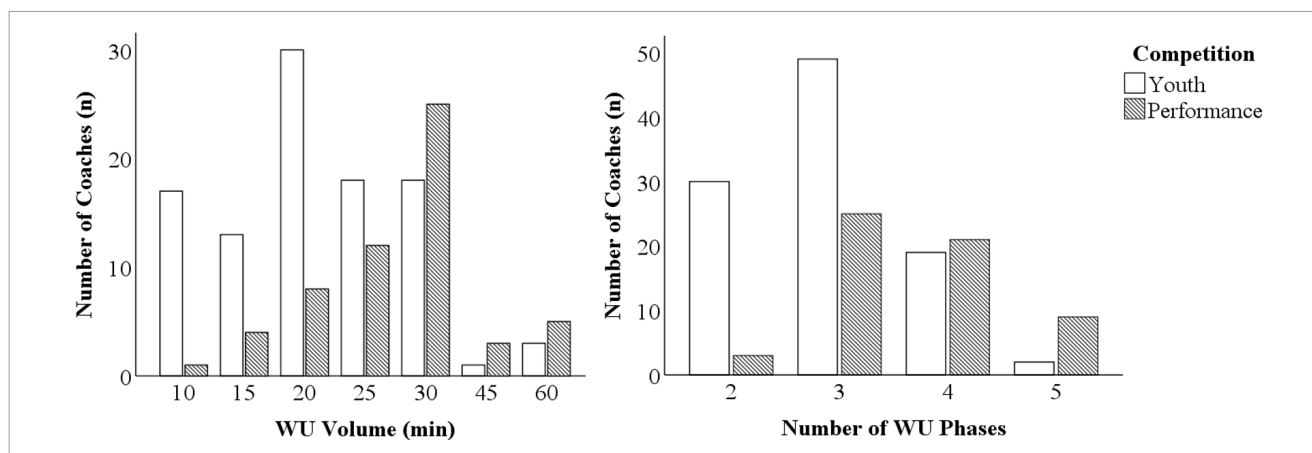


Figure 1. Overview of WU volume and phases structured by the coach's competition.

Table 1. The three most represented WU tasks in each phase structured by the coach's competition.

	WU Tasks	Youth	%	Performance	%	Total
General	Aerobic	62	67.40	33	62.30	95
	Stretching	51	55.40	31	58.50	82
	Strength exercises	25	27.20	15	28.30	40
Specific	Technical exercises	52	64.20	39	78.00	91
	Free throws	31	38.30	17	34.00	48
	SSG	19	23.50	9	18.00	28

SSG: small sided games.

Regarding RWU strategies after prolonged rest periods, 41.77% of coaches do not implement RWU protocols for substitutes. No significant associations were found between coaches ($p = .796$; $V = 0.021$). Also, no associations were observed between coaches at youth or performance competitions that use RWU strategies ($p = .768$; $V = 0.131$). The majority of the coaches that use RWU (66.70%) reported 2 to 3 minutes of RWU before player substitutions (Figure 2). In contrast, only 25.90% of coaches reported not programming RWU activities at HT, but no significant association was observed between coaches of youth and performance competitions in HT RWU strategies ($p = .057$; $V = 0.151$). When HT RWU was applied, the duration was mostly 5 minutes (Figure 2), with no significant associations between coaches of youth and performance competitions ($p = .332$; $V = 0.197$).

Concerning the tasks for RWU in-game, our results indicated that coaches of youth and performance competitions use mostly explosive tasks, while for the HT break, coaches in both competitions use mostly technical exercises.

Furthermore, there were no significant associations in the intensity of the RWU tasks of youth or performance coaches

Table 2. WU Intensity in general and specific phases structured by the coach's competition.

	WU intensity	Youth	%	Performance	%	Total	%
General	55–70%	59	64.10	35	66.00	94	64.80
	70–90%	12	13.00	2	3.80	14	9.70
	Self-controlled	21	22.80	16	30.20	37	25.50
Specific	55–70%	29	35.80	19	38.00	48	36.60
	70–90%	39	48.10	23	46.00	62	47.30
	+90%	5	6.20	1	2.00	6	4.60
	Self-controlled	8	9.90	7	14.00	15	11.50

during the game ($p = .349$; $V = 0.223$), with the majority of coaches opting for moderate or vigorous intensity (Table 3), neither in HT RWU tasks ($p = .416$; $V = 0.155$), with mostly using moderate intensities (Table 4).

DISCUSSION

This study analysed the WU and RWU strategies of basketball coaches in youth and performance competitions. Specifically, coaches in performance competitions used more complex WU routines, including higher volumes and additional phases, compared to coaches in youth competitions. Despite its importance, the RWU is often neglected, especially during in-game. Our results showed no associations in RWU practices between youth or performance competitions, with durations ranging from 1 to 3 minutes during the game and 5 minutes at HT, primarily at moderate to vigorous intensities.

The multiphase WU, which includes general and specific phases, is predominantly used by coaches of performance teams. This structured approach, characterised by greater WU

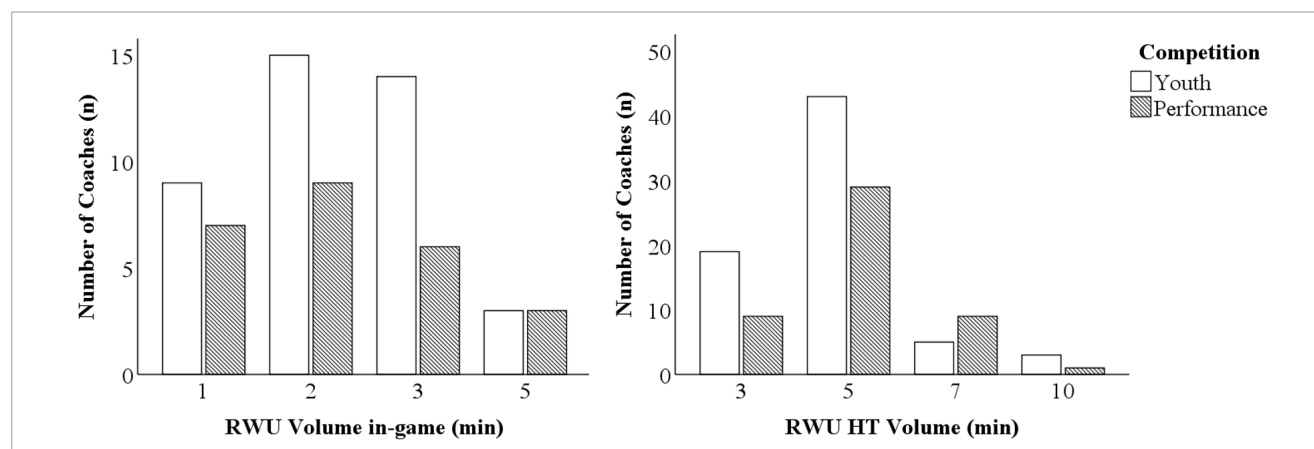


Figure 2. Overview of RWU volume structured by the coach's competition.

Table 3. The three most represented RWU tasks structured by the coach's competition.

RWU Tasks		Youth	%	Performance	%	Total
In-game	SAQ exercises	9	34.60	8	32.00	17
	Sprints	8	30.80	6	24.00	14
	Jump exercises	6	23.10	5	20.00	11
HT	Technical drills	18	69.20	29	60.40	47
	Jogging	9	34.60	13	27.10	22
	SSG	2	7.70	9	18.80	11

SSG: small sided games.

Table 4. RWU Intensity structured by the coach's competition.

RWU Intensity		Youth	%	Performance	%	Total	%
In-game	55–70%	15	36.60	8	32.00	23	34.80
	70–90%	14	34.10	12	48.00	26	39.40
	+90%	4	9.80	0	0.00	4	6.10
	Self-Controlled	8	19.50	5	20.00	13	19.70
HT	55–70%	42	59.20	24	50.00	66	55.50
	70–90%	13	18.30	15	31.30	28	23.50
	+90%	1	1.40	1	2.10	2	1.70
	Self-Controlled	15	21.10	8	16.70	23	19.30

volume, reflects a strategic emphasis on comprehensive player preparation to improve performance and reduce injury risk. This is consistent with previous research indicating that experienced coaches prioritise a holistic preparation strategy that addresses physical, mental, strategic, and neuromuscular aspects to optimise pre-competition readiness (Räsänen et al., 2021). Multiphase WU are tailored to the specific needs of the sport

and the athlete (Silva et al., 2018). They enhance game readiness, muscle memory, and technical precision, which are crucial for executing complex in-game movements (Ferioli et al., 2020).

However, there are disadvantages to prolonged WU, such as potential depletion of energy stores and reduced heat storage capacity, which could impair explosive performance (Silva et al., 2018). In contrast, our findings suggest that youth team coaches generally implement shorter WU with fewer phases and moderate intensities. While this approach effectively increases body temperature and prepares athletes for sport-specific movements, it may not adequately prepare players for the higher demands of competitive basketball, potentially reflecting a gap between current evidence-based practices and WU routines used in youth settings (Räsänen et al., 2021).

Following WU, physiological measures such as core temperature, heart rate, and muscle temperature begin to decline and return to baseline within approximately 6 minutes, and performance levels are nearly back to baseline within 17 minutes (Crowther et al., 2017; Silva et al., 2022). To counteract these declines, a well-designed transition period using passive WU strategies can mitigate potential performance losses and improve player readiness for the game (Cowper et al., 2024). Our study found that only 39% of coaches implement an in-game RWU protocol, typically lasting 1–3 minutes at moderate to vigorous intensity. Research supports that 2 minutes of active RWU, including explosive tasks at maximum intensity, immediately prior to re-entering the game is critical to maintaining performance levels (Silva et al., 2018). Conversely, RWU is more routinely practised during the HT break, with 70% of coaches performing approximately 5 minutes of moderate-intensity RWU. Integrating passive strategies during this break has been shown to offset the negative effects of inactivity, thereby improving explosive performance and reducing the likelihood of early fatigue in the second half (González-Devesa et al., 2021).

A notable limitation of this study is the uneven distribution of coaches surveyed, with fewer coaches from performance competitions. This may limit the generalisation of the findings, particularly for high-performance coaching contexts. A more balanced sample could reveal greater associations in practices between coaches.

Further research should also analyse additional factors, such as the sporting level of the coaches, specific routines employed, and adaptability to different environmental conditions throughout the season. This may provide deeper insights into the WU and RWU routines employed by the coaches.

CONCLUSIONS

This study identifies key differences in WU practices between youth and performance-level coaches, highlighting the need for more structured RWU strategies, especially during games. Coaches in the performance context generally implement more comprehensive WU strategies characterised by increased volume and multiple phases, while coaches of youth competitions implement less WU volume and phases. Nevertheless, it is notable that RWU is often overlooked by coaches of youth and performance competitions, especially during games, and is primarily addressed during HT. Effective WU and RWU are critical to improving player performance and should be carefully planned to meet the specific needs of different competitions.

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