Improved Metabolic Risk Markers Following Two 6-Month Physical Activity Programs Among Socioeconomic Marginalized Women of Native American Ancestry in Lima, Peru

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It is known that ethnicity is a risk factor for diabetes. Thus, individuals of African, Latin American, and Asian descent are particularly susceptible (1). As an example, a health survey in six urban areas in Peru found a diabetes prevalence of 17% among women (2,3). It was also found that low socioeconomic status was associated with a high burden of noncommunicable diseases and appeared as an independent risk factor for diabetes. In several populations, it is known that increased physical activity reduces the risk for diabetes (4,5). Whether this applies for all populations is, however, not known. The aim of the present study was to explore if supervised endurance training is feasible among socioeconomically marginalized women of a poor urban area in Lima, Peru.

RESEARCH DESIGN AND METHODS — The study population consisted of 142 Amerindian women. They were all examined in 1999 (6) and had a normal fasting plasma glucose concentration (range 2.8–5.6 mmol/l). Five years later, a total of 83 women participated in a follow-up examination (7). Of these, 76 consented to take part in the present training study. Mean age was 41 years (range 25–64 years). The women were randomly assigned into group A (one training session per week) or group B (three training sessions per week). No economic compensation was given besides free athlete suits and shoes.

Exercise training
All exercise sessions were verified by the direct supervision by a physiotherapist and took place outdoors on a square with a concrete surface. A warm-up with stretching, light jogging, and flexibility movements was followed by a mixture of traditional folk and modern aerobic dances for a total of 60 min. This was undertaken once or three times per week for 6 months.

Laboratory and clinical measurements
Body weight and height, BMI, waist circumference, fasting plasma glucose, and cardiorespiratory capacity ($V\text{O}_{2max}$) were measured at baseline and after the intervention period. All subjects refrained from any severe physical activity 48 h before the measurements. Glucose was determined with the glucose oxidase technique. $V\text{O}_{2max}$ was estimated indirectly after subjects ran around two cones, spaced 20 m apart, for 12 min, as previously decribed (8).

Statistical analyses
Comparisons within groups were performed by paired Student's *t* test and between groups by Mann-Whitney *U* test. Correlations were performed using Spearman rank correlations and multiple regression analysis for training sessions, changes of plasma glucose, body weight, BMI, waist circumference, and $V\text{O}_{2max}$. A *P* value of <0.05 was considered statistically significant.

RESULTS — Fifty-nine patients completed the study, with 33 in group A and 26 in group B. The mean total attendance was 21 in group A (maximal possible 27) and 64 in group B (maximal possible 77). During the 6-month study period, 20% in group A (one session per week) and 16% in group B (three sessions per week) discontinued the training sessions.

Effects of intervention
No significant differences were observed between groups A and B in 1999 before the start of the exercise program ($P > 0.05$) (Table 1). In both groups, plasma glucose decreased ($P < 0.01$), waist circumference decreased ($P < 0.05$), and $V\text{O}_{2max}$ increased significantly ($P < 0.05$) after the training sessions. These effects were more pronounced among members of group B ($P = 0.019$).

Correlations
The number of training sessions was associated with changes in plasma glucose (Rho = 0.37, $P = 0.013$), waist circumference (Rho = 0.29, $P = 0.034$), and $V\text{O}_{2max}$ (Rho = 0.38, $P = 0{,}009$). In contrast, these variables did not correlate significantly with BMI. Multiple regression analysis showed that the number of training sessions and the increase of $V\text{O}_{2max}$ independently contributed to changes in plasma glucose, whereas waist circumference and BMI did not correlate significantly.

CONCLUSIONS — The dramatic increase of type 2 diabetes in Latin America among subjects with Amerindian heritage (9–11) is seen mainly among populations with low socioeconomic status. For prevention and management, these at-risk

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A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Changes in plasma glucose concentration, body weight, waist circumference, BMI, and cardiorespiratory fitness in 76 women who participated in the aerobic exercise training for 6 months during 2005**

	1999	2005 Before training	2005 After training
Plasma glucose (mmol/l)			
A	4.0 ± 0.4†	5.1 ± 1.7	4.6 ± 1.6‡
B	4.2 ± 0.7§	5.1 ± 0.9	4.1 ± 1.1‖
Body weight (kg)			
A	59.0 ± 12.0†	61.4 ± 12.1	60.7 ± 10.7
B	60.5 ± 11.4§	64.7 ± 12.8	62.9 ± 11.7
Waist circumference (cm)			
A	83.0 ± 10.5†	89.7 ± 8.6	89.0 ± 8.8¶
B	85.7 ± 11.5§	93.0 ± 10.6	90.5 ± 10.6‡
BMI (kg/m^2)			
A	25.6 ± 5.0§	26.9 ± 4.6	26.7 ± 4.3
B	26.1 ± 5.3§	27.9 ± 5.5	27.2 ± 5.3
Vo_{2max} (ml · kg^{-1} · min^{-1})			
A	ND	19.1 ± 3.9	20.6 ± 4.1¶
B	ND	18.6 ± 3.9	21.7 ± 4.3‡

Data are group means ± SD. *No lifestyle intervention took place between 1999 and 2005. A and B denote group activities once and three times per week, respectively. Values 1999 vs. 2005 before training: †$P < 0.01$ and §$P < 0.001$. Values before vs. after 6 months exercise training: ‡$P < 0.01$, ‖$P < 0.001$, and ¶$P < 0.05$. ND, not done.

populations require a tailored approach. This study shows that a supervised physical group activity is feasible among women living in poor urban areas. The attendance rate was high and the drop out rate acceptable. Furthermore, the study shows that after following such an activity for 6 months, circulating glucose and waist circumference are reduced and Vo_{2max} increased. Furthermore, the number of exercise sessions independently contributed to the reduction of glucose concentrations. In fact, in group B, the mean plasma glucose concentration decreased to the same level as in 1999. Also, in group A, the glucose concentration was significantly reduced, although not to the same degree as in group B.

The exercise regime resulted in a reduction of waist circumference but with no significant change in body weight. Exercise in women is associated with a marked increase in lipolysis in the abdominal subcutaneous adipose tissue in comparison with the femoral adipose tissue (12). This suggests that exercise-induced weight loss would be associated with a preferential reduction in abdominal obesity.

Although encouraging, it may be surprising that only one exercise session per week significantly reduced fasting glucose. This supports results showing that marked changes of the metabolic potential of muscle occur with small variation in the level of physical activity (13). It is also known that men with impaired glucose tolerance normalize their glucose tolerance by increasing their weekly physical activity pattern, without any change in body weight (14).

The findings in this study are extremely encouraging in that supervised exercise may be a low-cost safe therapy with favorable benefits, exercise need not be strenuous or prolonged, and exercise does not have to be done every day.

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