

- 11 Ismail AH, El-Naggar AM. Effect of exercise on cognitive processing in adult men. *J Hum Ergol (Tokyo)* 1981;10:83-91.
- 12 Gondola JC, Tuckman BW. Effects of a systematic program of exercise on selected measures of creativity. *Percept Mot Skills* 1985;60:53-4.
- 13 Tuckman BW, Hinkle JS. An experimental study of the physical and psychological effects of aerobic exercise on school children. *Health Psychol* 1986;5:197-207.
- 14 Zevras Y, Danis A, Klissouras V. Influence of physical exertion on mental performance with reference to training. *Percept Mot Skills* 1991;72:1215-21.
- 15 Gondola JC. The enhancement of creativity through long and short term exercise programs. *Journal of Social Behaviour and Personality* 1986;1:77-82.
- 16 Gondola JC. The effects of a single bout of aerobic dancing on selected tests of creativity. *Journal of Social Behaviour and Personality* 1987;2:275-8.
- 17 Clarkson-Smith L, Hartley AA. Relationships between physical exercise and cognitive abilities in older adults. *Psychol Aging* 1989;4:183-9.
- 18 Clarkson-Smith L, Hartley AA. Structural equation models of relationships between exercise and cognitive abilities. *Psychol Aging* 1990;5:437-46.
- 19 Hassmén P, Blomstrand E, Ekblom B, Newsholme EA. Branched chain amino acid supplementation during 30-km competitive run: mood and cognitive performance. *Nutrition* 1994;10:405-10.
- 20 Adcock F. Labour of love. *Sunday Times, Style* 1995; December 10:8.
- 21 *Diagnostic and statistical manual of mental disorders (DSM-IV)*, 4th ed. Washington, DC: American Psychiatric Association, 1994.
- 22 Greene TR, Noice H. Influence of positive effect upon creative thinking and problem solving in children. *Psychol Rep* 1988;63:895-8.
- 23 Richards R, Kinney DK. Mood swings and creativity. *Creativity Research Journal* 1990;3:202-17.
- 24 Richards R, Kinney DK, Daniels H, Liskins K. Everyday creativity and bipolar and unipolar affective disorder: preliminary study of personal and family history. *European Psychiatry* 1992;7:49-52.
- 25 Eysenck HJ. *Genius: the natural history of creativity*. Cambridge: Cambridge University Press, 1995.
- 26 Andreasen ND, Glick ID. Bipolar affective disorder and creativity: implications and clinical management. *Compr Psychiatry* 1988;29:207-17.
- 27 Eisenman R. Creativity, preference for complexity, and physical and mental illness. *Creativity Research Journal* 1990;3:231-6.
- 28 Slaby AE. Creativity, depression and suicide. *Suicide Life Threat Behav* 1992;22:157-66.
- 29 Ludwig AM. Creative achievement and psychotherapy: comparison among professions. *Am J Psychother* 1992;42:307-20.
- 30 Weisberg RW. *Creativity: beyond the myth of genius*. New York: W H Freeman, 1992.
- 31 Boden M. *Dimensions in creativity*. London: MIT Press, 1994.
- 32 Torrance PE. *Torrance tests of creative thinking*. New Jersey: Personnel Press, 1966.
- 33 Jamison KR. *Touched with fire: manic depressive illness and the artistic temperament*. New York: Free Press, 1993.
- 34 Sachs ML, Buffone GW. *Running as a therapy: an integrated approach*. London: University of Nebraska Press, 1984.
- 35 Isen AM, Daubman KA, Nowicki GP. Positive effect facilitates creative problem solving. *J Pers Soc Psychol* 1987;6:1122-31.
- 36 Oaksford M, Morris F, Grainger B, Williams JMG. Mood reasoning and central executive processes. *J Exp Psychol Learn Mem Cogn* 1996;22:476-92.
- 37 McNair DM, Lorr M, Droppleman LF. Psychological effects of acute physical activity. *Arch Phys Med Rehabil* 1971;52:422-5.
- 38 Hendrick C, Lillie RS. Self-reported mood and running under natural conditions. *Work and Stress* 1970;7:161-77.
- 39 Steinberg H, Sykes EA. Mood enhancement through physical exercise. In: Shroder H, Reschke K, Johnston M, Maes S, eds. *Health psychology, potential in diversity*. Regensburg: Roderer Verlag, 1993.
- 40 Steinberg H, Salmon P, Morris M. The "runner's high": dimensions of mood states after running. In: *Proceedings of sport, health, psychology and exercise symposium 88*. London: Sports Council and Health Education Authority, 1990; 147-52.
- 41 Watson D, Clark LA, Tegellen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J Pers Soc Psychol* 1988;6:1063-70.
- 42 Sykes EA, LeBoutillier N, Moss T, Steinberg H. Dissociation between improvement of mood and creativity following exercise. *The British Psychological Society Sport and Exercise Psychology Section Newsletter* 1995;4:5-7.
- 43 Sykes EA, LeBoutillier N, Moss T, Steinberg H. Dissociation between improvement of mood and creativity following exercise [abstract]. *British Psychological Society Annual Conference* 1995;3:133.
- 44 Morris M, Steinberg H, Sykes EA, Salmon P. Temporary withdrawal from regular running. *J Psychosom Res* 1990;34:493-500.
- 45 Tomporowski PD, Ellis RN. Effects of exercise on cognitive processes: a review. *Psychol Bull* 1986;99:338-46.

### Commentary

If the sport and exercise sciences were ever asked to agree on a corporate slogan then a front runner undoubtedly would be "mens sane in corpore sano". Indeed, many seem to support this sentiment with a zeal that borders on the fanatical, and that can cloud the execution of a reasoned evaluation of the precise psychological benefits accruing from exercise.

Hannah Steinberg and her coworkers are to be encouraged for adding to a growing literature that at long last is prepared to acknowledge the complexity of the relation between psychological wellbeing and physical exercise. To develop this debate the first step must be a disaggregation of both the "mens" and the "corpora"—that is, which types of physical exercise (for example, aerobic or anaerobic, maximal or submaximal, massed or

distributed, short or long term) are related to which cognitive and affective functions. As this paper and previous work<sup>1-3</sup> show there are no simple answers here, complexity is writ large. Hence further empirical work of this nature is vital to add to our uncertainty before we can start to piece together the psychological, physiological, and contextual components of this fascinating jigsaw.

JOHN KREMER

*Reader in psychology  
The Queen's University of Belfast*

- 1 McMurray RG. Exercise, mood states and neuroendocrinology. In: Diamant L, ed. *Mind-body maturity, psychological approaches to sports exercise and fitness*. New York: Hemisphere, 1991:237-54.
- 2 North TC, McCullagh P, Tran ZV. Effect of exercise on depression. *Exerc Sport Sci Rev* 1990;18:379-415.
- 3 Willis JD, Campbell LF. *Exercise psychology*. Champaign, IL: Human Kinetics, 1992.