## From the Editor

## Fatigue, Performance, and Overtraining

lmost by definition, the perform-Ance of dance, music, or any other performing art involves physical exertion of some type and some degree. In most performances, the amount of energy expended appears to be substantially higher than the resting state but significantly lower than many athletic events that last about the same amount of time. Performing artists and performing arts medicine specialists have long been interested in the interactions between physical exertion and the quality of the artistic effort. Does some amount of physical activity actually improve performance through a "warm up" effect? At what point does the amount of physical activity expended start to cause lower quality of the performance? What role does mental versus physical fatigue play? The article by Drinkwater and Klopper<sup>1</sup> in this issue of the journal provides new information on how fatigue during a performance may affect the quality of the music produced.

It is worth reviewing how Drinkwater and Klopper designed their study so that we can draw appropriate conclusions from the data. They studied a convenience sample of 10 wind instrumentalists (six woodwind, four brass) with a wide range of playing experience and age. We do not know the gender mix or baseline fitness of the study participants. Each of them played a self-selected piece of music that lasted 10 minutes, then rested for 3 minutes, played the same piece again, rested for 3 minutes again, and then played the piece for a third time. Various physiologic parameters were measured at rest and after each 10minute performance, and self-ratings of perceived exertion and anxiety were recorded. The performances were then analyzed for errors.

In a nutshell, the data showed that the number of errors was lowest during the second performance and highest during the third, even though all of the physiologic indicators of exertion increased steadily from rest through the three performances. The authors attribute the increase in errors to fatigue, but some caution is warranted in drawing this conclusion. Without the individual data correlating the indictors of exertion with error rates, it's hard to know how strong the association between fatigue and error is. While Drinkwater and Klopper collected data showing that the performers' anxiety levels decreased during the course of the three renditions, it is possible that the musicians were bored by the third performance. Future studies with more participants and different instruments will improve our understanding of the effects of fatigue on the quality of performance.

If it turns out to be true that playing a musical instrument for 30 minutes is fatiguing and that fatigue causes a higher error rate, we should be able to design interventions that could improve the quality of performance. It is possible that instrumentalists should be doing more aerobic exercise, not only for the physical and mental health benefits but to be better musicians. While we don't have a lot of data on the aerobic exercise habits and fitness levels of musicians, aerobic training has not been widely recommended for or practiced by musicians. I am not aware of any studies that have used aerobic exercise as a means of preventing injuries or improving performance. Dr. Brandfonbrener's study of orchestral musicians<sup>2</sup> used strengthening and flexibility exercises.

Such a finding could also lead to a change in practice schedules, since many wind, string, and keyboard musicians currently practice for much more than 30 minutes continuously without so much as a 3-minute break. It is not

uncommon for instrumentalists (especially pianists and string players) to tell me that they practice for 2 hours before taking a break. How much benefit are they really getting after the first half hour? How much faster might they improve, and how many fewer injuries might they incur, if they were to take more frequent breaks?

The preliminary findings in the Drinkwater and Klopper study also raise the question of whether instrumentalists might be suffering from "overtraining syndrome." If playing a wind instrument for 30 minutes once causes measurable fatigue, it is possible that playing an instrument for 30 hours/week over many months may, in some individuals, lead to cumulative damage that results in both physical and mental health problems.

Overtraining syndrome is defined as "a prolonged maladaptation (to physical exercise) of multifactorial origin,"3 typically in athletes who are training at an intense level. A recent study of college athletes in the US showed that 50% reported chronic injury, with over 30% of men and over 25% of women feeling physically exhausted frequently during their competition season.4 Women were more likely to suffer from chronic injury, whereas men were more likely to have acute injuries, and training intensity levels correlated with exhaustion.4 These student-athletes were averaging 2 to 3 hours of moderate to high-intensity training per day, 4 to 5 days/week year round in addition to lighter training and leisure physical activity.4 Abnormalities of hormone levels (e.g., cortisol) have been described in athletes with this condition.3

How might overtraining syndrome apply to instrumentalists? Many university and professional musicians "train" (practice and rehearse) at least as many hours per day as the student-athletes mentioned above. Chronic injury rates for orchestral musicians in the ICSOM study<sup>5</sup> were similar to the 50% point prevalence rate for university athletes,4 and two studies on instrumentalists have reported that about 15% of those with a performance-related musculoskeletal disorder still had persistent symptoms 1 year after initial presentation.<sup>6,7</sup> It is well accepted that female instrumentalists have a higher injury rate than do male instrumentalists, even after controlling for instrument,8 concordant with the higher chronic injury rate in the female student-athletes.4

The full spectrum of symptoms affecting athletes with overtraining syndrome includes not only the physical but also the mental/emotional.3 Anyone who has seen musicians with more chronic "overuse syndrome" symptoms has observed the same phenomenon: in addition to a combination of specific and ill-defined somatic complaints, the patient often describes symptoms consistent with depression and other affective disorders. The latter are frequently thought to be secondary to not being able to play their instrument and advance their career, but they may be a more intrinsic part of an overtraining syndrome.

One of the interesting aspects of overtraining syndrome is that the complexity of its effects (i.e., the symptoms and objective abnormalities) is probably mirrored by the multiple factors that contribute to its evolution. While one theory is that overtraining syndrome is caused by excessive physical training, an alternative theory holds that it results from the combination of several factors. including both training and nontraining related events.<sup>3</sup> This, too, will sound

familiar to experienced performing arts medicine professionals: the violinist who was doing well until the end of a relationship, when left arm discomfort developed; the pianist who struggled with hand symptoms after the death of a parent; the flutist whose neck pain became unmanageable coincident with the arrival of a new conductor.

oth performing artists and perform-B oth performing areas and ing arts medicine professionals have to choose among competing priorities when deciding on preventive and therapeutic strategies, and we are often making these decisions with a dearth of high-quality scientific evidence to guide us. We don't have randomized controlled trials of intensive vs moderate practice loads or constant vs periodized schedules, and we probably won't in the foreseeable future. Lacking those, it may be useful to look at the conclusions of a paper written by several physicians and scientists on the prevention of physical training-related injuries. 10 They used a multistep process to review 40 prevention strategies that had been studied and published in peer-reviewed journals. In addition to education, leader support, surveillance and research, the first recommended intervention was overtraining prevention. While the overlap between the physical training that is done by army recruits and the musical training that instrumentalists do is far from complete, it is worth some thought.

While it may be shown in the future that musicians with chronic performance-related pain have a totally different set of physiologic aberrations than do athletes with overtraining syndrome, the process of looking for the markers of overtraining syndrome in musicians will probably be a fruitful

undertaking. Even if we don't find a direct explanation, there's a good chance that we will make other discoveries that will improve our understanding of this puzzling clinical scenario. At the same time, we should do similar studies in dancers and other performing artists with chronic performancerelated pain.

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- 1. Drinkwater EJ, Klopper CJ. Quantifying the physical demands of a musical performance and their effects on performance quality. Med Probl Perform Art 2010;25:66-71.
- Brandfonbrener AG. Report on a multiorchestra injury prevention program. Presented at the 10th Annual Symposium on Medical Problems of Musicians and Dancers, Aspen, CO, June 1992, pp 2-5.
- Roose J, deVries WR, Schmikli SL, et al. Evaluation and opportunities in overtraining approaches. Res Q Exerc Sport 2009; 80(4):756-764.
- Vetter RE, Symonds ML. Correlations between injury, training intensity, and physical and mental exhaustion among college athletes. J Strength Condition Res 2010; 24(3):587-596.
- Fishbein M, Middlestadt SE, Ottati V, et al. Medical problems among ICSOM musicians: overview of a national survey. Med Probl Perform Art 1988; 3:1-8.
- Knishkowy B, Lederman RI, Instrumental musicians with upper extremity disorders: a follow-up study. Med Probl Perform Art 1986; 1:85-89.
- Manchester RA, Lustik S. The short-term outcome of hand problems in music students. Med Probl Perform Art 1989; 4: 95-96.
- Manchester RA, Flieder D. Further observations on the epidemiology of hand injuries in music students. Med Probl Perform Art 1991: 6:11-14.
- Manchester RA. Periodization for performing artists? Med Probl Perform Art 2008; 23:45-46.
- 10. Bullock SH, Jones BH, Gilchrist J, Marshall SW. Prevention of physical training-related injuries. Am J Prev Med 2010; 38(1S):S156-S181.

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