Short Communication

Effect of a Lifestyle Intervention Program in Women at Risk for Type 2 Diabetes with a History of GDM

Valentina De Mori[1]*, Giancarla Meregalli[1], Annalisa Balini[1], Denise Berzi[1], Rita Carpinteri[1], Franco Forloni[1], Raul Manenti[2], Elena Menegola[2], and Antonio C. Bossi[1]

[1]*Endocrine Unit, Diabetes Regional Center, Italy*
[2]*Department of Developmental Biology, University of Milan, Italy*

Abstract

Healthy lifestyle habits, such as good diet and physical activity, are modifiable factors to prevent or delay the development of type 2 diabetes (T2DM) and other obesity-related morbidities. The Finnish Diabetes Risk Score (FINDRISC) is a simple, fast, and inexpensive tool to identify individuals at high risk for T2DM. The aim of the study was to verify whether the risk to develop T2DM,assessed by FINDRISC questionnaire, should be reduced by a 6-month lifestyle intervention among women with a history of Gestational Diabetes Mellitus (GDM). Among 255 females with a history of GDM, 88 non-pregnant Caucasian women were recalled. At baseline, their current glycemic status was revisited by a 75 gr OGTT. Every three months, they received an individual counseling session about healthy diet, physical activity, and diabetes and other risk factors management, maintenance of a healthy lifestyle. At every visit scheduled anthropometric parameters were assessed and FINDRISC questionnaire was administered. All the modifiable factors improved after educational intervention. During the study, the mean risk of T2DM development, as assessed by FINDRISC, was significantly reduced by − 2.18 points from baseline. Lifestyle intervention programs may have a significant effect in people at high risk to develop diabetes. In Italy, action should be taken to encourage women with GDM in order to allow the prevention and/or the early detection of T2DM.

ABBREVIATIONS

GDM: Gestational Diabetes Mellitus; IFG: Impaired Fasting Glucose; IGT: Impaired Glucose Tolerance; T2DM: Type 2 Diabetes Mellitus; FINDRISC: Finnish Diabetes Risk Score; OGTT: Oral Glucose Tolerance Test; IADPSG: International Association of the Diabetes and Pregnancy Study Groups; HbA1: glycated hemoglobin; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; SD: Standard Deviation; BMI: Body Mass Index.

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy. The definition applies whether insulin or only diet modification is used for treatment and whether or not the condition persists after pregnancy. It does not exclude the possibility that unrecognized glucose intolerance may have antedated or begun concomitantly with the pregnancy [1].

Women with GDM have an increased risk to develop impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) or T2DM, in the years following pregnancy. Indeed, T2DM is diagnosed in up to 10% of women with a history of GDM soon after delivery. During a 10-year follow-up, the risk can be as high as 70% [2]. However, the successful effect of lifestyle intervention on T2DM risk reduction has been demonstrated in some studies: healthy lifestyle habits, such as good diet and physical activity, are modifiable factors to prevent or delay the development of T2DM and other obesity-related morbidities [3,4]. FINDRISC is a simple, fast, and inexpensive tool to identify individuals at high risk for T2DM within the next 10 years [5]. The aim of the study was to verify whether the risk to develop T2DM, assessed by FINDRISC questionnaire, should be reduced by a 6-month lifestyle intervention among women with a history of GDM.

MATERIALS AND METHODS

All women attending the Diabetes Outpatient Clinic for GDM

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at the Treviglio Hospital, Italy, between 2007 and 2011, were identified: before March 2010, the diagnosis of GDM complied with Carpenter and Coustan criteria, based on a 100 gr OGTT. After that date IADPSG criteria were introduced and diagnosis relied on a 75 gr OGTT. So, 255 non-pregnant cases were detected, but only 88 accepted to participate to the study. The remainder fulfilling the selection criterion either refused to participate or could not be traced (Figure 1). All study participants gave their informed consent. The protocol was approved by the local ethics committee. Medical history, anthropometric data (weight, height, and waist circumference), systolic and diastolic blood pressure, were recorded at baseline and after 3 and 6 months of follow-up. Fasting plasma glucose, HbA1c and lipid profile (total cholesterol, HDL and LDL) were measured at baseline and after 3 months. Their current glycaemic status was assessed by a 75gr OGTT. At every visit they received an individual counseling session by the study nutritionist about healthy diet, physical exercise, smoking and alcohol intake, diabetes and risk factors management in order to induce and maintain a healthy lifestyle. They were encouraged to be engaged in physical activities according to a position Statement of American Diabetes Association. Moderate exercise, such as brisk walking or other activities of equivalent intensity, were recommended for at least 150–175 min/week [1]. The dietary counseling focused on optimizing consumption of vegetables, fruits, whole-grain products rich in fiber, low-fat dairy products, vegetable fats high in unsaturated fatty acids, fish, and low-fat meat products, and a lower intake of sugar-rich foods, according to Italian Standards of Care for Diabetes Mellitus 2016 [6]. FINDRISC questionnaires about previous health and disease, consumption of fruit, berries or vegetables, use of anti-hypertensive medication, history of high blood glucose and family history of diabetes were collected at baseline and every 3-month visits. The FINDRISC scoring is represented in Figure (2). Statistical analyses were performed using SAS for Windows. Continuous variables are presented as mean ± SD and categorical variables are presented as percentages in the text and tables, and were compared by paired Student *t* test or paired sign test or linear regression.

RESULTS AND DISCUSSION

A full set of data from 49 out of 88 non-pregnant women (55.6%) who accepted to participate in the study, were collected. Baseline characteristics of participants are shown in Table (1). The mean age was 39.3 ± 5 years (mean±SD); the majority of women was overweight (BMI>25 kg/m²); 71.5% had family history of T2DM in first- or second-degree relative; 5.7% used anti-hypertensive medication. At baseline, all the risk factors for T2DM, in addition to GDM, were evaluated as shown in Table (2). As expected, unhealthy diet, sedentary lifestyle and alcohol consumption were associated to increased risk. Furthermore, fasting glycemia was statistically higher in smoking women than in non smokers (98.47 vs. 121.30; p <0.01). Indeed nicotine, one of the many components of tobacco smoke, is associated with decreased insulin sensitivity in humans and therefore may link smoking with insulin resistance [7]. The study confirms that lifestyle intervention programs may have a significant effect in people with high risk to develop diabetes. As a matter of fact, all the modifiable factors were improved after the 6-months educational intervention study. BMI (baseline vs 3-months
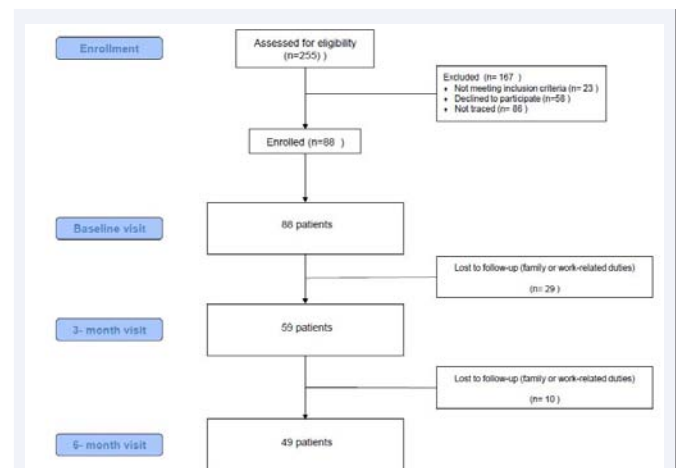

Figure 1 The study flowchart.

Figure 2 The FINDRISC questionnaire.

vs 6-months: 26.7 ± 6 vs 26.3 ± 6 vs 25.8 ± 6 Kg/m²; p<0.05) and waist circumference (86.7±13 vs. 85.3±13 vs 84.6 ±13 cm; p<0.05) decreased. Whereas, studied women reported an increase in physical activity (12.2% vs 28.6% vs 51%; p<0.05) and dietary changes in a healthier direction, improving the daily consumption of vegetables, fruits or berries (36.7% vs 57.1% vs 59.2%; p<0.05). There were small though non-significant reductions also in body weight and hip circumference in this small subset of patients. The final result looks encouraging, as there was an interesting improvement in the FINDRISC score, with a significant reduction (-2, 18 points from baseline after 6 months: Table (3), Figure (3)). Diabetes Risk Scores are considered to be a cost-efficient and practical way to identify individuals at high risk for T2DM in the general population [5]. FINDRISC has been developed and validated in two Finnish population-based cohorts to predict future diabetes [3,5,7]. It has also been validated in Germany [8], in Greece [9], in Slovenia [10] and in Italy [11]. Evidence supports the importance of maintaining a healthy diet in order to prevent diabetes onset. In Italy, we should encourage

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the consumption of the Mediterranean diet, which is relatively rich in monounsaturated fats [12], as well as the ingestion of diet rich in whole grains, nuts [13] and berries [14] in order to help T2DM prevention. Women with previous GDM should be engaged in regular moderate-intensity physical activity [15]. Previous studies, as the Diabetes Prevention Program [16], the Da Qing study [17] and the Finnish Diabetes Prevention Study [3,5], have shown that T2DM prevention is possible and feasible by lifestyle intervention. However, these studies look to be too labor intensive and therefore not directly applicable to real-life

Table 1: Clinical features of completers patients (N=49).

Visits	Baseline	+3 months	+6 months
Caucasian%	96 %		
Age, years	39.3 (±5)	-	-
Weight, kg	69.6 (±16,9)	68.9 (±16.1)	67.70 (±16)
BMI, Kg/m^2	26.3 (±6)	26.7 (±6.1)	26.3 (±5.9)
Waist circumference, cm	86.7 (±13)	85.4 (±13.4)	84.6 (±13)
Hip circumference, cm	102.7 (±13.2)	100.1 (±13)	98.2 (±11.4)
Body fat, %	35.1 (±6.7)	34.6 (±6.3)	34 (±6.5)
Blood systolic pressure, mmHg	1201(±12.3)	116.6 (±16.4)	119.2 (±12.1)
Blood diastolic pressure, mmHg	68.6 (±9.3)	75.5 (±10.8)	77.1 (±7.8)
Fasting glucose, mg/dL	103,3 (±23.5)	96.7 (±10.6)	-
HbA1c, mmol/mol	41.3 (±10.2)	40 (±8.5)	-
Total cholesterol, mg/dL	201.8 (±39,8)	192.7 (±24.8)	-
HDL, mg/dL	60.2 (±16.8)	61.1 (±17.3)	-
Triglycerides, mg/dL	77 (56-131)	82 (60-125)	-

Abbreviations: HbA1c: Glycated Hemoglobin; HDL: High Density Lipoprotein Data are mean ± SD, or median and interquartile range

Figure 3 Evolution of the FINDRISC score (%) at baseline (A), after 3 (B), and after 6 months (C).
* p<0.05 vs. baseline visit; ** p<0.01 vs. baseline visit
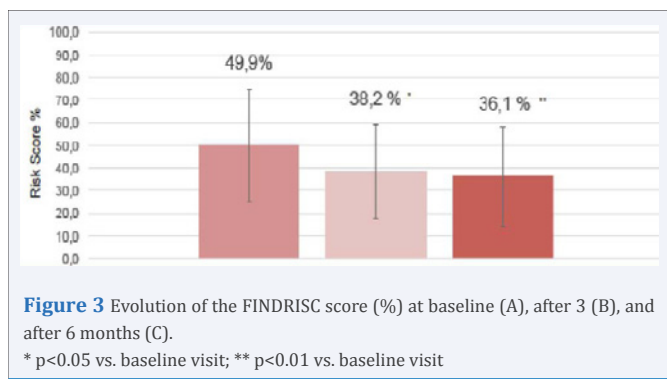
Table 2: Risk factors for the development of diabetes.

History of T2DM	71.5 %
Smoker[1]	19.7 %
Alcohol consumption[2]	15.1 %
Unhealthy diet[3]	80.3 %
Sedentary[4]	71.3 %

[1]Smoker: ≥ 1 cigarette/die; [2] Alchol consumption: ≥1 drink/week; [3] Unhealthy diet: < 3 meals/die, < 3-4 fruits and vegetables/die; [4] Sedentary: < 30 minutes twice a week.

Table 3: FINDRISC score (data are expressed as mean ± SD).

	Baseline visit		+3 months visit		+6 months visit	
Score, n	15.4	(±3.4)	13.7	(±3.7)*	13.2	(±3.6)**
Risk Score, %	49.9	(±24.6)	38.2	(±20.8)*	36.1	(±21.9)**

*p<0.05 vs. baseline visit
** p<0.01 vs. baseline visit

setting [18]. In our study, the protocol was simple and easy to be implemented: lifestyle changes and improvement of FINDRISC score required a very modest number of visits. A limitation of the present study is the loss to follow up, but this reflects the real-life setting and the difficulty in recurrent evaluations of these patients. Unfortunately, women with GDM may not perceive themselves as being at high risk for T2DM after delivery: they seem to have many barriers to lifestyle changes, such as childcare duties, fatigue, lack of motivation; financial, time and work-related obstacles are often perceived. It has been shown that only 16% of women with previous GDM believed themselves to be at high risk for T2DM and women with greater perceptions of risk intended more often to change their lifestyle in a healthier direction [19]. In women with history of GDM, studies should be promoted to improve healthy education in order to develop and maintain behaviors that can prevent or delay the onset of diabetes.

CONCLUSION

Previous GDM is known to be a strong risk factor for future diabetes. Lifestyle intervention program may have a significant effect in people with high risk to develop diabetes, by improving BMI, waist circumference, fasting glucose, consumption of vegetables and fruits. Action should be taken to encourage women with GDM in order to allow the prevention and/or early detection of T2DM.

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REFERENCES

1. American Diabetes Association Standards of Medical Care in Diabetes. Diabetes Care. 2016; 39: S13-S22.

2. Kim C, Newton KM, Knopp R. Gestational diabetes and the incidence of type 2 diabetes. Diabetes Care. 2002; 25: 1862-1868.

3. Tuomilehto J, Lindström J, Eriksson JG, Valle T, Hämäläinen H. Prevention of Type 2 Diabetes Mellitus by Changes in Lifestyle among Subjects with Impaired Glucose Tolerance. N Engl J Med. 2001; 344: 1343-1350.

4. Ratner RE, Christophi CA, Metzger BE, Dabelea D, Bennett PH, Pi-Sunyer X, et al. Prevention of diabetes in women with a history of gestational diabetes: Effects of metformin and lifestyle interventions. J Clin Endocrinol Metab. 2008; 93: 4774–4779.

5. Lindstrom J, Tuomilehto J. The diabetes risk score: a practical tool to predict type 2 diabetes risk. Diabetes Care. 2003; 26: 725-731.

6. Standard Italiani per la Cura del Diabete Mellito – 2016 (last accessed November 24th, 2016).

7. Bergman BC, Perreault L, Hunerdosse D, Kerege A, Playdon M, Samek AM, et al. Novel and Reversible Mechanisms of Smoking-Induced

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Insulin Resistance in Humans. Diabetes. 2012; 61: 3156-3166.

8. Bergmann A, Li J, Wang L, Schulze J, Bornstein SR, Schwarz PE. A simplified Finnish diabetes risk score to predict type 2 diabetes risk and disease evolution in a German population. Horm Metab Res. 2007; 39: 677-682.

9. Makrilakis K, Liatis S, Grammatikou S, Perrea D, Stathi C, Tsiligros P, et al. Validation of the Finnish diabetes risk score (FINDRISC) questionnaire for screening for undiagnosed type 2 diabetes, dysglycaemia and the metabolic syndrome in Greece. Diabetes Metab. 2011; 37: 144-151.

10. Štiglic G, Fijačko N, Stožer, Sheikh A, Majda Pajnkihar M. Validation of the Finnish Diabetes Risk Score (FINDRISC) questionnaire for undiagnosed type 2 diabetes screening in the Slovenian working population. Diabetes Res Clin Pract. 2016; 120: 194-197.

11. Franciosi M, De Berardis G, Rossi MC, Sacco M, Belfiglio M, Pellegrini F, et al. Use of the diabetes risk score for opportunistic screening of undiagnosed diabetes and impaired glucose tolerance: the IGLOO (Impaired Glucose Tolerance and Long-Term Outcomes Observational) study. Diabetes Care. 2005; 28: 1187-1194.

12. Salas-Salvadó J, Bulló M, Babio N, Martínez-González MÁ, Ibarrola-Jurado N, Basora J, et al. Reduction in the incidence of type 2 diabetes with the Mediterranean diet: results of the PREDIMED-Reus nutrition intervention randomized trial. Diabetes Care. 2011; 34: 14-19.

13. Afshin A, Micha R, Khatibzadeh S, Mozaffarian D. Consumption of nuts and legumes and risk of incident ischemic heart disease, stroke, and diabetes: a systematic review and meta analysis. Am J Clin Nutr. 2014; 100: 278-288.

14. Mursu J, Virtanen JK, Tuomainen TP, Nurmi T, Voutilainen S. Intake of fruit, berries, and vegetables and risk of type 2 diabetes in Finnish men: the Kuopio Ischaemic Heart Disease Risk Factor Study. Am J Clin Nutr. 2014; 99: 328-333.

15. Herman WH, Hoerger TJ, Brandle M, Hicks K, Sorensen S, Zhang P, et al. The cost-effectiveness of lifestyle modification or metformin in preventing type 2 diabetes in adults with impaired glucose tolerance. Ann Intern Med. 2005; 142: 323-332.

16. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002; 346: 393-403.

17. Li G, Zhang P, Wang J, Gregg EW, Yang W, Gong Q, et al. The long-term effect of lifestyle interventions to prevent diabetes in the China Da Qing Diabetes Prevention Study: a 20-year follow-up study. Lancet. 2008; 371: 1783-1789.

18. Kahn R, Davidson MB. The reality of type 2 diabetes prevention. Diabetes Care. 2014; 37: 943-949.

19. Kim C, Mc Ewen LN, Piette JD, Goewey J, Ferrara A, Walker EA. Risk perception for diabetes among women with histories of gestational diabetes mellitus. Diabetes Care. 2007; 30: 2281-2286.