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ANALYSIS OF A WEEKLY MICROCYCLE IN PROFESSIONAL HANDBALL TRAINING

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ABSTRACT

The purpose of this study was twofold: (1) to determine the training tasks and load of professional handball players during a weekly microcycle; (2) to analyse the technical performance among tactical positions, days of the week and formats of play that occurs during training sessions. Fourteen male professional handball players of the first Spanish league participated in this study. The two-way MANOVA revealed that the day of the week ($p=0.001$; $\eta^2=0.183$; minimum effect) and type of task ($p=0.001$; $\eta^2=0.047$; minimum effect) had significant main effects on heart rate variables. An analysis of variance also revealed that the day of the week ($p=0.001$; $\eta^2=0.109$; minimum effect), format of the game ($p=0.001$; $\eta^2=0.147$; minimum effect) and tactical position ($p=0.001$; $\eta^2=0.124$; minimum effect) had significant main effects on the technical performance. These suggest that more intense exercise occurs in middle week sessions and in drill-based tasks. A greater volume of technical actions was performed by centre backs in larger formats of the game and in the Friday session. This study characterised the microcycle periodisation planned by professional handball coaches and identified which formats induced greater technical participation.

***Keywords*:** Training load; Periodisation; Heart rate; Technical performance; Sports training.

INTRODUCTION

Heart rate (HR) has been used widely to monitor exercise intensity of team handball (TH) game-play (Michalsik *et al.*, 2015; Nikolaidis *et al.*, 2015a). An explanation of the popularity of HR as a measure of exercise intensity might be that it presents certain advantages compared to other measures, such as oxygen uptake (VO_2), lactate and rate of perceived exertion (RPE). Considering VO_2 as the gold standard of exercise intensity, the rationale to use HR as a proxy is the linear relationship between VO_2 and HR for submaximal intensities. In addition, HR correlates very strongly with RPE during training in elite TH players (Cuadrado-Reyes *et al.*, 2012).

When HR has been used to evaluate exercise intensity of TH game-play, it can be expressed either as absolute values (beats per minute/bpm) or in relative to HRmax (%) values. HR usually refers to the mean HR during a match. Ziv and Lidor (2009) in their review concluded that HR rises above 160bpm during a match. For instance, HR during 41 match-plays in elite TH players was 163bpm (Michalsik *et al*., 2015). Due to the objective difficulties to evaluate HR in official matches, many studies have studied HR in simulated matches. For instance, HR in regulation games of 15-year-olds was 172bpm or 82% of HRmax (determined during the Yo-Yo test and assumed to be the individual's HRmax (Chelly *et al*., 2011). HR in a 30-minute simulated match in elite TH players was 83% of HRmax (estimated by subtracting your age from 220) (Barbero *et al*., 2014). HR in experimental matches of 14-year-olds was 174bpm or 87% of HRmax (determined during the Yo-Yo test and assumed to be the individual's HRmax) (Souhail *et al*., 2010). HR in 20-minute simulated matches, using either 6:0 or man-to-man defensive formations, of 15-year-old TH players was 180bpm (Nikolaidis *et al*., 2015b). Based on these findings, it was summarised that HR may lie between 80% and 90% in the major percentage of time during a handball match (Chelly *et al*., 2010; Souhail *et al*., 2010; Barbero *et al*., 2014).

PURPOSE OF RESEARCH

Although the mentioned studies have enhanced our understanding of the metabolic demands of TH match, little information exists regarding the exercise intensity variation during training. Such information would be crucial for TH coaches and fitness trainers in order to evaluate the metabolic demands of training compared to those of matches. Moreover, according to short-term periodisation (microcycle), the training intensity varies during a week, and it would be of practical importance to be aware of HR variation during a microcycle. Therefore, the aim of the present study was to examine the variation of HR by day of the week for TH players.

METHODOLOGY

Participants

Fourteen male professional handball players in the First Spanish League participated in this study during the season 2015/2016. Chronological and anthropometric characteristics of players are presented in Table 1.

***Table 1*. CHARACTERISTICS OF PARTICIPANTS** (n=14)

Variables	M±SD
Age (yrs)	25.69±6.73
Height (cm)	181.4±5.56
Weight (kg)	76.8±8.91
Training experience (yrs)	14.06±7.26
HRmax (bpm)	194.31±6.73

Before the commencement of the study, all participants received written and verbal explanations of the procedures involved in the study informing them about all risks and benefits associated with participation, and written informed consent was signed by all of them. The study followed the recommendations of Declaration of Helsinki for the study of humans.

Experimental design

HR responses and technical performance were recorded and analysed during four training sessions of a weekly microcycle during the entire training session. The researchers did not interfere in the training sessions, thus ensuring the regular performance of the coaches' exercise prescription. The selected handball team had four training sessions in a week (Monday: post-match; Wednesday and Thursday: mid-week; Friday: pre-match). Training sessions occurred between 18h00 and 20h00 in an indoor sporting arena with a temperature of ~24ºC and a relative humidity of ~38%. The measurements were conducted in the second week of September 2015 (pre-season). The time spent per training session and per format of play was normalised to ensure the reliability of analysis of variance.

Description of the tasks

An observational process was used to categorise the training drills into four tasks: (1) strength and conditioning tasks (these tasks were classified as analytical exercises to strengthen and condition, without the inclusion of technical or tactical elements); (2) technical drills (tasks designed to improve the technique with no tactical influence or game-based situations); (3) tactical tasks (tasks designed to emulate the reality of the game, with some sub-phases of the game, smaller formats and with specific movements to improve the collective organisation); and (4) game (regular 7-vs.-7 format played among teammates). This categorisation was used to analyse the type of tasks used by the coach during training sessions and also to measure the HR responses during the different exercises.

Strength and conditioning tasks

The strength and conditioning tasks were generally performed immediately after the warm-up. These tasks did not involve handling the ball in the majority of the cases. Calisthenics and functional training were the exercises often used in this context. Circuit training workout with 2 to 3 bouts and 3 to 10 repetitions were the typical format employed by the coaches. Exercises were focused on resistant strength in the upper body and core, lower limb power and speed/agility.

Technical drills

Technical drills were designed to promote a player's technique and skills. Shooting and passing were the main focus of these drills. Technical drills were often unopposed to allow the players to feel comfortable when making errors. Running followed by pass or shooting was the common characteristic identified in the drills. Queuing for shooting and passing was the main strategy employed by the coach. Some passing routines or passing plus shooting were used during these tasks.

Tactical tasks and formats

The formats of the game (included in tactical tasks or game) were classified based on the sub-phases of the game used in training sessions: 2-vs.-2; 3-vs.-1; 3-vs.-2; 4-vs.-3; 4-vs.-4; 6-vs.-4; 7-vs.-7; and 6-vs.-6. The formats of 2-vs.-2, 3-vs.-1 and 3-vs.-2 (classified by the coach as high-demanding tasks to improve the individual action and the quick decision-making) were employed in a 15×7 to 17×9m field with a high-intensity method with 2-3 bouts of 1-3 minutes each and a work-to-rest ratio of 1:1.5. The formats of 4-vs.-3, 4-vs.-4 and 6-vs.-4 (classified by the coach as the aerobic tasks to improve tactical behaviour and teammates' synchronisation) were employed in a 23×11 to 27×14m field with 1-2 bouts of 3-5 minutes each and a work-to-rest ratio of 1:1.

Game

Finally, 6-vs.-6 and 7-vs.-7 formats (classified by the coach as the realistic tasks to simulate the game) were employed on a 40×20m field with 1-2 bouts lasting 5-10 minutes and a work-to-rest ratio of 1:0.5.

Data collection

The HR data was recorded via Bluetooth technology (Polar Team App, Polar Electro Oy, Kempele, Finland) in all training sessions. The HR results were grouped into five different zones of %HRmax: zone 1 [Z1] (50-60% HRmax), zone 2 [Z2] (60-70% HRmax), zone 3 [Z3] (70-80% HRmax), zone 4 [Z4] (80-90% HRmax), and zone 5 [Z5] (≥90% HRmax). To measure the players' HRmax, the Yo-Yo Intermittent Recovery Test level 1 was performed one week before the study commenced (Montgomery *et al*., 2010). The days of the week and type of tasks served as independent variables for the comparison of HR responses.

Each player was coded based on his tactical position: (1) left (LW) and right (RW) wings (n=5); (2) left (LB) and right (RB) backs (n=5); (3) centre backcourt (CB) (n=2); and (4) pivot (P) (n=2). This codification allowed measuring the technical performance in different formats used by the coach during training sessions and was in agreement with previous studies (Nikolaidis *et al*., 2015a). The days of the week, tactical position and formats of the game were treated as independent variables in the analysis of variance of technical performance.

The technical performance was evaluated using observational analysis. Six variables were classified following the Team Sport Assessment Procedure (Gréhaigne *et al*., 1997; Clemente *et al*., 2014): (1) received balls per player (player received the ball from a teammate and did not immediately lose control of the ball); (2) conquered balls per player (the player intercepted or stole the ball from an opponent or recaptured it after an unsuccessful shot); (3) lost balls per player (player lost control of the ball); (4) neutral balls (it is a routine pass to a teammate without exerting pressure on the opponents); (5) attacking balls per player (pass to a partner that contributes to the displacement of the ball towards the defensive region of the opponents); and (6) shots per player (it is considered successful when he scores or ensures retaining the possession of the ball).

Statistical analyses

The data were computed as mean±standard deviation. A two-way MANOVA (followed by one-way ANOVA per factor) was performed to identify differences in %HRmax average, %time spent in Z1, Z2, Z3, Z4 and Z5 intensity zones according to the day of the week and type of task. The same procedure was applied in the case of the technical variables (balls received per player, conquered ball per player, lost balls per player, neutral balls per player, attacking balls per player and shots per player). Pairwise differences and post hoc comparisons were assessed by applying the Bonferroni post hoc test. Effect size (ES) was presented as η^2 (Eta squared) and interpreted using the follow criteria (Ferguson, 2009): no effect (η^2<0.04), minimum effect (0.04<η^2<0.25), moderate effect (0.25<η^2<0.64) and strong effect (η^2>0.64) (Ferguson, 2009). All data sets were treated with each statistical technique and corresponding assumptions using SPSS software (version 23.0, Chicago, IL, USA). Statistical significance was set at 5%.

RESULTS

The two-way MANOVA revealed that the day of the week (p=0.001; η^2=0.183; *minimum effect*) and type of task (p=0.001; η^2=0.047; *minimum effect*) had significant main effects on the HR variables. There was significant interaction (Pillai's Trace=0.242; p=0.001; η_p^2=0.040; *minimum effect*) between the day of the week and the type of task. Two-way ANOVA revealed interactions between the factors %HRmax (p=0.001; η^2=0.094; *minimum effect*), %time in Z1 (p=0.001; η^2=0.076; *minimum effect*), %time in Z3 (p=0.001; η^2=0.058; *minimum effect*), %time in Z4 (p=0.001; η^2=0.063; *minimum effect*) and %time in Z5 (p=0.001; η^2=0.079; *minimum effect*). No interactions were found between the factors %time and Z2 (p=0.150; η^2=0.023; *no effect*).

One-way ANOVA revealed significant differences in %HRmax between days of the week (p=0.001; η^2=0.161; *minimum effect*). Values per day can be observed in Figure 1. The analysis of variance between days of the week regarding S&C tasks revealed that the lowest %HRmax (54.12%HRmax) and the most time spent in Z1 (37.02%) occurred on Monday. The most time spent in Z2 of intensity occurred in the training of Wednesday (44% of the time). The highest percentage of time that was spent in Z3 (27.86%) occurred on Friday. The comparison between days of the week and technical drills showed that the highest %HRmax (71.79%) occurred on Thursday and the most time spent in Z2 (39.49%) occurred on Wednesday. Similarly with the technical drills, the highest % HRmax on tactical tasks occurred on Thursday (76%) and the most time spent in Z2 (30.53%) on Wednesday. Descriptive statistics of weekly variance of HR and zones is presented in Table 2.

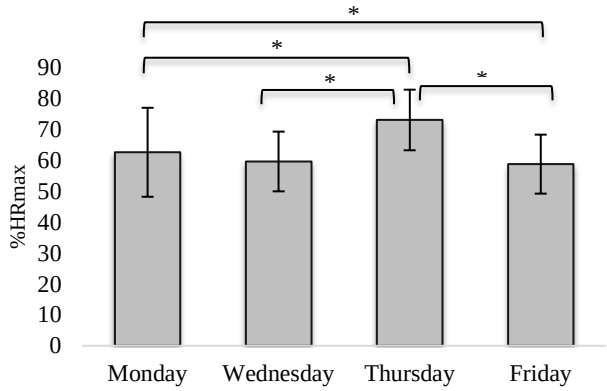

Figure 1. **WEEKLY VARIANCE OF %HRmax**

Table 2. **DESCRIPTIVE STATISTICS OF WEEKLY VARIANCE OF HR ZONES**

Variables	Monday	Wednesday	Thursday	Friday	p-Value	ES
%HRmax	62.67±14.41 c,d	59.69±9.67 c	73.13±9.81 a,b,d	58.83±9.55 a,c	0.001	0.161 *Min. effect*
%time in Z1	27.31±26.17	28.96±20.15	31.27±25.04	29.35±26.15	0.687	0.003 *No effect*
%time in Z2	21.69±18.69 b	35.22±20.37 a,c,d	27.17±21.79 b	24.93±19.80 b	0.001	0.074 *Min. effect*
%time in Z3	19.26±21.23	17.34±18.24	17.73±24.59	16.14±21.35	0.690	0.003 *No effect*
%time in Z4	12.00±19.12 b,c,d	6.88±13.96 a	4.04 ±11.73 a	5.41 ±12.30 a	0.001	0.036 *No effect*
%time in Z5	4.91±14.21 b,c,d	0.56±3.14 a	0.07 ±0.46 a	0.13 ±0.52 a	0.001	0.068 *Min. effect*

Significantly ($p<0.05$) different from Monday[a]; Wednesday[b]; Thursday[c]; Friday[d]
Z=Zone ES=Effect Size *Min.*=Minimum

According to the tactical tasks, the most time spent in Z1 occurred on Wednesday (30.03%) and the most time spent in Z3 (30.93%), Z4 (19.36%) and Z5 (14.93%) occurred on Monday. Variance of %HRmax between the types of tasks are illustrated in Figure 2.

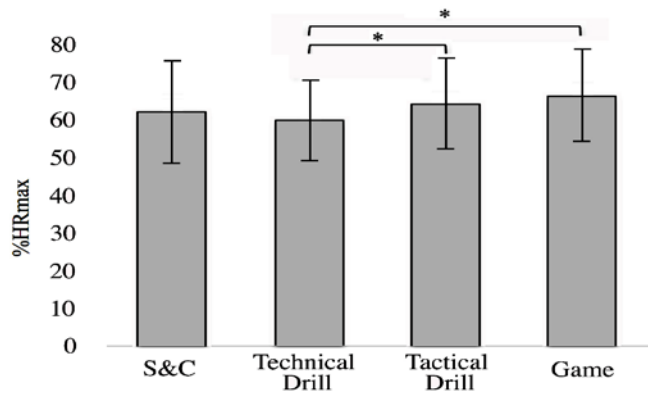

Figure 2. **VARIANCE OF %HRmax BETWEEN TYPES OF TASKS**

Finally, concerning the game task, the analysis revealed that the highest %HRmax (71.12%) and the most time spent in Z4 (23.33%) and Z5 (9.17%) occurred on Monday. In the same game task, the most time spent in Z1 (36.86%) occurred on Friday, and the most time in Z2 (27.37%) and Z3 (24.90%) on Wednesday. Descriptive statistics of HR zones variance between the types of tasks are displayed in Table 3.

Table 3. **HR ZONES VARIANCE BETWEEN TYPES OF TASKS**

Variables	S&C	Technical drills	Tactical drills	Game	p-Value	ES
%HRmax	61.95±13.44	59.86±10.75 c,d	64.26±11.95 b	66.29±12.24 b	0.001	0.040 *Min. effect*
%Time in Z1	29.00±24.37 d	33.43±28.17 d	28.39±17.87 d	19.34±16.65 a,b,c	0.001	0.040 *Min. effect*
%Time in Z2	29.03±21.83	30.15±23.71	27.46±17.70	23.69±15.07	0.103	0.012 *No effect*
%Time in Z3	17.75±23.65	17.35±22.86	15.30±16.25	21.80±17.05	0.161	0.010 *no effect*
%Time in Z4	4.83±12.49 d	5.80±14.05 d	5.86±11.42 d	17.29±20.94 a,b,c	0.001	0.082 *Min. effect*
%Time in Z5	0.17±1.19 d	0.57±3.65 d	1.78±9.84 d	5.24±13.41 a,b,c	0.001	0.049 *Min. effect*

Significantly ($p<0.05$) different from S&C[a]; Technical drills[b]; Tactical drills[c]; Game[d]
S&C=Strength and Conditioning ES=Effect Size Z=Zone *Min.*=Minimum

A two-way MANOVA revealed that the day of the week (p=0.001; η^2=0.109; *minimum effect*), the format of the game (p=0.001; η^2=0.147; *minimum effect*) and tactical position (p=0.001;

η^2=0.124; *minimum effect*) had significant main effects on the technical performance. There were significant interactions between the day of the week*format (Pillai's Trace=0.129; p=0.010; η_p^2 =0.129; *minimum effect*) and day of the week*tactical position (Pillai's Trace=0.902; p=0.005; η_p^2=0.150; *minimum effect*). No statistical interactions were found in format*tactical position (Pillai's Trace=1.365; p=0.344; η_p^2=0.227; *minimum effect*) and day of the week*format*tactical position (Pillai's Trace=0.326; p=0.065; η_p^2=0.065; *minimum effect*). A two-way ANOVA examining tactical position*day of the week and day of the week*format, did not reveal significant interactions among the technical variables.

A one-way ANOVA analysed the variation of technical performance among different tactical positions of players. The descriptive statistics are reported in Table 4.

The comparison among tactical positions revealed differences in the number of balls received (p=0.001; η^2=0.140; *minimum effect*), neutral balls per player (p=0.001; η^2=0.162; *minimum effect*) and attacking balls per player (p=0.001; η^2=0.181; *minimum effect*). Statistical analysis showed that CBs had the greater volume of balls received (25.25), neutral balls made (21.64) and attacking balls (7.43). On the other hand, Pivot had the smaller number of balls received (2.67), neutral balls (0.31) and attacking balls (0.98).

Table 4. **TECHNICAL PERFORMANCE BETWEEN TACTICAL POSITIONS: ANALYSIS OF VARIANCE**

Performance (per player)	LW M±SD	LB M±SD	CB M±SD	RW M±SD	RB M±SD	P M±SD	p-Value	ES
Balls received	5.21±12.19 [c]	14.24±22.06	25.25±34.70 [a,d,f]	6.11±9.29 [c]	19.93±32.34	2.67±3.52 [c]	0.001	0.140 *Min. effect*
Balls conquered	0.17±0.54	0.29±0.74	0.21±0.69	0.21±0.50	0.21±0.58	0.24±0.62	0.976	0.004 *No effect*
Lost balls	1.05±1.50	1.31±1.58	1.25±1.38	1.07±1.61	1.64±1.50	0.76±1.38	0.400	0.026 *No effect*
Neutral balls	2.86±8.54 [c]	9.43±16.49 [c]	21.64±32.46 [a,b,d,f]	3.07±6.60 [c]	11.93±21.79	0.31±0.75 [c]	0.001	0.162 *Min. effect*
Attacking balls	1.10±2.76 [c,e]	3.57±4.97 [c]	7.43±9.61 [a,b,d,f]	1.54±2.67 [c,e]	7.07±9.39 [a,d,f]	0.98±2.07 [c,e]	0.001	0.181 *Min. effect*
Shots	0.45±0.71	0.88±1.17	0.86±0.93	0.82±0.98	0.71±1.20	0.74±1.11	0.450	0.024 *No effect*

Significantly ($p<0.05$) different from LW[a]; LB[b]; CB[c]; RW[d]; RB[e]; P[f] *Min.*=Minimum
LW=Left Wing; LB=Left Back; CB=Centre Backcourt; RW=Right Wing; RB=Right Back; P=Pivot

The analysis of the technical performance by days of the week is presented in Table 5.

Table 5. **TECHNICAL PERFORMANCE BETWEEN DAYS OF THE WEEK: ANALYSIS OF VARIANCE**

Play (per player)	**Monday** M±SD	**Wednesday** M±SD	**Thursday** M±SD	**Friday** M±SD	**p-Value**	**ES**
Balls received	3.93±3.34 [d]	7.11±11.38 [a]	15.14±23.94	28.57±41.29 [a,b]	0.001	0.145 *Min. effect*
Balls conquered	0.12±0.33 [d]	0.15±0.42 [d]	0.29±0.76	0.57±1.10 [a,b]	0.008	0.060 *Min. effect*
Lost balls	0.50±0.77 [c,d]	1.00±1.12 [d]	1.75±1.65 [a]	1.82±2.52 [a,b]	0.001	0.098 *Min. effect*
Neutral balls	1.40±1.98 [d]	4.31±9.46 [d]	10.32±20.72 [d]	22.07±33.59 [a,b,c]	0.001	0.146 *Min. effect*
Attacking balls	0.81±1.15 [d]	2.80±3.88 [d]	2.96±5.44 [d]	7.00±11.46 [a,b,c]	0.001	0.100 *Min. effect*
Shots	0.64±0.88	0.72±0.99	0.93±1.15	0.71±1.15	0.711	0.007 *No effect*

Significantly ($p<0.05$) different from Monday[a]; Wednesday[b]; Thursday[c]; Friday[d]
Min.=Minimum

The analysis of variance between days of the week showed statistical differences in balls received (p=0.001; η^2=0.145; *minimum effect*), balls conquered (p=0.008; η^2=0.060; *minimum effect*), lost balls (p=0.001; η^2=0.098; *minimum effect*), neutral balls (p=0.001; η^2=0.146; *minimum effect*) and attacking balls (p=0.001; η^2=0.100; *minimum effect*). The greater volumes of balls received (28.57), balls conquered (0.57), lost balls (1.82), neutral balls (22.07) and attacking balls (7.00) were made during Friday training session. The smaller volumes of technical actions were made in Monday training session.

The results of the technical performance per formats of the game used in training sessions can be observed in Table 6.

One-way ANOVA revealed statistical differences between formats of the game in balls received (p=0.001; η^2=0.204; *minimum effect*), neutral balls (p=0.001; η^2=0.209; *minimum effect*), attacking balls (p=0.001; η^2=0.152; *minimum effect*) and shots per player (p=0.023; η^2=0.081; *minimum effect*). The greater volumes of balls received (25.61), neutral balls (19.52) and attacking balls (6.14) were made during 6-vs.-6 format. The greater volume of shots per player (1.36) was made in 3-vs.-1 format. In contrast, the smaller number of balls received (3.21) occurred in 3-vs.-2 format, the smaller number of neutral balls (0.00) in 3-vs.-1, the smaller volume of attacking balls (0.32) in 2-vs.-2 and the smaller volume of shots per player (0.32) in 7-vs.-7 format.

***Table 6*. TECHNICAL PERFORMANCE BETWEEN FORMATS OF THE GAME: ANALYSIS OF VARIANCE**

Plays (per player)	**2-vs.-2** M±SD	**3-vs.-1** M±SD	**3-vs.-2** M±SD	**4-vs.-3** M±SD	**4-vs.-4** M±SD	**6-vs.-4** M±SD	**7-vs.-7** M±SD	**6-vs.-6** M±SD	**p-Value**	**ES**
Balls received	3.93±2.34 h	4.29±2.40 h	3.21±2.55 h	4.61±3.83 h	7.29±7.80 h	6.50±7.34 h	4.11±3.29 h	25.61±34.89 a-g	0.001	0.204 *Min. effect*
Balls conquered	0.14±0.45	0.00±0.00	0.07±0.27	0.07±0.27	0.07±0.27	0.14±0.36	0.39±0.63	0.41±0.93	0.063	0.068 *Min. effect*
Lost balls	1.61±1.57	1.29±0.83	0.36±0.63	1.07±1.18	0.64±0.93	0.71±0.99	0.96±1.26	1.34±2.02	0.144	0.056 *Min. effect*
Neutral balls	0.64±1.19 h	0.00±0.00 h	0.86±0.95 h	2.25±2.95 h	5.36±6.97	4.07±5.73 h	2.50±2.69 h	19.52±28.78 a-d,f-g	0.001	0.209 *Min. effect*
Attacking balls	0.32±0.67 h	4.29±3.10	0.93±1.27 h	2.50±3.33	2.00±2.94	2.86±3.84	0.82±1.25 h	6.14±9.26 a,c,g	0.001	0.152 *Min. effect*
Shots	1.04±1.04	1.36±1.22 g	0.36±0.63	0.82±0.94	0.43±0.85	0.79±1.19	0.32±0.61 b	0.75±1.12	0.023	0.081 *Min. effect*

Significantly ($p<0.05$) different from: 2-vs.-2[a]; 3-vs.-1[b]; 3-vs.-2[c]; 4-vs.-3[d]; 4-vs.-4[e]; 6-vs.-4[f]; 7-vs.-7[g]; 6-vs.-6[h] *Min.*=Minimum

DISCUSSION

This investigation addressed the training load distribution over a weekly microcycle of training in the pre-season phase of handball players. The main findings of the present study were that (a) higher HR and technical performances occurred in midweek (Thursday) and pre-game (Friday) training sessions, and (b) there was a higher volume of technical actions in the 6-vs.-6 format than in smaller formats (2-vs.-2 to 6-vs.-4).

HR responses were monitored during four training sessions. The lowest HR values during S&C and technical drills were found in the post-match training session (Monday). Moreover, a higher percentage of time spent in zone 1 of intensity (50% to 60% of HRmax) was also observed in the Monday training session. On the other hand, the tactical tasks and game between teammates were statistically more intense than in the remaining sessions of the week. Generally, post-match training sessions can be characterised by a considerable volume and smaller intensity, thus it is easier for the oxidative system and leads to a lower impact on muscle (Coutinho *et al*., 2015). The tasks in the post-match session targeted strength and conditioning followed with the low intensity.

Nevertheless, the tactical tasks conducted by the coach did not follow the rationale of the warm-up and initial fundamental phase of the training, thereby statistically increasing HR responses and the time spent in zones 4 and 5 (80% to 100% of HRmax). To the best of our knowledge, no previous handball study has targeted weekly training load; nevertheless, in a study conducted in football it was observed that the greatest perceived exertion reported by players was during Monday sessions. Interestingly, similar evidence has been found in professional basketball players (Manzi *et al*., 2010). Thursday (midweek session) induced the highest HR values in all the tasks promoted. Thursday can be characterised as the day dedicated to acquisition and development, similarly to the weekly training periodisation for football and basketball for one single match per week (Manzi *et al*., 2010; Coutinho *et al*., 2015), thereby increasing the intensity of the exertion. It was also possible to verify that in this specific case, the coach did not opt to use a formal game as a task in the Thursday session. Finally, the pre-match session (Friday) induced a decrease of intensities by using shorter periods of exercise with a greater tactical prominence in the tasks assigned.

Generally, higher HR intensities were found in tactical tasks or in games. S&C tasks only induced greater HR responses in the Friday training session, thereby suggesting that drill-based tasks may be more intense than controlled exercises as used in S&C tasks. Apparently, no study has compared S&C with tactical tasks or games. Nevertheless, a comparison between technical tasks and tactical tasks suggested that drill-based tasks might increase the HR variability and the HR responses through the use of shorter rest periods between the exercises. Tactical tasks were also important exercises for reproducing the type of muscular contraction and the cardiovascular development of players, and were therefore important tasks for ensuring the specificity of the training (Buchheit *et al*., 2009). On the other hand, S&C tasks can ensure a better control of training load per player, thereby decreasing the inter-player variability, although these types of tasks are less specific and not very closely related to the technical and tactical requirements of a match.

As far as we could establish, technical performance has not been monitored in handball training sessions. For that reason, the tactical tasks and the games between teammates were analysed. The different formats of the tasks prescribed across the week were coded and then used as independent variable. An analysis of variance revealed that the 6-vs.-6 format increased the volume of balls received, neutral balls and attacking balls executed per player. Previous studies in small-sided handball games revealed that smaller formats increase the individual participation of players in the game. Similar results were found in football and basketball.

In the present study, the time spent in each format was not balanced and for that reason the greater time spent in the 6-vs.-6 format may have contributed to the greater volume of technical actions per player. It was also possible to verify that in eight formats prescribed by the coach, four of them represented unbalanced games (with numerical superiority or inferiority). These games were used to develop specific tactical conditions and to augment the perception of specific attacking or defensive issues. Despite these findings, the physiological responses were not analysed between SSGs. An interesting study conducted in rugby players suggested the possibility that conditioning might be achieved without also achieving the best technical performance (Vaz *et al*., 2012). Future studies should monitor both acute physiological responses and technical performance to identify possible associations.

Comparison among days of the week showed that the highest volumes of technical actions were performed in the Friday session and the lowest in the Monday one. This may have been as a result of the time dedicated to tactical tasks or games in sessions and the specificity of the tasks used per session. It might be suggested that the pre-match session may have a greater tactical prominence and for that reason a greater individual prominence in the game. On the other hand, Monday may have been characterised by a greater prominence of resting and individual activities and a smaller prominence of tactical tasks. Finally, differences in technical actions between players' positions were tested. CBs had a statistically greater volume of balls received, neutral balls made and attacking balls during drill-based tasks. This tactical position is extremely important for building the attacking process (Clanton & Dwight, 1997). For that reason, tasks organised by the coach may have contributed to emulating the prominence of each player in the game.

One limitation of the findings was that the analysed period was relatively short for generalising the findings. Moreover, the analysis was carried out in pre-season and this may contribute to a specific type of periodisation adopted in this period. Finally, physiological responses between SSGs were not analysed. This may have had an influence on the technical performance measured in our study. Nonetheless, this study contributed to identifying the weekly training periodisation prescribed by handball coaches, and was thus novel for that reason. In the case of technical analysis, the non-homogeneity in the time spent per format might have influenced the results. Future studies should analyse a full season period and add some new variables to measure the external load (accelerometers and tracking systems) and the physiological variations (blood samples to measure the hormonal changes and inflammation markers). Moreover, a comparison between match and training sessions should be considered to test the specificity of training drills and training methodology.

PRACTICAL APPLICATION

The congested schedules and proper recovery periods before and after matches should be taken into consideration when organising the weekly training microcycle. It would seem, this is the first study to have analysed the internal load of a weekly training microcycle in professional handball. It was found that a greater internal load was programmed in the middle of the week. The recovery period of 48 to 72 hours after a match and 48 hours before the next game occurs in the middle of the week. This may be the main justification for this finding. This also partially confirms the findings for football and basketball.

Games and tactical drills were identified as the most demanding tasks. Strength and conditioning tasks and technical drills had the lowest levels of internal load. The prescription for these latter two enable control of the cardiorespiratory system and emphasises the development of neuromuscular ability. Game situations and tactical drills seem to be the most demanding and may be fitted into the middle sessions. Finally, the greater technical participation in smaller formats and a higher rate of tactically demanding and decision-making situations in larger formats seem to be the main reasons for introducing SSGs in daily training sessions.

CONCLUSION

The present study analysed the training intensity of a professional handball team during a one-week period. The results showed that middle-week training sessions were more intense. Then again, the Friday session (pre-match) increased the volume of technical actions by the specificity of tasks. It was also revealed that drill-based tasks were generally more intense than S&C and technical drills. The notational analysis of drill-based tasks revealed that CB was the position with greater participation in the game and the 6-vs.-6 format generated greater volumes of technical actions performed by the player.

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