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Improvement in diet habits, independent of physical activity helps to reduce incident diabetes among prediabetic Asian Indian men

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ABSTRACT

Aims: To assess the beneficial effects of the components of lifestyle intervention in reducing incidence of diabetes in Asian Indian men with impaired glucose tolerance (IGT) in India.
Methods: This analysis was based on a 2 year prospective, randomized controlled primary prevention trial in a cohort of Asian Indian men with IGT ($n = 537$) (Clinical Trial No: NCT00819455). Intervention and control groups were given standard care advice at baseline. Additionally, the intervention group received frequent, mobile phone based text message reminders on healthy lifestyle principles. Dietary intake and physical activity habits were recorded by validated questionnaires. The lifestyle goals were: reductions in consumption of carbohydrates, oil, portion size and body mass index of at least 1 unit (1 kg/m^2) from baseline and maintenance of good physical activity. The association between diabetes and lifestyle goals achieved was assessed using multiple logistic regression analyses. Changes in insulin sensitivity (Matsuda's insulin sensitivity index) and oral disposition index during the follow-up were assessed.
Results: At the end of the study, 123 (23.8%) participants developed diabetes. The mean lifestyle score was higher in the intervention group compared with control (2.59 ± 1.13 vs. 2.28 ± 1.17; $P = 0.002$). Among the 5 lifestyle variables, significant improvements in the 3 dietary goal were seen with intervention. Concomitant improvement in insulin sensitivity and oral disposition index was noted. Higher lifestyle score was associated with lower risk of developing diabetes (odds ratio: 0.54 [95% CI: 0.44–0.70]; $P < 0.0001$).
Conclusions: Beneficial effects of intervention were associated with increased compliance to lifestyle goals. The plausible mechanism is through improvement in insulin sensitivity and beta cell preservation.

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Abbreviations: BMI, body mass index; DPP, Diabetes Prevention Programme; DPS, Finnish Diabetes Prevention Study; IDRF, India Diabetes Research Foundation; IGT, impaired glucose tolerance; IFG, impaired fasting glucose; NCD, non communicable diseases; OGTT, oral glucose tolerance test; WHO, World Health Organization.

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1. Introduction

The rising prevalence of common behavioural risk factors, namely poor diet, lack of physical activity, tobacco use and excessive alcohol consumption are associated with increased prevalence of diabetes, cardiovascular diseases, cancer and chronic pulmonary diseases. These diseases account for nearly 80% of deaths from non-communicable diseases (NCD), especially in developing countries [1]. Several randomized controlled trials in white populations [2,3] and in Asians [4–7] have successfully demonstrated that by controlling these lifestyle risk factors, it is possible to prevent or postpone development of type 2 diabetes in prediabetic participants. In western populations, the beneficial changes were largely associated with weight reduction [2,3], whereas in Asian populations the benefit of lifestyle intervention occurred independent of weight loss [4,6,7]. The components of lifestyle intervention that are responsible for the reduced incidence of diabetes have not been studied in detail in Asian Indians and this analysis has focused on this aspect.

2. Materials and methods

The present analysis is based on a primary prevention trial done in a cohort of Asian Indian men with impaired glucose tolerance (IGT) at baseline in south-east India between August 10, 2009, and November 30, 2012 [7]. The study design, methods, recruitment and characteristics of the study participants have been reported previously [7]. Briefly, all the participants had IGT at baseline on an initial testing with a 2 h post glucose capillary blood glucose followed by a confirmatory oral glucose tolerance test (OGTT) done within a week. During the second test, we collected venous blood samples at fasting, 30 min and 2 h after 75 g glucose ingestion. The eligible participants were randomly assigned to either the control group ($n = 266$) in which the participants received personalized standard advice and also printed educational information on healthy lifestyle practice only at baseline. The intervention group ($n = 271$) in addition, received frequent reminders on healthy lifestyle principles through automated, mobile-phone based text messages (SMS) for two years. Both the control and intervention groups received one-to-one, identical, lifestyle advice, the groups being distinguished solely by whether they received reinforcement of lifestyle advice by SMS. The study was approved by the Ethics Review Committee of the India Diabetes Research Foundation (IDRF) and all participants gave written informed consent before enrolling in the study (ClinicalTrial.Gov no: NCT00819455).

The primary outcome was incident diabetes. Diabetes was diagnosed on the basis of an annual OGTT or a semi-annual 2 h post glucose load test, according to the World Health Organization criteria [8]: plasma glucose of a value of 7.0 mmol/l or higher in the fasting state or 11.1 mmol/l or higher two hours after a 75-g oral glucose load. During interim visits, if the values were $\geq$11.1 mmol/l by 2 h post glucose load test, an OGTT was performed within a week to re-confirm the diagnosis of diabetes. The study showed for the first time that motivation through text messaging could help reduce the incidence of diabetes (intervention ($n = 50$ (18%) vs. standard care advice: $n = 73$ (27%); (HR: 0.64, 95% CI 0.45–0.92; $P = 0.015$)). Since the main objective of this post hoc analysis was to ascertain the benefits of compliance to the healthy lifestyle goals on incident diabetes and since both groups were advised on lifestyle changes at baseline we considered both groups as a single cohort for this analysis.

The prescribed healthy lifestyle recommendations were similar to those used in a previous trial in India [6]. Lifestyle advice was advocated by researchers experienced in epidemiological surveys and primary prevention strategies. We individualized the dietary recommendations to balance food intake and physical activity and to maintain appropriate bodyweight. The advice included: (a) avoidance of simple sugars and refined carbohydrates; (b) Reduce total fat intake (<20 g per day); (c) Restrict use of saturated fat; (d) Include more fibre-rich food—e.g., whole grains, legumes, vegetables, and fruits. Physical activity recommendations included: To enhance aerobic exercise like walking (3–4 km in 30 min at least 5 days a week or equivalent), cycling (6–7 km in 30 min), and jogging in participants with sedentary lifestyle. If occupation involves strenuous work, no specific advice was given.

All participants were reviewed at 6 monthly intervals for measurements of anthropometry and biochemical variables and for assessment of diet and physical activity habits. Matsuda's insulin sensitivity index was calculated by the following formula: (10^4/square root of (fasting glucose * insulin) * (mean OGTT glucose * mean OGTT insulin)), with mean glucose and insulin calculated from values at fasting, 30 and 120 min of the OGTT test [9] and beta cell function was calculated using and disposition index (total AUC insulin/glucose * Matsuda's insulin sensitivity index) [10].

2.1. *Lifestyle measurements*

The habitual nutrient intakes of the participants were recorded by a trained dietician by interview using the 24 h dietary recall method [6,7] at baseline and at the 6 monthly reviews. The total energy intake (kcal) and components of individual food constituents (carbohydrates, proteins and fat (in grams)) consumed by the participants were calculated with an in-house dietary analysis programme (visual basic programming tool) using the National Institute of Nutrition guidelines for India [11]. Information about adherence to recommendations for dietary intake was recorded at the 6-monthly reviews.

Physical activity was quantified on a score of 7–70. The activity questionnaire was based on that used previously in south-Asian Indians in a UK epidemiological survey [12], which we used in our previous study of diabetes prevention in India, but was slightly modified for the Indian environment [6,7]. The healthy lifestyle goals comprised of: (a) decreased consumption of carbohydrates; (b) decreased portion size; (c) decreased consumption of oil; (d) decrease in BMI of at least 1 unit (1 kg/m^2) from baseline; and (e) maintenance of good physical activity. Success in achieving healthy lifestyle goals were assessed on the basis of the food records and physical activity questionnaire. The success in each lifestyle change is determined based on achieving lifestyle recommendations