Barriers to physical activity among patients with type 1 diabetes

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Objectives: To determine, in an adult population with type 1 diabetes (TIDM), barriers to regular physical activity using a diabetes specific barriers measure (BAPAD1 scale) and factors associated with these barriers.

Research design and methods: 100 adults with TIDM answered a questionnaire assessing perceived barriers to physical activity and related factors. Glycated hemoglobin (A1c) was obtained from the medical chart.

Results: The fear of hypoglycemia was identified as being the strongest barrier to physical activity. Greater knowledge about insulin pharmacokinetics and using appropriate approaches to minimize exercise-induced hypoglycemia were factors associated with fewer perceived barriers. Greater barriers were positively correlated with A1c levels (r=0.203, p=0.042) and negatively to well-being (r=-0.45, p<0.001).

Conclusion: Fear of hypoglycemia is the strongest barrier to regular physical activity practice in adults with T1DM, who should therefore be informed and supported in its management.
Regular physical activity (PA) is associated with numerous benefits such as improved quality of life (1), decreased cardiovascular risk factors (2) and mortality (3). Despite this evidence, more than 60% patients with type 1 diabetes mellitus (T1DM) remain sedentary (4; 5). To our knowledge, there is only one report that specifically addressed barriers for the practice of PA among individuals with type 1 diabetes (6). The authors developed the BAPAD1 (Barriers to physical activity in type 1 diabetes) scale, a 12-item self-administered questionnaire (6). The objectives of the present study were 1) to determine the most salient barriers using the BAPAD1 scale, and 2) to determine factors associated with these barriers.

**RESEARCH DESIGN AND METHODS**

One hundred and three patients with T1DM answered a 44-item questionnaire when attending their regular appointment at the University of Montreal Hospital Center (CHUM) or at the Montreal Institute of Clinical Research (IRCM) out-patient clinics. The project was approved by the Ethics and Research committee at each institution.

The questionnaire included socio-demographic characteristics and diabetes treatment. For the BAPAD1 scale, participants had to rate 12 barriers to PA from 1 to 7 (1-Extremely unlikely to 7-Extremely likely if the item would keep them from engaging in regular PA over the next 6 months). In addition, social support for PA was assessed by 3 questions adapted from Sallis et al.'s questionnaire (7); participants had to indicate on a scale of 1 (never) to 5 (very often) how often family or friends encouraged them to do PA, proposed to do PA with them, and did PA with them. Patients were asked to report the number of hypoglycemic episodes of the previous 2 weeks and of severe hypoglycemic episodes of the last year. For management of exercise-induced hypoglycemia, patients were asked what actions they took to prevent such episodes (insulin dose reduction and/or snacks for exercise or at bedtime). Knowledge of insulin pharmacokinetics was assessed by asking patients to state the time of onset and peak action of their insulin prescription (correct/incorrect). The WHO-5 Well-being index, a validated scale of 5 questions developed to assess quality of life, was included in the questionnaire (8). The most recent value (within 3 months) of A1c was obtained from the medical chart. This value was missing for 3 patients who were excluded from the study.

Data was analyzed with SPSS software (version 15.0). Pearson’s correlations and Student t-tests for independent sample were performed to determine the relation between various factors and perceived barriers. Internal consistency reliability (Cronbach alpha coefficient) for the BAPAD1 scale, social support measure, and the WHO-5 well being index was 0.82, 0.77, and 0.84, respectively.

**RESULTS**

The final sample consisted of 100 adults with T1DM (50% women). Ninety-two percent of the participants were Caucasian, aged $43.5 \pm 11.6$ years, duration of diabetes was $23.3 \pm 13.2$ years and BMI was $25.9 \pm 4.9 \text{ kg/m}^2$. Glucose control was suboptimal with a mean A1c of $7.7\% \pm 1.1$, mean number of hypoglycemic episodes in the previous two weeks was $7.47 \pm 7.25$ and 25% of the participants experienced severe hypoglycemia in the previous year. A third of the cohort had a low income ($\leq 20 000\$ per year) and/or a low level of education ($\leq$ secondary education) while a fifth reported active smoking.

The mean BAPAD1 total score was $2.51 \pm 1.00$. The highest barrier scores were
the fear of hypoglycaemia (mean 3.58 ± 2.02), the work schedule (3.05 ± 1.98), the loss of control over diabetes (2.83 ± 1.80) and low levels of fitness (2.83 ± 1.95). Factors associated with barriers are summarized in Table 1. Perceived well-being, knowledge of insulin pharmacokinetics, implementing strategies to reduce the probability of exercise-induced hypoglycaemia, and greater social support were associated with fewer barriers. Moreover, having someone with whom to perform PA was also associated with fewer barriers (r=-0.36; p<0.001). Glycemic control, as assessed by A1c, was positively correlated with the total score of the BAPAD1. The frequency of mild or severe hypoglycemia were not associated with level of perceived barriers.

Since the fear of hypoglycaemia was the strongest barrier, we investigated factors associated with this specific item of the BAPAD1 scale. The number of severe hypoglycemic episodes in the previous year was significantly associated (r=0.26; p=0.009) with fear of hypoglycaemia. The number of strategies used to prevent hypoglycemic episodes related to PA was not associated with perceived fear of hypoglycaemia, but some sub-items such as eating an evening snack post PA to prevent nocturnal hypoglycemia were associated with less fear of hypoglycemia (t=3.00; p=0.007). Knowledge of insulin pharmacokinetics, answered correctly by only 52% of participants, was also associated with less fear of hypoglycemia (t=2.34; p=0.021).

CONCLUSION
The four main barriers to PA identified among T1DM patients attending university hospital out-patient clinics were fear of hypoglycemia, work schedule, loss of control over diabetes and a low fitness level. Factors associated with barriers to PA included basic knowledge about insulin pharmacokinetics and implementing strategies to prevent hypoglycemia. Half of the participants were not knowledgable about these fundamental elements, suggesting that there is a major gap for information and support required by individuals with T1DM in this field. Thus, programs intended to increase PA in adults with T1DM should incorporate diabetes specific actions to prevent hypoglycaemia. Furthermore, the striking inverse relationship between social support, a powerful motivator to help initiate and then maintain a physically active lifestyle (9), with perceived barriers suggests that this factor should also be considered in programs to enhance PA participation.

Finally, we found that individuals with greater perceived barriers to PA had poorer glycemic control as measured by A1c. The association between A1c and barriers suggests that the BAPAD1 scale probably captures general aspects related to type 1 diabetes care. It is possible that patients able to manage barriers for physical exercise are also the ones able to cope with other problems.

Our study design does not allow us to establish the causal direction of the associations found, and further research is needed using a prospective controlled design.

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Table 1 Factors associated with barriers to physical activity

| Factor                                                                 | Association with the mean total BAPAD1 score |
|------------------------------------------------------------------------|---------------------------------------------|
| Knowledge of the insulin pharmacokinetics                              | t = 1.99 p = 0.051                          |
| Strategies to prevent exercise-induced hypoglycemia                    | r = -0.20 p = 0.047                         |
| Perceived social support to engage in physical activity from friends and family | r = -0.23 p = 0.022                         |
| Perceived well-being                                                   | r = -0.45 p = 0.000                         |
| Number of severe hypoglycemic episodes in the previous year            | r = 0.17 p = 0.087                          |
| Number of mild hypoglycemic episodes in the previous 2 weeks           | r = 0.04 p = 0.667                          |
| A1c                                                                    | r = 0.20 p = 0.042                          |
| Male sex                                                               | t = 1.91 p = 0.059                          |
| Age                                                                    | r = 0.01 p = 0.908                          |
| Active smoking                                                         | t = -3.35 p = 0.001                         |