Stress-Related Breathing Problems: An Issue for Elite Swimmers

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Abstract

The purpose of this preliminary study was to test if there are any links between breathing problems, and physiological and psychological recovery (or perceived lack thereof) in elite swimmers. In order to do so, twenty-four elite competitive swimmers (range 15-25 years, Mage = 18.25 years, SD = 1.60), from two swimming clubs in Norway both performed three physiological tests for bronchial hyperresponsiveness (BHR) and also completed a series of psychological questionnaires. The results are important for coaches, as it was revealed an alarmingly high prevalence of BHR. Possible links between physiological and psychological stress markers in athletes are explained by the use of Cognitive Activation Theory of Stress (CATS). Correlations revealed an association between one perfectionism factor (concern over mistakes) and the recovery scale (balance between training and recovery), practically meaning there might be a relationship between breathing problems and reduced recovery. However, a mastery climate may protect the swimmers against both perfectionism and burnout, helping their recovery in the long run. In conclusion, there is evidence that we need more research about this possible (breathing) stress-recovery imbalance in order to identify under recovery and avoid more severe negative consequences for elite swimmers.

Introduction

The numbers of swimmers diagnosed with breathing problems are presently rising. Coaches have therefore realized that this issue should be integrated in the planning of the swimmers training programs. A prevalence of exercise induced asthma (EIA) and bronchial hyper responsiveness (BHR) is elevated especially amongst elite endurance athletes, and, in addition, this problem has increased markedly over the last three decades (7, 8, 12, 23). For a coach this means that swimmers may be prone for trouble as well. In fact, swimmers may be particularly exposed for trouble, because the inhalation of chlorine is thought to be an airway provoking factor during training and competitions (3). Recently, coaches and swimmers have asked us whether breathing problems could be worse in more stressful periods.

Many endurance sports require hard training regimes. Swimming is by no means an exception. Some argue that swimming is one of the most physically and mentally demanding of all sports, because it comprises of hard in-water and out-of-water training program (20). Thus, Treasure and his colleagues (20) point out that these athletes are part of a high-risk group for experiencing overtraining and burnout. Besides the hard training routine, many of the swimmers are students and have school requirements to meet, with their two passes a day usually accomplished before and after school. Then, the swimmers commit to their homework in the evenings. In other words, they have to adhere to a strict regime in order to succeed in their sport while simultaneously be a good student. The total stress load they are exposed to might be exacerbated by breathing problems that impede their recovery process.

One theory that considers both physical and psychological stress as part of the total load (i.e. stress stimuli or stressor), is the Cognitive Activation Theory of Stress (CATS; 22). According to CATS the stress load is not harmful per se. However, the load might elicit a stress response with an increased wakefulness and brain arousal. This is termed activation in CATS. If the total load is not too severe or too prolonged, it might lead to training of the ability to tackle this load. On the other hand, if the load and its subsequent activation are high and sustained over a long time, the increased arousal levels will lead to straining and possible health problems. These problems include changes in immune functions. Considering the total load of the swimmers, and possible lack of restitution, the aim of this preliminary investigation is to test if there are any links between breathing problems, and physiological and psychological recovery (or perceived lack thereof) in elite swimmers.

Methods

Participants

Twenty-four elite competitive swimmers were included in the study, 15 male and nine female swimmers (range 15-25 years, *Mage* = 18.25 years, SD = 1.60), from two swimming clubs in Norway. At the time of the study completion, all athletes were competing at a high national and/or international level. They were training at least a minimum of 2-3 hours daily. At the same time they were full time students at different high schools/universities. Four swimmers had a diagnosis of asthma and five had a diagnosis of allergy when starting the testing. In reality then, a total of nine swimmers (37.5 %) used anti-allergic or anti-asthma drugs before the study commenced. In comparison, the number of asthma diagnosis in the normal population among children (10 years old) is 11.1% (14), and for 20-44 year olds in the Nordic countries the figure is 6-11% (9).

Procedure

Contact with the swimmers was made through their clubs, and some also volunteered to take part in the research project themselves. Informed consent was obtained from all participants and the investigation was conducted in accordance with ethical and national research guidelines. The adolescent swimmers performed one Methacholine challenge and two Eucapnic voluntary hyperventilation (EVH) tests. EVH is an indirect test for bronchial hyperresponsiveness (BHR) and act through the same mechanisms as exercise, through dehydration of the airways causing mediator or transmitter release effecting on bronchial smooth muscles, bronchial vessels and glands (1). Methacholine provocation is a direct measurement of BHR with methacholine acting directly on the effector cells (2). In addition, the swimmers completed a questionnaire package that consisted of scales measuring perfectionism, burnout, recovery and perceived motivational climate.

Research protocol

15 male and nine female adolescent swimmers performed one Methacholine challenge (determination of the methacholine dose causing 20% fall in forced expiratory volume in the first second (FEV_1; PD_{20}) and two EVH tests in randomized order. Dry air containing 5% CO_2 was inhaled with a target ventilation of ≥85 % MVV (minimum 65%) over a time period of 6 minutes. The positive result definition was according to the criteria suggested by the

International Olympic Commission – Medical Committee (IOC-MC; Methacholine challenge: $PD_{20} \leq 2$ µmol; EVH: ≥10% decrease in FEV_1). The entire protocol is thoroughly explained by Stadelmann and colleagues (19).

<u>Psychological measurements</u>
Translated versions of the different questionnaires were used in the psychological questionnaires package. Due to brevity, information about the psychometrics of these instruments are reported in previous studies for Norwegian language (see appendix), with one exception. The recovery scale has previously been utilized to a lesser degree, although the present investigation lends preliminary support for the instrument's properties, revealing results that are comparable to previous findings.

Motivation: The motivational climate was measured with the Perceived Motivational Climate in Sport Questionnaire (PMCSQ; 18), and it consists of two valid and reliable subscales; the mastery and performance climate scales. Responses were indicated on a 5-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5).

Recovery: To measure to what degree the swimmers were good at getting enough recovery we used part of the Training practice Inventory scale (11). The part included here has three different parts; the different types of recover, finding the balance between training and recovery and finally knowledge about the signals from their own bodies. The different items were indicated on a 7-point Likert scale ranging from *not correct* (1) to *completely correct* (7).

Perfectionism: The athletes' perfectionist dispositions were measured using the Multidimensional perfectionism scale (MPS; 5). The sport specific version of the MPS (e.g., 6) is a five-subscale, 29-item assessment tool. The five subscales are personal standards, concern over mistakes, doubts about actions, parental expectations and parental criticism. Perfectionism scores were recorded on a 5-point Likert scale, anchored by *strongly disagree* (1) and *strongly agree* (5).

Burnout: The 15-item sport specific Athlete Burnout Questionnaire (ABQ; 16), were used to measure Burnout. The questionnaire has three different subscales, reduced sense of accomplishment, emotional and physical exhaustion and devaluation of sport participation. Burnout scores were recorded on a 5-point Likert scale, anchored by *almost never* (1) to *almost always* (5).

Discussion

15 of 24 swimmers had at least one positive test result to either one of the EVH tests or to the methacholine challenge ($PD_{20} \leq 2$ µmol). When coding the swimmers as responsive or not responsive, we found evidence for a correlation between BHR and psychological variables which included some significant and meaningful results, despite that the study has a low number of participants. BHR correlated negatively with accomplished recovery (-.44, $p<.05$), and positively with perfectionism (concern over mistakes .44, $p<.05$), see table 1.

Table 1

Pearson Correlations among Variables and Cronbach's alpha for each variable

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	α
1. Methacholine test	--															-
2. EVH	**.66**	--														-
3. MC	.25	.14	--													.77
4. PC	.30	.22	-.12	--												.75
5. Rec - types	-.40	**-.44**	-.08	.21	--											-
6. Rec - balance	-.26	**-.33**	-02	-.00	**.51**	--										-
7. Rec - knowledge	.04	-.09	-.16	.13	.37	.35	--									-
8. Perf – pers. stand.	.04	-.18	-.01	.36	.26	.26	.10	--								.82
9. Perf – conc. mis	**.49**	.24	-.04	**.59**	-.09	.12	.01	**.50**	--							.75
10. Perf – doubts act	-.09	**-.**19	**-.45**	.12	-.27	-.40	-.24	.07	.30	--						.65
11. Perf – parent. ex.	.04	**-.**26	-.15	**.55**	.28	.19	.17	**.49**	**.56**	.29	--					.72
12. Perf – parent. cri.	.05	-.06	**-.45**	**.43**	.21	.05	.26	.27	**.64**	.33	**.66**	--				.81
13. ABQ – exh.	-.03	.20	-.20	-.29	-.39	**-.48**	-.25	-.18	-.11	.19	-.33	-.12	--			.64
14. ABQ – red. acc..	.23	.00	-.17	-.20	-.23	.17	.06	-.17	.17	.16	-.10	.05	.26	--		.76
15. ABQ – dev.	-.11	.19	**-.43**	-.06	-.27	-.38	**-.48**	-.37	.15	.38	-.17	.27	**.53**	**-.52**	--	.75

Significant correlations are in bold ($p < .05$) and bold underline ($p < .01$), two-tailed test

This preliminary investigation emphasizes two points: The first is physiologically related, concerning the fact that the prevalence of bronchial hyper responsiveness (BHR) among these elite swimmers is alarmingly high. Breathing problems may lead to underperformance, although BHR is rarely mentioned as a physiological marker for overtraining (15). Secondly, there seem to be a research cavity on the possible links between physiological and psychological stress markers in athletes, the way for instance predicted by CATS (4, 22). Hence, there is a need for further investigations on potential health related problems and possible associations between prolonged stress load and physiological problems concerning elite athletes.

Although there is no established cause and effect here, this preliminary investigation discovered an association between one perfectionism factor (concern over mistakes) and the recovery scale (balance between training and recovery), which points to a likely relationship between breathing problems and markers for reduced recovery. That the occurrence of exercise induced asthma (EIA) and bronchial hyper responsiveness (BHR) amid elite endurance athletes has been on a rise over the last decades (7, 8, 12, 23), may in some regard be related to the total load the athletes undergo; whether it is physical, psychological or a combination of both. As predicted by CATS (4, 22), if the total load becomes elevated (i.e. excessive training due to perfectionism *and* additional respiratory issues), the recovery of athletes might suffer. Future investigations should approach these issues both from applied and ethical perspectives: it may help athletes perform better without causing them health problems.

Conclusion

The study intended to break ground into a new are of study, which also have applied implications. First of all, we would like to underscore the relationship between the perceived motivational climate and the association with burnout and perfectionism. These associations are predicted by theory (13) and may be important for coaches to consider. The present results highlight that perceptions of a performance climate together with perfectionism (concern over mistakes and parental criticism and expectations) could force athletes to train excessively hard over time. This might degrade their recovery and recuperation. A lot more promising for coaches were the finding that athletes' perceptions of a mastery climate correlated negatively with doubts over action, parental criticism and also one of the burnout subscales (sport devaluation). Coaches that emphasize a mastery climate may protect the swimmers against both perfectionism and burnout, helping their recovery in the long run.

The second important issue is related the association between reduced recovery and increased exhaustion and sport devaluation. Evidently, when athletes are not been given enough time to rest, it may be hard to endure a hard training regime and motivation might diminish. The influential role that significant others (such as coaches) may have on athletes dealing with stress related issues is imperative (21). In an individual sport, like swimming, coaches and athletes have more opportunities to develop deeper and more interdependent relationships than in team sports (10). To communicate and adapt individually, the training-recovery-schoolwork nexus is paramount. The total load (parental pressure, massive training, and unsuccessful recovery) may be a central concern for coaches, both in training and competition. The coaches must know their swimmers and *trust* them when they say that they have breathing problems during a workout. Pushing athletes that struggle more than they are comfortable with could be extra difficult for swimmers with asthma. Especially care should be made when they for example have a cold, or perceives an extra load of stress (from school, federations, team or parents) that may affect their recovery time.

The participants in this study talked openly about breathing problems being tenser in the aforementioned situations, and a trustful coach-athlete relationship benefitted their recovery and how they approached training on the tougher breathing days. If they felt that the coach did not believe, them, the consequences would be that they were even more susceptible for problems during the following training. In other words and in accord with CATS (4), both physical and psychological stress as part of the total load may elicit breathing problems among elite swimmers. Applied sport psychology consultants helping such athletes, should carefully monitor the total load, and not give home assignments that exacerbate the problem with an increased workload.

Finally, perfectionism was positively correlated with asthma and perceptions of a performance climate, but no significant relationship to recovery and perfectionism was revealed. This is at odds with previous research; that has found a positive relationship of under-recovery and perfectionism to burnout (13). To settle this issue, more research is needed. Strain from a hard training regime and ambitions in school may lead to higher perception of stress. Recollecting that stress and burnout is related (e.g., 17), burnout may eventually have a negative impact on physical and psychological well-being, although our claim that bronchial hyper responsiveness is one of the signs for coaches to look out for is, to our knowledge, original.

<u>Limitations</u>
Being a preliminary investigation, the present study has some limitations. First of all, only 24 swimmers participated in this study. The reason is that testing bronchial hyper responsiveness is rather expensive. The psychological measurements were an additional extension, which is easier and less costly to complete. However, we are currently collecting more data to be able to be more precise about these relationships, and urge others to do likewise. Second, this is not a longitudinal study. Monitoring elite athletes in studies spanning several years, conducting both physical and psychological tests regularly, would again help us to gain more knowledge and give a better understanding of these complex relationships. In conclusion, there is evidence that we need more research about this possible (breathing) stress-recovery imbalance in order to identify under recovery and avoid more severe negative consequences for elite swimmers.

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Appendix

Table 2

Previous alpha for the translated versions (into Norwegian) of the four questionnaires

Questionnaire	Alpha of different subscales	Study
PMCSQ – motivational climate (Seifriz et al., 1992)	Mastery climate α =.81 Performance climate α =.79	Lemyre et al., (2008).
ABQ - Burnout (Raedeke & Smith, 2001)	Phys. and emotional exhaustion α =.81 Reduced sense of accomplishment α =.82 Sport devaluation α =.72 Total burnout α =.87	Lemyre et al., (2008).
MPS - Perfectionism (Hall et al., 1889)	Personal standards α =.77 Concern over mistakes α =.81 Doubts about action α =.69 Parental expectations α =.84 Parental criticism α =.74	Lemyre et al., (2008).
Recovery	This instrument is currently under development. Please refer to Kenttä & Hassmén (1999)	