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Pain and pain tolerance in professional ballet dancers

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Pain experience in sport had been the subject of increasing research in recent years. While sports professionals have generally been found to have higher pain thresholds than control subjects the reasons for this are not entirely clear. The present study seeks to investigate one possible explanatory factor, the importance of the popular image of the physical activity and of the self-image of its participants, by examining pain experience in professional ballet dancers. Like sports professionals, dancers were found to have higher pain and pain tolerance thresholds than age matched controls in the Cold Pressor Test. However, they also reported a more acute experience of the sensory aspects of the pain. Explanations of this apparent paradox are discussed both in terms of the neuroticism scores of the two groups and in terms of the dancers' greater experience of pain and its relationship with physical activity. The results illustrated the importance of using multidimensional measures of pain in this type of investigation.

Keywords: pain, threshold, tolerance, ballet dancers, cold pressor test

Pain experience in sport has been the subject of increasing research in recent years^{1–6}. Some studies have yielded equivocal results while others have supported the apocryphal accounts of pain due to sporting injuries often being experienced only after the competition is over. Differences in pain tolerance have been found among different sports disciplines⁷, with possible divisions emerging between individual and team sports⁸ and contact and noncontact sports⁹. Numerous variables have been considered in seeking to explain higher pain tolerance in sports participants, including anxiety¹⁰, stress¹¹, fitness¹², personality¹³, cultural background¹⁴ and coping strategies¹⁵.

Overall, this type of research has highlighted previously unexpected complexities in pain experience and has certainly raised more questions than it has answered for those with a professional interest in sport.

A so far unexploited category of subjects which may help us to understand some of the complexities of this aspect of pain experience is that of professional

ballet dancers. While having many characteristics in common with professional sports people, for example, the rigorous training, self discipline, physical fitness, competitiveness and performance anxiety, ballet is seen as quite separate from sport. As a major branch of the performing arts, ballet is associated with beauty, grace and sensitivity and has none of the 'winning is all', slightly aggressive image of professional sport. It is of interest to know whether this fundamental difference in culture and the consequent differences in self image between dancers and sports people has implications for pain experience.

Pain experience in ballet dancers is anyway an issue worthy of investigation in its own right. A survey of injuries to dancers¹⁶ revealed that 47% of those investigated had experienced chronic injury and 42% had suffered an injury in the previous 6 months that had prevented them from performing. Moreover, the author of this survey has expressed the opinion that this is likely to be an under estimate. Certainly there is great concern among both the dancers and the management of dance companies about the present rate of injuries. A serious injury may have a detrimental effect on a dancer's entire career, while high rates of injury among dancers have financial consequences for the company as a commercial organization.

Sometimes dancers are reluctant to report injuries to management for fear of losing roles or being considered unreliable. However, failure to report injury may, in turn, result in the development of additional compensatory injuries and increased severity of the original injury. Such chronic injuries will inevitably take longer to treat when medical advice is eventually sought and are likely to result in the dancer needing long periods of time off work. Thomassen¹⁷ collected data from 760 dancers, almost all of whom reported chronic rather than acute symptoms. High pain tolerance among ballet dancers would, of course, help them to perform despite minor injuries and thus invite the development of chronic, long-term injuries. An understanding of the pain experience and pain tolerance of dancers is therefore important both in terms of protecting the career of individual dancers and to inform the planning of those who manage ballet companies.

In the present study pain and pain tolerance thresholds of professional ballet dancers and control subjects were compared using the Cold Pressor Test.

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Measures of coping styles, extraversion/introversion and neuroticism were also taken in order to help in interpreting the findings.

Method

A total of 105 subjects took part in the study. Of these, 52 were professional ballet dancers from a national ballet company, the remaining 53 subjects being control subjects selected from students at a university institution. There were equal numbers of male and female dancers and, within the ballet group, ages ranged from 18 to 45 years (mean(s.d.) 25.3(6.0) years). Within the control group there were 27 men and 26 women. Ages ranged from 18 to 52 years (mean(s.d.) 24.3(5.9) years).

Subjects were told that this was a study of aspects of pain but given no further information regarding objectives at this stage. They were than asked to complete the Miller Behaviourial Style Questionnaire (MBSQ) and the Eysenck Personality Inventory (EPI) before being given the Cold Pressor Test.

The MBSQ assesses the subjects' coping style, distinguishing between 'Monitors' (who seek further information about a threat situation) and 'Blunters' (who seek to distract themselves from information relevant to the threat). The EPI gives a measure of the subjects' introversion/extraversion and neuroticism.

The Cold Pressor Test is a standard laboratory technique used to measure pain and pain tolerance thresholds. The subject's hand is immersed in luke warm water (37°C) for 2 min to provide a baseline condition, before being placed in a bowl of iced water. The subject is then asked to indicate both when it begins to hurt (pain threshold) and when the pain becomes intolerable (pain tolerance threshold) at which point the subject is asked to remove his or her hand from the water. The times taken to reach the pain, and pain tolerance/threshold are measured in seconds. A cut-off point of 120 s is imposed, subjects being instructed to remove their hand from the water then if they had not already done so.

Immediately after the Cold Pressor Test subjects were asked to report on their pain by responding to items on the Short Form McGill Pain Questionnaire (SFMPQ)¹⁸ read to them by the experimenter. The SFMPQ consists of 15 descriptors (11 sensory, four affective) which are rated on a three-point intensity

scale (0 = no pain, 2 = moderate pain, 3 = severe pain). Three pain scores are derived from the intensity readings of sensory, affective and total descriptors, respectively. The SFMPQ also yields two further measures of pain, present pain intensity (PPI) which is a measure of overall pain intensity, and a visual analogue score (VAS), given by the subjects rating his/her pain experience on a linear scale.

At the end of the experiment each subject was given a full explanation of the nature and objectives of the study and invited to ask questions if they wished.

Results

The mean and standard deviations of all the pain measures employed in this study are given in *Table 1*.

Most notably dancers had significantly higher pain thresholds and pain tolerance thresholds than non-dancers ($F(d.f.1,101) = 38.48, P < 0.001$ and $(F(d.f.1,101) = 80.63, P < 0.001$ respectively). On both measures there were also sex differences ($F(d.f.1,101) = 6.08, P < 0.05$ and $(F(d.f.1,101) = 5.62, P < 0.05$, respectively) men having both higher pain and pain tolerance thresholds than women, but there was no significant interaction between subject groups and sex. These pain thresholds and pain tolerance threshold findings are also shown graphically in *Figures 1* and *2*.

Interestingly, while having higher pain and pain tolerance thresholds than controls the dancers also reported significantly more pain in the Cold Pressor Test. On three of the five pain experience measures dancers gave significantly higher scores (total pain score (TPS) $F(d.f.1,101) = 12.22, P = 0.001$; sensory pain score (SPS) $F(d.f.1,101) = 8.75, P < 0.01$; affective pain score (APS) $F(d.f.1,101) = 7.10, P < 0.01$; visual analogue score (VAS) $F(d.f.1,101) = 5.83, P < 0.05$ and present pain intensity score (PPIS) $F(d.f.1,101) = 4.35, P < 0.05$). On none of the pain measures did analysis of variance reveal sex differences or sex by group interactions. The various pain measures for dancers and nondancers are shown graphically in *Figure 3*.

As noted above, subjects in the present study were also tested on personality and coping style measures in order to facilitate interpretation of any pain differences which might emerge. However, only in

Table 1. Pain measures employed in the present study

	Dancers			Nondancers		
	Male	Female	All	Male	Female	All
Pain threshold (s)	67.5(43.5)	43.8(36.3)	55.5(41.4)	21.4(19.7)	15.9(10.5)	18.7(15.9)
Pain tolerance (s)	106.4(23.5)	94.5(36.0)	100.3(30.8)	54.1(37.3)	37.0(26.1)	45.5(33.0)
TPS	9.1(6.5)	9.9(5.2)	9.5(5.8)	5.3(3.1)	7.1(3.9)	6.2(3.6)
SPS	6.7(4.7)	8.0(4.1)	7.4(4.4)	4.4(2.8)	5.9(3.4)	5.1(3.2)
APS	2.4(2.6)	1.9(2.6)	2.2(2.6)	0.9(1.1)	1.3(1.7)	1.1(1.4)
VAS	2.7(1.2)	2.7(1.3)	2.7(1.2)	2.0(0.8)	2.4(0.9)	2.2(0.9)
PPIS	2.4(1.3)	2.9(1.3)	2.6(1.3)	2.1(0.8)	2.2(0.9)	2.2(0.8)

Values are mean(s.d.); TPS, total pain score; SPS, sensory pain score; APS, affective pain score; VAS, visual analogue score; PPIS, present pain intensity score

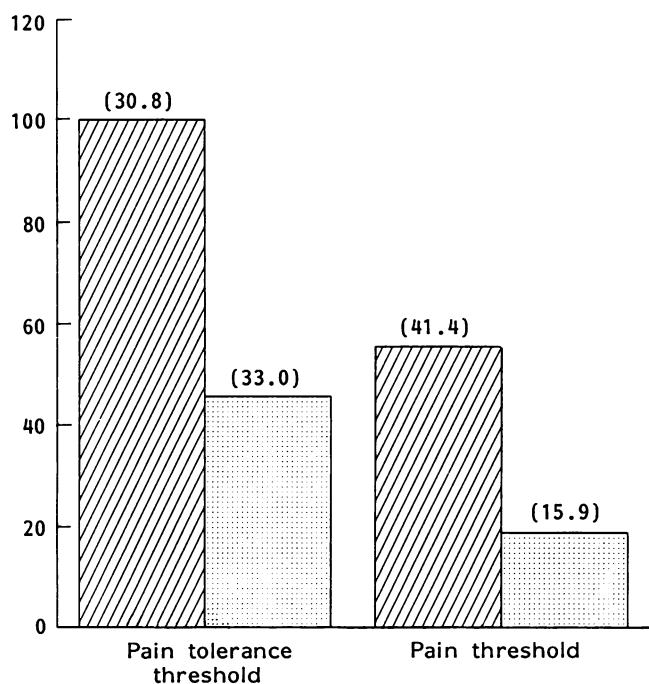


Figure 1. Mean pain and pain tolerance thresholds in seconds for dancers and nondancers. (Standard deviations are shown in brackets.) □, dancers; ▨, nondancers

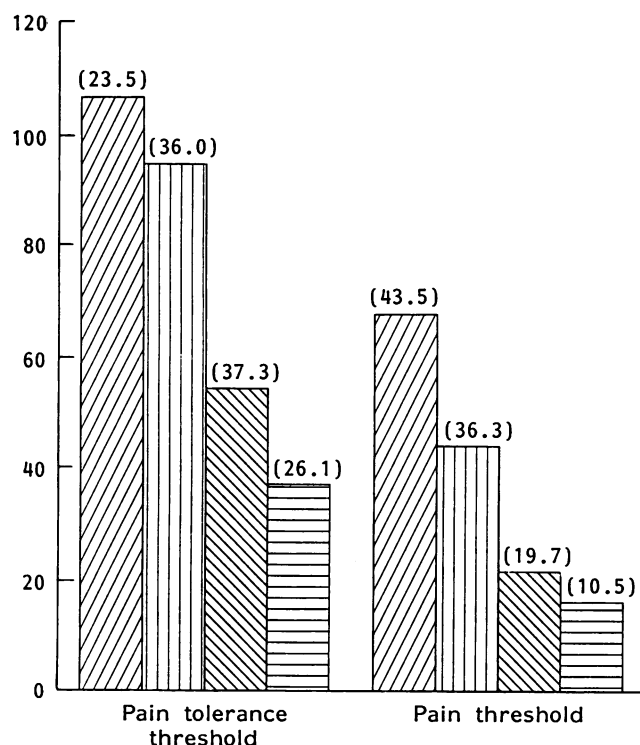


Figure 2. Mean pain and pain tolerance thresholds in seconds for male and female dancers and nondancers. (Standard deviations are shown in brackets.) ▨, dancers (male); ▩, dancers (female); ▧, nondancers (male); ▦, nondancers (female)

Table 2. Summary of significant F values from analyses of variance carried out in the present study

Measure	F (d.f.)	Significance
Pain threshold:		
Main effect dance	38.49(1,101)	$P < 0.001$
Main effect sex	6.08(1,101)	$P < 0.05$
Pain tolerance:		
Main effect dance	80.63(1,101)	$P < 0.001$
Main effect sex	5.62(1,101)	$P < 0.05$
TPS:		
Main effect dance	12.22(1,101)	$P = 0.001$
SPS:		
Main effect dance	8.75(1,101)	$P < 0.005$
APS:		
Main effect dance	7.10(1,101)	$P < 0.01$
VAS:		
Main effect dance	5.83(1,101)	$P < 0.05$
PPIS:		
Main effect dance	4.35(1,101)	$P < 0.05$
Neuroticism score:		
Main effect dance	5.02(1,101)	$P < 0.05$

d.f., degrees of freedom; TPS, total pain score; SPS, sensory pain score; APS, affective pain score; VAS, visual analogue score; PPIS, present pain intensity score

terms of neuroticism was there a significant difference between dancers and nondancers ($F(d.f.1,101) = 5.02, P < 0.05$), the former having higher scores than the latter. In terms of extraversion/introversion and coping style dancers and nondancers did not differ. Nor did they differ statistically in age.

Significant F values in the present analyses are summarized in Table 2.

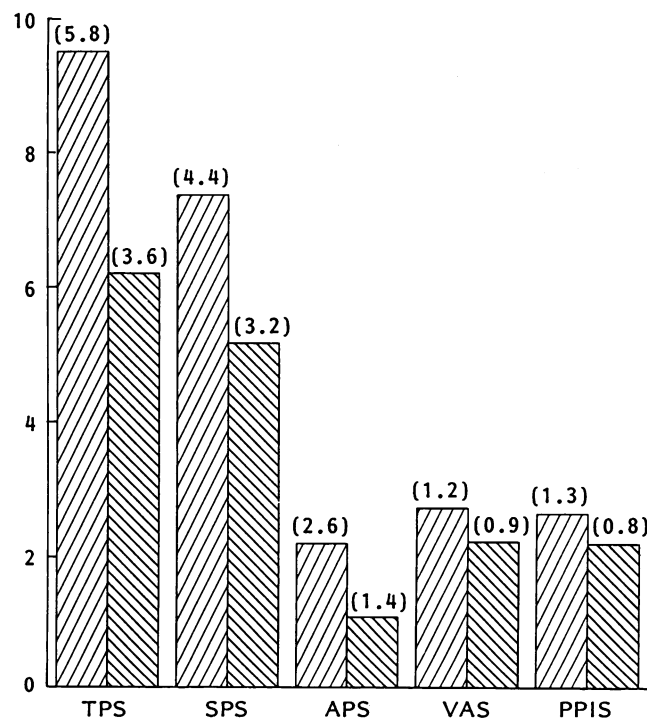


Figure 3. Means of the various pain measures for dancers and nondancers. (Standard deviations are shown in brackets.) ▨, dancers; ▩, nondancers, TPS, total pain score; SPS, sensory pain score; APS, affective pain score; VAS, visual analogue score; PPIS present pain intensity score

Discussion

The present study has clearly demonstrated higher pain and pain tolerance thresholds among professional ballet dancers than among age matched control subjects. In this respect there is a clear similarity between professional sports people and professional ballet dancers, despite the very different 'cultures' and self-images associated with the two categories of subjects.

In the case of the ballet dancers the raised thresholds cannot be explained in terms of differential coping strategies. Nor are they likely to be due to differences between dancers and controls in terms of neuroticism – the direction of those differences (higher neuroticism scores in dancers) would lead to the prediction of lower rather than higher pain thresholds. Equally, given the relaxed and indeed somewhat artificial nature of the test situation, any explanation in terms of differential anxiety or stress is unlikely. Finally, the differences in threshold between dancers and control subjects cannot be explained in terms of age or sex since the groups were matched with respect to these characteristics.

The most likely explanation of the higher pain and pain tolerance thresholds in ballet dancers than in controls lies in their greater exposure to physical training and their increased fitness. Not only does such an interpretation explain the similarity between professional dancers and professional sports people in this respect, there is considerable support for it in findings of increased levels of circulating endogenous opioids resulting from physical exercise¹⁹.

However, in the opinion of the authors it would be a mistake to overlook the possible contribution of psychological factors to the present findings. In the course of their physical training and performance regimens both dancers and sports people explore boundaries and relationships between extreme physical activity and pain experience in a way in which most of us do not. This necessarily gives them a familiarity with the interface between physical activity and pain experience which, in turn, may give an understanding of, and even a perception of control²⁰ over that interface. The perception of some degree of control of pain experience would stand in sharp contrast to the perception most of us have of painful events as unwanted, unpredictable and uncontrollable, and might well explain the threshold findings reported here.

This type of interpretation might also help to explain the finding that despite higher pain tolerance thresholds the dancers experienced the pain encounter more acutely than the controls. The dancers' greater familiarity with pain may make them more objective observers of its characteristics. Of course this aspect of the present findings would also be predicted from the higher neuroticism scores in the dancers than in the controls.

However, the dissociation between effects on pain thresholds and on aspects of pain experience raises an issue which we feel has received insufficient attention in studies of pain in sportsmen and women.

Almost without exception such studies have relied upon threshold measures to the exclusion of more sophisticated multidimensional measures of pain. In so doing valuable information may have been lost, making it more difficult to arrive at a correct interpretation of the threshold data.

In terms of the training and management of ballet dancers the present findings provide a cogent argument for an open and cooperative regimen in which dancers are helped to understand the relationship between their pain and physical activity. Such a regimen would facilitate superior performance while at the same time minimizing injuries and would help to avoid the sort of chronic injuries which can be so damaging both to the individual dancer and his/her company. The meaning of pain, the importance of acknowledging pain and of learning how to respond to it should be targeted as early as possible in a dancer's training.

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