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The effect of stress and recovery on field-test performance in floorball

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Physical and psychosocial stress and recovery are important performance determinants. A holistic approach that monitors these performance determinants over a longer period of time is lacking. Therefore this study aims to investigate the effect of a player's physical and psychosocial stress and recovery on field-test performance. In a prospective non-experimental cohort design 10 female Dutch floorball players were monitored over 6 months. To monitor physical and psychosocial stress and recovery, daily training-logs and three-weekly the Recovery-Stress Questionnaire for Athletes (RESTQ-Sport) were filled out respectively. To determine field-test performance 6 Heart rate Interval Monitoring System (HIMS) and 4 Repeated Modified Agility T-test (RMAT) measurements were performed. Multilevel prediction models were applied to account for within-players and between-players field-test performance changes. The results show that more psychosocial stress and less psychosocial recovery over 3 to 6 weeks before testing decrease HIMS performance ($p \leq 0.05$). More physical stress over 6 weeks before testing improves RMAT performance ($p \leq 0.05$).
In conclusion, physical and psychosocial stress and recovery affect submaximal interval-based running performance and agility up to 6 weeks before testing. Therefore both physical and psychosocial stress and recovery should be monitored in daily routines to optimize performance.

Keywords: longitudinal study, monitoring, agility, submaximal interval-based running, physical, psychosocial

INTRODUCTION

Floorball players need to train hard with sufficient recovery in order to meet the high physical demands of a match [26]. Floorball matches are played indoors and contain elements of both ice-hockey and field hockey. The match consists of three periods of 20 minutes in which players' perform 5 or 6 times for 60 to 90 seconds [28]. The match demands are characterized by high-intensity efforts interspersed with recovery-periods. Activities consist of movements such as sudden accelerations, decelerations, twists, turns and changes of direction to anticipate to the ball and other players [26,28]. This requires well-developed aerobic and anaerobic energy systems and agility [26]. To meet and optimize these physical characteristics an adequate balance between the physical stress of training and recovery is needed. Physical stress arises from stressors like training frequency and/or duration [12]. However, players also experience psychosocial stress from stressors like interactions with other people or an imbalance between expected and actual performance [12,19,20]. Therefore both physical and psychosocial stress and recovery play an important role in performance [20].

Previous research has evaluated the effects of physical and psychosocial stress and recovery on field-test performance in high training load or monitor studies [4,5,9,11]. A decreased field-test performance was shown in most training studies as a result of a short period of increased physical stress in terms of training load [8-10]. After this period of increased physical stress the players completed a taper period with a reduction in training intensity and frequency, which led to an increase in field-test performance due to a super-compensation effect [8-10]. Monitor studies showed conflicting results. A one-season monitor study showed improved field-test performance after increased physical stress one week before testing [4]. In contrast, other monitoring studies found only a pre-season or no relation between physical stress and field-test performance 1 to 3 weeks before testing [14,24]. The contradictions in results may be related to the study design; aforementioned studies had a period of intensified training after which testing was done, whereas other studies monitored a regular training season. In a regular training season physical stress is periodized more smoothly to optimize performance. Monitor studies that evaluated the effects of psychosocial stress and recovery on field-test performance by means of the RESTQ-Sport questionnaire all showed that more psychosocial stress and less recovery resulted in a decreased field-test performance one week [9] and 2 months [5,11] before testing.

The field tests used in these studies mainly focused on aerobic endurance. However, floorball match demands show that agility is important, next to aerobic endurance. Findings of Gabbett et al. [14] showed a decreased agility as a result of increased physical stress in rugby players. However, in most of the aforementioned studies agility-type field tests are not incorporated at all. Moreover, most studies focus on average group-wise performance change and therefore neglect between-player and within-player performance changes.

So, to determine the effects of stress and recovery on field-test performance a holistic approach is warranted that includes the individual player's physical and psychosocial stress and recovery. An individual player experiences both types of stress and recovery, and this may affect their performance. In measuring field-test performance the match demands of floorball should be met properly including both aerobic endurance and agility. Therefore the aim of this study is to investigate the effect of a player's physical and psychosocial stress and recovery on field-test performance.

METHODS

Subjects

In this study 10 female Dutch floorball players (mean ± SD: age 24.8 ± 4.5 yr, body mass 64.5 ± 4.9 kg, height 169.9 ± 6.3 cm, VO_2max 45.2 ± 2.8 $ml \cdot min^{-1} \cdot kg^{-1}$) participated during 6 months in preparation for the World Cup qualifications. These participants all played at the highest national level and were part of the Dutch national team. The floorball players trained on average 2 times a week and played 1 match a week with their own team. They trained with the Dutch national team one weekend every 6 weeks consisting of 2 training sessions a day and/or a practice match. A sports physician screened all participants to exclude cardiovascular risks, according to the Lausanne recommendations [2]. The participants signed an informed consent after being fully informed about the study. This study is part of a larger study known as the Groningen Monitoring Athletic Performance Study (MAPS). Approval was granted by the medical ethical committee of the University Medical Center Groningen, the Netherlands conform the declaration of Helsinki and in accordance with the ethical standards of the IJSM [16].

Procedure

A prospective non-experimental cohort design was used to monitor stress, recovery and field-test performance. The study timeline is shown in figure 1. To monitor field-test performance over the course of the season two field tests were administered every 6 weeks. The participants performed both the Heart rate Interval Monitoring System (HIMS), a submaximal interval-based running test, and the Repeated Modified

Agility T-test (RMAT), an intermittent agility test. These field-tests were developed for intermittent team sports and are characterized by an interval profile [15,21,22] as well as validated against aerobic or anaerobic laboratory tests or match performance [7,15,23]. During the preparation phase the HIMS and RMAT were performed 6 and 4 times respectively. The HIMS was performed twice within one week; once for familiarization and once to obtain baseline measurements. The RMAT was done once for familiarization. Participants were verbally encouraged to evoke maximal effort during the RMAT.

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During the preparation phase the participants were asked to fill out a daily training-log to measure physical stress and recovery. To assess the psychosocial stress and recovery the participants completed the Dutch version of the Recovery-Stress Questionnaire for Athletes (RESTQ-Sport) [25] every 3 weeks, referring to their stress and recovery activities in the preceding 3 weeks (figure 1).

To determine submaximal heart rate (HR_{submax}) for the HIMS the maximal heart rate (HR_{max}) had to be determined. Therefore at the start of the monitoring period a maximal test was done on a treadmill (Valiant, Lode B.V., Groningen, The Netherlands) using a ramp protocol that was adapted for indoor team sport players [17,18]. The participants started at a slope of 2% at 8 km·h^{-1} increasing speed with 0.8 km·h^{-1} per minute, after a warm-up period of 5 minutes until 18 km·h^{-1}. Thereafter, the slope increased with 1% a minute. The test was stopped at voluntarily exhaustion of the participant. A breath-by-breath gas analyzer (Cortex Metalyzer 3B, Procare B.V. Groningen, The Netherlands) was used for the metabolic measurements. HR_{max} was determined as the highest HR during the test.

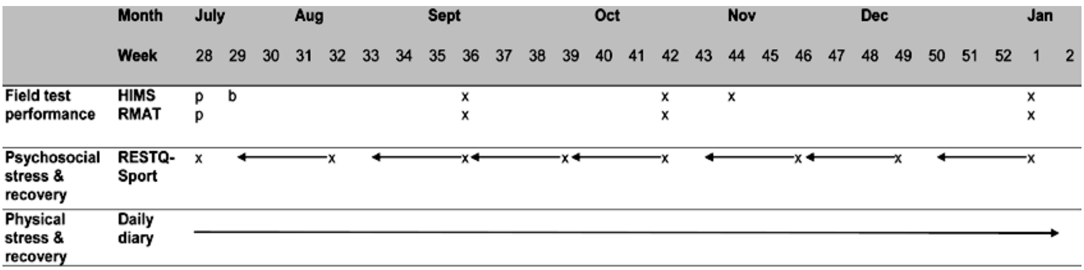

Figure 1. The longitudinal study design. p=practice session, b=baseline measurement, x=measurement moment, →=asking back period.

Stress and recovery

The training-log consisted of daily recording of the Total Quality of Recovery (TQR) on a scale from 6-20 [20] before each training and match. After every training or match participants recorded the duration in minutes as well as the session Rating of Perceived Exertion (RPE) score on the original 15-point Borg scale ranging from 6-20 [13,20]. To calculate the load, the session RPE was multiplied by the duration of the training or match as proposed by Foster (1998). The weekly load and duration were calculated as the sum over a week period. For session RPE and TQR the average over the week was calculated. When 25% or less of a week was missing of the TQR scores, these scores were replaced with the week average [4]. Next to week sums or averages, also the averages over 3 and 6 weeks before the performance tests were calculated.

The RESTQ-Sport consists of 77 items, which are rated on a Likert-type scale from 0: never to 6: always (Figure 2), scoring the frequency of participating in various stress and recovery related activities during the last 3 weeks [19]. The items can be divided into 12 general and 7 sport-specific scales, with 4 questions for each scale and 1 warm-up question (Figure 2). Scores of the RESTQ-Sport were classified in a general stress (GS) score, sport-specific stress (SS) score, general recovery (GR) score and sport-specific recovery (SR) score; each score was calculated by taking the average of the subscales associated with the specific score [19]. These scores were also calculated for 6 weeks before field-test performance taking the average of the scores of the 2 RESTQ-Sport questionnaires filled out 3 and 6 weeks before testing. The Dutch version of the RESTQ-Sport shows sufficient reliability and validity for sports practice and science purposes [25].

Please answer the question with the number corresponding to the best fitting answer

0	1	2	3	4	5	6
never	*seldom*	*sometimes*	*often*	*more often*	*very often*	*always*

In the past 3 weeks....

...I was dead tired after work (GS)

...I couldn't switch my mind off (GS)

...my muscles felt stiff or tense during performance (SS)

...I had pain after performance (SS)

...I felt as if I could get everything done (GR)

...I finished important tasks (GR)

...I pushed myself during performance (SR)

...I was convinced that I had trained well (SR)

Figure 2. Example questions RESTQ-Sport of the 4 main scores: General Stress (GS), Sport Stress (SS), General Recovery (GR) and Sport Recovery (SR) [19].

Field-test performance

The HIMS protocol was performed as described by Lamberts et al. [21]. The protocol consists of four 2-minute stages of running between 2 lines 20m apart, each stage was followed by 1 minute of rest. Starting speed was set at 7.2 $km \cdot h^{-1}$ and intensity increased over the stages by 1.2 $km \cdot h^{-1}$ each stage. During the HIMS HR was monitored (Polar Team[2], Kempele, Finland). Field-test performance is defined as the HR_{submax} at the end of the 4th stage, expressed as a percentage of the HR_{max} and in absolute $beats \cdot min^{-1}$. Besides, absolute and relative heart rate recovery (HRR and HRR%) in the first minute after the 4th stage was determined. Both HR_{submax} and HRR were calculated as an average over the final 15 seconds of the concerning period [21]. For the lowest day-to-day variation in HR_{submax} and HRR the HR at the end of the 4th stage should be between 86-93% of the HR_{max} [22]. The participants were allocated to either the same, a slower or faster starting speed depending on their HR_{submax} at the end of the 4th stage after the baseline measurements [22].

The RMAT was performed as described by Haj-Sassi et al. [15] (Figure 3). The participants started at the line 55 cm before A (Figure 3) at which the first electronic timing gate (TAG Heuer, Marinn, Swiss) was placed. Sensors were mounted on tripods and placed 1.35m above the ground (approximately at shoulder height). After a 3 to 1 countdown the participants ran towards B, shuffled left or right to either C or D, shuffled further to the other side and back to B from which they ran backwards back to A. Participants performed this course 10 times, starting every 30 seconds and were instructed not to cross their feet while shuffling and touch the tape at each mark with their feet. Field-test performance was determined as peak time (PT) and total time (TT). Both variables proved reliability and validity [15].

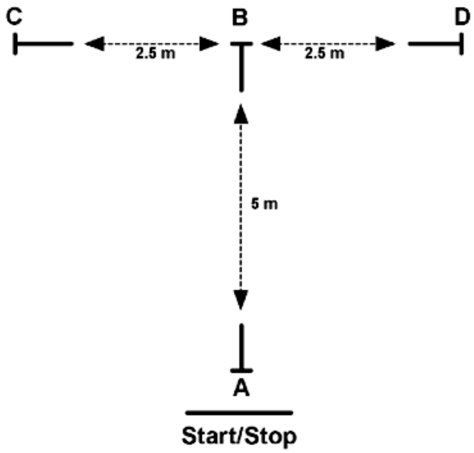

Figure 3. Repeated Modified Agility T-test (RMAT) modified from Haj-Sassi et al. [15].

Data analysis

The HIMS and RMAT were completed by 10 and 9 floorball players, respectively. The goalkeeper did not perform the RMAT due to the specific match demands of the goalkeeper. After exclusion of the familiarization and baseline trials 4 HIMS and 3 RMAT measurements remained for the analysis (Figure 1). Means and standard deviations were computed for all variables using IBM SPSS Statistics 20 for Windows. The data was analyzed using the *MLwiN* Version 2.23 software package. Multi-level modeling allows for repeated measures with missing data, which is inevitable in this longitudinal design, assuming that these are random. Multi-level modeling was developed to analyze nested data and takes into account the relations within (player's development) and between players [3]. For the field-test performance parameters of the HIMS (HR_{submax} and HRR) and RMAT (PT and TT), 4 random intercept 2-level models were created. In these 2-level models level 1 represented the measurement occasions within individual players and level 2 represented the differences between players. Hereafter predicting variables for physical stress and recovery were added to all four 2-level models. The predicting variables were added one-by-one to quantify the effect of that particular variable on the field-test performance change. The predictive model was evaluated by comparing the -2 Log likelihoods (deviance) of the empty model (without predicting variables) to the model including predicting variables. The level of statistical significance was set at $p \leq 0.05$.

RESULTS

During 25 weeks, data of 753 training sessions and matches were collected. The players completed on average 3 training sessions/matches every week. A total of 77 RESTQ-Sport questionnaires were filled out. Descriptive data of HIMS and RMAT field-test performance, training duration, session-RPE, weekload, TQR and RESTQ-Sport are reported in table1.

Duration	sum of 1 week (min)	228.03	±	229.16
	average 3 week (min)	282.46	±	150.09
	average 6 week (min)	266.35	±	107.39
RPE	average 1 week (6-20)	14.63	±	1.72
	average 3 week (6-20)	14.50	±	1.60
	average 6 week (6-20)	14.36	±	1.36
Weekload				
*(Duration*RPE)*	1 week (AU)	3493.95	±	4854.72
	average 3 week (AU)	4308.71	±	2429.13
	average 6 week (AU)	4022.70	±	1712.45
TQR	average 1 week (6-20)	14.39	±	1.48
	average 3 week (6-20)	14.50	±	1.32
	average 6 week(6-20)	14.26	±	2.65
RESTQ-Sport	GS 3 wk (0-6)	1.76	±	0.69
	GS 6 wk (0-6)	1.70	±	0.59
	SS 3 wk (0-6)	1.04	±	0.57
	SS 6 wk (0-6)	1.00	±	0.52
	GR 3 wk (0-6)	3.12	±	0.74
	GR 6 wk (0-6)	3.15	±	0.62
	SR 3 wk (0-6)	2.63	±	0.79
	SR 6 wk (0-6)	2.57	±	0.64
HIMS	Submaximal Heart rate (%)	92.18	±	3.84
	Submaximal Heart rate (beats·min^{-1})	185.19	±	11.69
	Heart rate Recovery (%)	24.91	±	6.56
	Heart rate Recovery (beats·min^{-1})	45.76	±	10.62
RMAT	Peak Time (sec)	6.40	±	0.25
	Total Time (sec)	66.06	±	2.61

Table 1. Physical and psychosocial stress and recovery and field test performance in Dutch female Floorball players. Scores are represented as mean ± SD for the Heart rate Interval Monitoring System (HIMS), Repeated Modified Agility Ttest (RMAT), Duration, Rating of Perceived Exertion (RPE), Weekload, Total Quality of Recovery (TQR) and RESTQ-Sport General Stress (GS), Sport Stress(SS), General Recovery (GR), Sport Recovery (SR).

HIMS performance prediction improves significantly ($p<0.01$) using 2-level models compared to a 1-level model. In this 2-level model, level 1 represents measurement occasion within individual players and level 2 represents differences between players. The 2-level model is stronger in comparison to the 1-level model, which just analyzes the differences between players. In other words individual field-test performance development over time differs between players. For RMAT performance the 2-level models did not improve the prediction of RMAT performance indicating no differences between individuals in agility development over time.

HIMS

In Table 2 the results for the 2-level models predicting HR_{submax} and HRR on the HIMS are shown. Physical stress and recovery show to have no effect on the prediction of HIMS performance. More psychosocial stress 3 weeks before field-test performance in terms of GS and SS predicts an increase of HR_{submax} by 1.81% and 2.50% respectively. Increased GR and SR predicts a decrease in HR_{submax} by 2.73% and 1.37% for every point on the Likert-scale on average over the score ($p≤0.01$) both from 3 to 6 weeks before field-test performance. In line, over the total 6 weeks before field-test performance more GS and GR predict an increase and a decrease in HR_{submax} by 1.83% and 2.43% respectively ($p≤0.05$). For HRR, increased GR predicts an improvement of 7.50 beats·min^{-1} for every point on the Likert-scale for mean GR ($p≤0.05$) from 3 to 6 weeks before field-test performance.

RMAT

Table 3 shows the results for the 2-level models predicting RMAT performance in both PT and TT. More physical stress in terms of duration (min) and weekload (AU) predicts faster PT and TT on the RMAT ($p≤0.05$) 6 weeks prior to performance testing. One hour of training or match play predicts a 0.08 (60*0.0013) and 0.96 (60*0.016) seconds faster PT and TT respectively. Psychosocial stress and recovery show to have no effect on RMAT performance prediction.

Table 2. Multilevel regression model for sub maximal heart rate (HR_{submax}) and heart rate recovery (HRR) on the Heart rate Interval Monitoring System (HIMS) (n=10). The empty models and the models that improved significantly ($p \leq 0.05$) by adding physical or psychosocial stress and recovery parameters are shown. The intercept represents the estimation according to one fixed factor. The estimated is the average change in the performance parameter with 1 unit of the predicting parameter.

	Model		Intercept (constant)	Estimate (s.e)	Measurement-level variance	Athlete-level variance	Log likelihood (χ^2)
HR_{submax}	Empty		92.20 (1.07)	-	3.10 (0.93)	10.49 (5.15)	151.45
		+ GS 3 wk	89.06 (1.47)	1.81 (0.55)	2.02 (0.61)	11.93 (5.63)	142.89**
		+ GS 6 wk	89.25 (1.69)	1.83 (0.79)	2.42 (0.73)	11.68 (5.57)	146.82*
		+ SS 3 wk	89.65 (1.56)	2.50 (0.88)	2.06 (0.62)	15.74 (7.34)	145.99*
		+GR 3 wk	99.57 (2.20)	-2.37 (0.62)	1.86 (0.56)	10.83 (5.12)	140.13**
		+GR 6 wk	99.95 (3.06)	-2.43 (0.90)	2.31 (0.70)	10.89 (5.21)	145.16**
		+ SR 3 wk	95.76 (1.72)	-1.37 (0.51)	2.28 (0.69)	11.49 (5.50)	145.36*
HRR	Empty		45.50 (2.75)	-	56.00 (16.89)	57.07 (33.99)	233.95
		+ GR 3 wk	22.27 (8.02)	7.50 (2.51)	60.20 (18.06)	17.12 (17.16)	228.35*

GS =General Stress; SS = Sport Stress; GR = General Recovery; SR = Sport Recovery
*Significant ($p \leq 0.05$) **Significant ($p \leq 0.01$)

Table 3. Multilevel regression model for Peak Time (PT) and Total Time (TT) on the Repeated Modified Agility Ttest (RMAT) (n=9). The empty models and the models that improved significantly ($p \leq 0.05$) by adding physical or psychosocial stress and recovery parameters are shown. The intercept represents the estimation according to one fixed factor. The estimated is the average change in the performance parameter with 1 unit of the predicting parameter.

	Model	Intercept (constant)	Estimate (s.e)	Measurement- level variance	Athlete-level variance	Log likelihood (χ^2)
PT	Empty	6.36 (0.06)	-	0.04 (0.02)	0.02 (0.02)	-2.33
	+ duration 6 wk	6.68 (0.14)	-0.0013 (0.00047)	0.02 (0.01)	0.03 (0.02)	-7.65*
	+ weekload 6 wk	6.68 (0.13)	-0.000086 (0.000029)	0.02 (0.01)	0.03 (0.02)	-8.06*
TT	Empty	65.81 (0.64)	-	3.18 (1.40)	2.04 (1.84)	83.33
	+ duration 6 wk	69.69 (1.17)	-0.016 (0.004)	1.21 (0.54)	3.21 (1.86)	73.90**
	+ weekload 6 wk	69.64 (1.11)	-0.0010 (0.0002)	1.07 (0.47)	3.55 (1.98)	73.23**

RPE= Rating of Perceived Exertion *Significant ($p \leq 0.05$) **Significant ($p \leq 0.01$)

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DISCUSSION

This study evaluates the effect of a player's physical and psychosocial stress and recovery on field-test performance. The first key findings of this study are that submaximal interval-based running (HIMS) performance decreases with more psychosocial stress and less psychosocial recovery in 3 to 6 weeks before performance testing. Second, agility improves after increased physical stress over 6 weeks before performance testing.

Our results show that both general and sport specific psychosocial stress and recovery affect HIMS performance. More GS and less GR over the last 6 weeks decreased submaximal performance, while over the last 3 weeks more SS and less SR decreased submaximal performance. This is in line with previous research that showed an increase in the GS subscales and a decrease in GR subscales over 3 days before a decrease in performance [9,11]. Also the study of Brink et al. showed an increase in GS and decrease in GR subscales 2 months before decreased submaximal performance [5]. These results indicate that general stress and recovery have a more long-term effect on performance, while sport stress and recovery seem to affect performance in short term. The general stress and recovery scales refer back to conflicts, pressure and successes in daily life. These factors can play a role for a longer period of time. The sport specific stress and recovery scales refer back to physical fitness, injuries and self-regulation during training and matches, these factors might be more dominant on the short term. This supports the importance of monitoring both general and sport specific psychosocial stress and recovery over the course of a season to be able to respond in time.

The effect of psychosocial stress and recovery on HIMS performance is supported by the fact that changes in psychosocial stress and recovery seem to elicit meaningful changes in HIMS performance. The day-to-day variation in HR_{submax} and HRR is ±2 beats·min^{-1} (i.e. ~1% of maximum HR) and ±3 beats·min^{-1} (i.e. ~5.5% of HR_{submax}) respectively when HR_{submax} is between 86%-93% at stage 4 [22]. Our players average HR_{submax} is 92.18% (table 1) and the changes in both HR_{submax} and HRR (Table 2) exceed the day-to-day variation. So for example a 1-point increase on a scale from 0 to 6 (never – always) in SS over 3 weeks elicits an increase in HR_{submax} of 2.5% (Table 2). Therefore, a meaningful change of 1% corresponds with an increase in SS of 1% / 2.5% = 0.4. Because the SS scale consists of 12 questions a 1-point increase on (0.4*12=) 5 out of 12 questions is necessary to elicit the required increase of 0.4. Likewise for HRR an increase of 1 unit on GR over 3 weeks elicits an increase in HRR of 7.5 beats·min^{-1} (Table 2). A meaningful change of 3 beats·min^{-1} corresponds with an increase in GR of 3 / 7.5 = 0.4, meaning a 1-point increase on (0.4*20=) 8 out of 20 questions. These magnitudes of change are realistic, considering the variation in scoring on the RESTQ (Table 1), so changes in psychosocial stress and recovery will elicit a meaningful change in HR_{submax} and HRR on the HIMS.

In contrast to psychosocial stress and recovery, physical stress and recovery does not affect HIMS performance. The sensitivity of the TQR, to measure physical recovery, has not been investigated yet. Similar to our study, physical recovery showed no contribution to field-test performance in the study of Brink et al. [4]. However an advantage of both the RPE and TQR is that they measure perceived physical stress and recovery. Therefore it is assumed that the players take their own capacity into account in the scoring. Nonetheless, a suggestion for future research may be to change the timing of scoring TQR. Players indicated that they rate their recovery more accurately during the warm-up because they are more aware of soreness, while TQR is scored before the warm-up. By filling out the TQR after the warm-up the sensitivity may be improved and may give a clarification of performance change by physical recovery to guide training.

More physical stress in terms of training duration and weekload over a 6-week period improves agility indicated by faster times on the RMAT. In literature contrasting results are found in which physical stress both increases and decreases agility. The time in the season and also type of sport may explain these contrasts. In pre-season an improvement in agility is shown with high levels of stress, while no change or decrement in agility is shown in early competition and during the season [6,14,27]. It is also known that match-related training and match play are important in the improvement of agility [6,27]. When looking at type of sport, improved agility was shown in soccer while decrement was shown in rugby [6,14,27]. In soccer, just as in floorball, agility may be a more important match demand in comparison to rugby. In soccer anaerobic speed training and small-sided games are important components in training [6]. While in rugby training the emphasis is on the aerobic conditioning, spending less time on agility type training [14]. Based on these studies it would be expected that in our sub-elite floorball players increased sport-specific training would lead to an increase in agility, which is confirmed by our results.

Furthermore physical stress appears to elicit meaningful changes in agility. The smallest worthwhile change is stated to be approximately 0.06 sec for PT and 0.65 sec for TT on the RMAT [15]. In our players agility increases 0.08 sec and 0.96 sec for PT and TT respectively, for each hour of training or match play per week on average over 6 week before testing. So, training duration elicits a meaningful change in agility measured with the RMAT.

In this study psychosocial stress and recovery did not affect agility and physical stress and recovery had no effect on submaximal interval-based running. Our study was executed during the preparation phase for the World Cup qualifications, which was at the end of their regular season with their own team. Therefore the aerobic capacity of the players was probably at their limit at this time. So, it might be that in this phase physical stress doesn't affect submaximal interval-based running measured by HR_{submax} and HRR. Besides, only modest changes are shown in aerobic endurance with training [1]. Psychosocial stress and recovery still might influence HR during submaximal interval-based running because psychosocial stress and recovery can change on a day-to-day basis. Physical stress might affect agility due to the high intensity of the training sessions with the national team in comparison to their home team. On the other hand, it can be speculated whether psychosocial stress and recovery affect short explosive agility type of movements.

This pioneering study has investigated the effect of physical and psychosocial stress and recovery on both submaximal interval-based running performance and agility. We were able to monitor players of the Dutch national floorball team over a unique 6-month period in preparation to the World Cup. In order to take within-player and between-player differences into account we used an individual approach. The frequency of monitoring psychosocial stress and recovery and field-test performance may be a limitation. Psychosocial stress and recovery can change on a day-to-day basis, so monitoring more often may give better insight in these changes and therefore better training guidance. However when monitoring over an entire season caution is needed to warrant the compliance of the players. Future research should take this into account.

This study shows that more psychosocial stress and less psychosocial recovery decreases submaximal interval-based running performance, while more physical stress in terms of training load improves agility both up to 6 weeks before performance testing. This indicates the importance of monitoring stress and recovery throughout the entire season to guide the training program and with that facilitate successful performances.

PRACTICAL APPLICATIONS

Monitoring player's physical and psychosocial stress and recovery must be incorporated into the daily routine of players, considering the effect on test performance even up to 6 weeks before testing depending on the field-test characteristics. The findings of current study implicate that to optimize aerobic performance more attention should be paid to daily life stressors like work and school and to recovery methods such as social life events on the long term. While on the short term more attention should be paid to physical fitness like muscle pain and to recovery methods like self-regulation and giving positive appraisal during training. Besides, changes in agility seem to be dominated by changes in sport-specific training and match play (physical stress). So, coaches can plan specific periods during the season in which agility can be optimized, by increasing physical stress.

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