Letters to the Editor

Exercise and Diabetes

Dear Sir,

The affirmative response offered by Sherwin and Koivisto to their own question, "Does exercise benefit the diabetic?" [1], confirms the wisdom of the inclusion of exercise in Joslin's triad of "insulin, exercise and diet" enunciated so many decades ago. Our group in recent years has performed a number of studies of exercise metabolic responses which support the conclusion that exercise is beneficial.

From the physiological and pathophysiological viewpoints, it matters a great deal whether exercise is in the post-absorptive, or post-prandial state. In post-absorptive exercise, glucoregulation is dependent upon matching of endogenous glucose production to its utilization by exercising muscle. The effect of increased subcutaneous insulin absorption during exercise (as directly measured as plasma insulin) is to attenuate the normal increase in production, but not to increase disposal by the exercising muscle [2, 3]. As long as marked insulin deficiency with hyperglycaemia and ketosis are not present, the increment in muscle glucose uptake will occur.

In post-prandial exercise, a larger portion of total muscle energy fuel appears to be glucose, derived mainly from the ingested food. In normal man, the post-prandial glycaemic and insulin excursions are attenuated during exercise, and smaller increments occur later [4]. In the poorly-controlled diabetic, exercise in this state has little immediate effect on glycaemia [5] since most of the glucose is likely to be exogenous and thus suppression of ongoing hepatic production by an accelerated absorption of insulin probably has little immediate influence. However, if sustained this may well be the mechanism of the delayed hypoglycaemic effect so well recognised in the clinical setting. Data as to the frequency of such exercise producing significant hypoglycaemia are lacking, except in the paediatric age group. Indeed, since most conventionally-treated insulin dependent diabetics are in a poor state of control, any exercise performed is likely to be beneficial rather than a hypoglycaemic hazard. In addition, when symptomatic hypoglycaemia occurs predictably, it becomes a simple matter to avoid by pre-exercise carbohydrate ingestion. However, with rigorous control by insulin infusion systems, altered insulin provision with post-prandial exercise is mandatory (unpublished results).

In insulin independent diabetics, post-absorptive exercise can cause a fall in glycaemia, in contrast to the assertion by Sherwin and Koivisto [1] that it does not. This occurs via a mechanism involving failure of the normal fall in insulin levels, and concurrent lesser increase in hepatic glucose production than in muscle glucose utilisation [6, 7]. Finally, there is an increase in the proportion of energy derived from fat during exercise in the hypocaloric state in non-diabetic obese individuals [8]. If such a mechanism also exists in insulin independent obese diabetics, exercise would have

a preferential fat-mobilizing effect. Thus an exercise programme, in addition to a hypocaloric diet, could have specific advantages in both weight reduction and glycaemic control.

We concur with the conclusions of Sherwin and Koivisto. There is a broader base of scientific data from many laboratories to support them than was acknowledged.

E. B. Marliss and B. Zinman

References

1. Sherwin RS, Koivisto V (1981) Keeping in step: Does exercise benefit the diabetic? *Diabetologia* 20: 84–86
2. Murray FT, Zinman B, McClean PA, Denoga A, Albisser AM, Leibel BS, Nakhoda AF, Stokes E, Marliss EB (1977) The metabolic response to moderate exercise in diabetics receiving intravenous or subcutaneous insulin. *J Clin Endocrinol Metab* 44: 708–720
3. Zinman B, Murray FT, Vranic M, Albisser AM, Leibel BS, McClean PA, Marliss EB (1977) Glucoregulation during moderate exercise in insulin treated diabetics. *J Clin Endocrinol Metab* 45: 641–652
4. Nelson JD, Marliss EB, Albisser AM, Zinman B (1981) The metabolic response of normal man and insulin-infused diabetics to postprandial exercise. *Clin Research* 29: 427 A
5. Caron D, Poussier P, Marliss EB, Zinman B (1981) Improved post-exercise glucoregulation in insulin-dependent diabetes. *Clin Invest Med* (in press) (abstract)
6. Minuk HL, Vranic M, Zinman B (1979) Glucoregulation during exercise in non insulin dependent diabetes mellitus (NIDDM). *Diabetes* 28: 316 (abstract)
7. Minuk HL, Vranic M, Marliss EB, Hanna AK, Albisser AM, Zinman B (1981) The glucoregulatory and metabolic response to exercise in obese non-insulin dependent diabetes. *Am J Physiol Endocrinol Metab* 240: E 458–E 464
8. Minuk HL, Hanna AK, Marliss EB, Vranic M, Zinman B (1980) The metabolic response to moderate exercise in obese man during prolonged fasting. *Am J Physiol* 238 (Endocrinol Metab 1) E 322–E 329

E. B. Marliss
 Room 5242, Clinical Science Division
 Medical Sciences Building
 University of Toronto
 Toronto Ontario, Canada
 M5S 1A8