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# Impact of lifestyle intervention on body weight and the metabolic syndrome in home-care providers

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## Abstract

**Aim.** – The study evaluated the impact of lifestyle intervention on body weight, metabolic syndrome parameters, nutrition and physical activity in home-care providers (HCPs).

**Methods.** – Of 551 screened employees of a nursing agency, 173 were eligible to participate and were assigned to either the intervention ( $n = 129$ ) or the control ( $n = 44$ ) group. Participants in the intervention group followed an educational programme that encouraged physical activity and healthy nutrition, and were equipped with bicycles free of charge. Anthropometric, biological and lifestyle parameters were assessed at baseline, and after 6 and 12 months.

**Results.** – Body weight, waist circumference and systolic blood pressure significantly decreased at 12 months in both study groups. Incidence of the metabolic syndrome in the intervention group at 12 months was reduced by 50% (from 17 to 9.2%;  $P = 0.04$ ). There were also decreases in LDL cholesterol ( $-0.36$  mmol/L;  $P < 0.01$ ), total cholesterol/HDL cholesterol ratio ( $-0.57$ ;  $P < 0.01$ ) and fasting glucose ( $-0.4$  mmol/L;  $P < 0.05$ ), and an increase in HDL cholesterol ( $+0.22$  mmol/L;  $P < 0.01$ ) in the intervention group. At 12 months, a decrease in daily caloric intake ( $-391$  kcal/day;  $P < 0.001$ ) and an increase in the percentage of participants engaging in physical activity ( $+3.4\%$ ;  $P < 0.05$ ) were also observed in the intervention group.

**Conclusion.** – Lifestyle changes among HCPs are possible with relatively modest behavioural education and within a short period of time. Educational strategies and workshops are effective, efficient and easy to perform, and should be encouraged in HCPs to promote the implementation of lifestyle modifications in their patients.

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**Keywords:** Lifestyle; Intervention study; Metabolic syndrome; Physical activity; Nutrition

## Résumé

Effets d'une intervention sur le mode de vie sur le poids et le syndrome métabolique chez des employés d'un établissement de soins à domicile.

**But.** – Évaluer les effets d'une intervention sur le mode de vie sur le poids, les paramètres du syndrome métabolique, la nutrition et l'activité physique chez des employés d'un établissement de soins à domicile.

**Méthodes.** – Parmi 551 employés initialement évalués, 173 remplissaient les critères d'inclusion et ont été inclus soit dans le groupe intervention ( $n = 129$ ), soit dans le groupe témoin ( $n = 44$ ). Les participants du groupe intervention ont bénéficié d'un programme éducatif structuré pour les encourager à pratiquer une activité physique et à manger équilibré. Un vélo leur a été offert. Des paramètres anthropométriques, biologiques et le mode de vie ont été examinés au départ et après six et 12 mois.

**Résultats.** – Le poids, le périmètre abdominal et la pression artérielle systolique ont diminué à 12 mois dans les deux groupes. Dans le groupe intervention, l'incidence du syndrome métabolique a diminué de 50 % à 12 mois (17 % vs 9,2 %,  $P = 0,04$ ). Le LDL-cholestérol ( $-0,36$  mmol/L,  $P < 0,01$ ), le rapport cholestérol total/HDL-cholestérol ( $-0,57$ ,  $P < 0,01$ ) et la glycémie à jeun ( $-0,4$  mmol/L,  $P < 0,05$ ) ont diminué et le HDL-cholestérol ( $+0,22$  mmol/L,  $P < 0,01$ ) a augmenté. Une diminution des apports énergétiques ( $-391$  kcal/j,  $P < 0,001$ ) ainsi qu'une augmentation du pourcentage de personnes pratiquant une activité physique ( $+3,4$  %,  $P < 0,05$ ) ont été observées à 12 mois dans le groupe intervention.

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**Conclusion.** – Un changement du mode de vie chez des employés de soins à domicile est possible même grâce à une intervention simple. Ces ateliers d'éducation efficaces et relativement faciles à mettre en place devraient être proposés dans des structures de soins à domicile afin que les infirmières puissent suggérer un changement de mode de vie à leurs patients.

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**Mots clés :** Mode de vie ; Syndrome métabolique ; Activité physique ; Alimentation ; Étude d'intervention

## 1. Introduction

Overweight and obesity are important health issues in both the developed and developing countries, and are increasing in prevalence [1,2]. A recent analysis showed that one-third of the world's adult population was overweight or obese in 2005 and could reach up to 60% by 2030 [3]. A similar trend was observed in Geneva (Switzerland), where the proportion increased between 1993 and 2003 from 44 to 59% among men and from 24 to 37% among women [4]. Overfeeding, inadequate nutrition and a sedentary lifestyle are the recognized risk factors for the development of obesity and become, in turn, cardiovascular risk factors [5,6]. The World Health Organization (WHO) has called for a worldwide initiative to increase physical activity and improve nutrition-related behaviours [7].

Low levels of physical activity and inadequate nutrition are behaviours that are modifiable by education [8], and it has been shown that multifaceted educational programmes are more efficient than single approaches [9]. Home-care providers (HCPs) play a key role in patient education and can affect the behaviour of patients in terms of controlling cardiovascular risk factors [10]. However, even though HCPs are often well informed about cardiovascular risk factors, nutrition and the importance of exercise, they often do not act in accordance with their knowledge [11]. Moreover, HCPs that do not behave in accordance with their own beliefs are probably less efficient in convincing their patients to do so. Programmes that aim to improve physical activity and nutrition are mostly patient-oriented. Nevertheless, HCPs are an important target for improvement, as they are at the centre of patient education on health-related behaviour. In particular, few authors have explored the impact of an educational programme on nutrition and physical activity targeted at HCPs [12].

The aim of the present study was to evaluate the impact of a lifestyle interventional programme on body weight, the metabolic syndrome, nutrition and physical activity among HCPs in a home-care nursing agency facility.

## 2. Methods

The *Fondation des services d'aide et de soins à domicile* (FSASD; Foundation for Help and Home Care Services) is a state-funded home-care nursing agency. It consists of 1900 HCPs who cover the Geneva (Switzerland) area, a population of nearly 500,000 habitants, and provides home-based nursing services. HCPs visit their patients' homes several times a day within an area of approximately 10 km, using their own cars most of the time. The FSASD executive committee in collaboration with the Service of Therapeutic Education for Chronic Diseases (the

WHO collaborating centre for patient education) proposed and developed a multifaceted interventional programme to encourage physical activity (mobility programme) and healthy nutrition (educational programme) among the agency's employees. The main goal was to improve the health status and satisfaction of FSASD employees as well as to consequently affect patients' physical activity and nutrition through such behavioural modifications in the HCPs.

### 2.1. Mobility programme

The intervention employed a multifaceted approach to encourage physical activity among FSASD HCPs. First, employees were encouraged to use non-motorized vehicles to get to their patients' homes as much as possible. To this end, 135 regular bicycles, 101 electric bikes and seven foldable bikes were provided free of charge at the agency workplace. Employees received exact instructions for adapting their transportation mode according to the distance to be covered: they were to walk for short distances (<300 m) and cycle for medium distances (<2 km). For longer distances or in cases of disability or bad weather, use of public transportation or a car-sharing system was permissible.

### 2.2. Educational programme

A 6-week cognitive behavioural education (CBE) programme on physical exercise and adequate nutrition was offered to all participants. Teaching methods were based on the cognitive and behavioural approaches used for obese patients that had recently been developed by the authors [8]. Key features of the method were an interdisciplinary teaching team, the subject's own experience-centred approach and long-term behavioural changes. Teaching consisted of practical exercises to suit the participants' individual preferences for nutrition and daily physical activities, and included trigger recognition, diet analysis, self-control and awareness learning, and tools for maintaining new habits. An initial conference was targeted at the participants' general knowledge of obesity, and the importance of physical activity and nutrition. The conference was followed by four motivational therapy workshops, which were focused on food preferences, physical activity and lifestyle choices. The workshops allowed participants to work in small groups (maximum 20 per group) and to immediately put into practice the knowledge they had acquired.

### 2.3. Study design

The FSASD covers eight city areas corresponding to eight different centres, five of which were assigned to the

intervention group. Following allocation, any HCP from any of these five agencies working 60% or more of the time was eligible, and encouraged to participate in the programme. Exclusion criteria were known pregnancy and any medical contraindication that would limit physical exercise. Three agencies were assigned to serve as the control group, where FSASD employees did not receive any of the intervention programmes, but benefited instead from a single workshop at the end of the study. However, the same approaches were offered to the controls and to those not participating in the programme at the end of the 1-year study.

Between September and December 2007, 551 participants were screened for inclusion and 173 agreed to participate. Of these, 129 were assigned to the intervention group and 44 to the control group. However, 46 subjects (35 from the intervention group and 11 from the control group) interrupted their participation and were not included in the 12-month follow-up.

At baseline and at 6 and 12 months, all participants, including controls, had a study checkup carried out by a nurse (C.B.) who was not blinded to participant allocation. During the checkup, anthropometric and physical parameters were collected, and body composition analyzed using the Tanita Bioimpedance Balance (Tanita International Division, West Dryton, UK).

Blood analyses were obtained at each scheduled appointment, and included fasting glucose, total cholesterol, low-density lipoprotein (LDL) and high-density lipoprotein (HDL) cholesterol, and triglycerides. In cases of highly abnormal values, participants were informed of their results and encouraged to visit their primary-care physician. The metabolic syndrome (MetS) was defined according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP–ATP III) [13]. Subjects who met three or more of the following criteria were considered to have the MetS: waist circumference greater or equal to 102 cm for men and greater or equal to 88 cm for women; fasting glucose greater or equal to 5.6 mmol/L or treatment of previously diagnosed type 2 diabetes; triglycerides greater or equal to 1.6 mmol/L; HDL cholesterol less than 1.04 mmol/L for men and less than 1.29 mmol/L for women, or treatment for previously diagnosed lipid abnormalities; and blood pressure greater or equal to 130/85 mmHg, or treatment for previously diagnosed hypertension.

At the end of each checkup, participants were invited to complete three questionnaires: the Short-Form Health Survey (SF-36) questionnaire [14]; the Food Frequency Questionnaire (FFQ); and the Physical Activity Frequency Questionnaire (PAFQ) [15]. The FFQ is an instrument that was developed and validated in the general Geneva adult population [16,17]. It records the diet of the past 4 weeks and lists 80 grouped food items with a ‘standard’ portion size. Respondents indicate their frequency of consumption and whether they consumed less than, the same as or more than the standard portion size. These data permit the evaluation of daily total energy intake (kcal), percentage of total energy provided by macronutrients, and intakes of dietary fibre (g/d) and alcohol (g/d).

The PAFQ measures total and individual activity-specific energy expenditures (EE). This was also developed in the general Geneva adult population and validated using a heart-rate

monitor [15]. It lists 70 physical activities grouped by general type (for example, occupational, housework, leisure time and sports), and the reference period is the past 7 days. About 20 min are required for respondents to indicate the number of days (0 to 7) and duration per day (0 to 10 h in 15-min increments) they spent performing each activity. Sedentarity was defined as less or equal to 10% of the total daily EE spent at four or more times the basal metabolic rate (BMR).

Primary outcomes were modifications of anthropometric parameters (body weight, waist circumference, fat mass), lifestyle parameters related to nutrition and physical activity, and modifications of the number of MetS components present during the follow-up. Secondary outcomes were modifications of blood pressure and biological parameters (fasting glucose, lipid profile).

The study had the approval of the Ethics Committee of the Geneva Physician’s Association (an approved institutional review board).

#### 2.4. Statistical analyses

Means and standard deviations (SDs) were calculated for normally distributed variables, and medians and interquartile ranges were used for non-normal data. Multilevel mixed models were used to account for repeated measures at the participants’ level, and to adjust for confounding factors and patients’ baseline characteristics. Linear mixed models were built for continuous variables, and generalized mixed models for dichotomous outcome variables. To allow comparisons of the intervention and control groups, an interaction term between allocation and time period was included in the model. Analyses were conducted using Stata version 10.0 software (StataCorp, College Station, TX, USA), and statistical significance was defined as a  $P$  value  $< 0.05$ .

### 3. Results

Physical and anthropometric parameters of the studied population at baseline are shown in Table 1. Most participants were women and nearly one-third were registered nurses. At baseline, participants in the intervention and control groups did not differ in terms of age, gender, anthropometric parameters or lipid profile. In addition, 47% of the participants in both groups were overweight—defined as a body mass index (BMI) greater or equal to 25 kg/m<sup>2</sup>—and 17% and 20% of the intervention and control groups, respectively, had the MetS (a non-significant difference).

#### 3.1. Anthropometric, clinical and biological parameters

Table 1 summarizes the evolution of the physical and anthropometric parameters measured at 6 and 12 months. Both group participants significantly improved their anthropometric parameters.

In the intervention group, the average weight loss was 1 kg at 6 months ( $P < 0.01$ ), which was maintained at 12 months, compared with baseline ( $-0.5$  kg;  $P < 0.05$ ). On the whole, 60% of

Table 1  
Physical and anthropometric parameters in the study participants.

	Intervention group			Control group		
	Baseline	Change at 6 months	Change at 12 months	Baseline	Change at 6 months	Change at 12 months
Body weight (kg)	69.6 (43–116)	−0.99**	−0.50*	70.3 (47–102)	−1.02*	−0.53
BMI (kg/m <sup>2</sup> )	26.2 (19–41)	−0.38**	−0.19*	25.8 (18–37)	−0.37*	−0.17
SBP (mmHg)	117 (90–160)	−3.9**	−5.9**	119.4 (90–160)	−4.9*	−6.4**
DBP (mmHg)	71.6 (40–100)	+0.1	+1.5	71.1 (60–90)	+2.1	+3.4**
Waist circumference (cm)	85.6 (62–126)	−0.1	−1.4**	86.9 (62–114)	+0.6	−2.1**
Fat mass (%)	32.0 (14–51)	−1.1**	−0.6*	31.7 (11–48)	−0.8	−0.7

Data are expressed as mean (range); BMI: body mass index; SBP/DBP: systolic/diastolic blood pressure.

\*  $P \leq 0.05$ .

\*\*  $P \leq 0.01$  vs baseline.

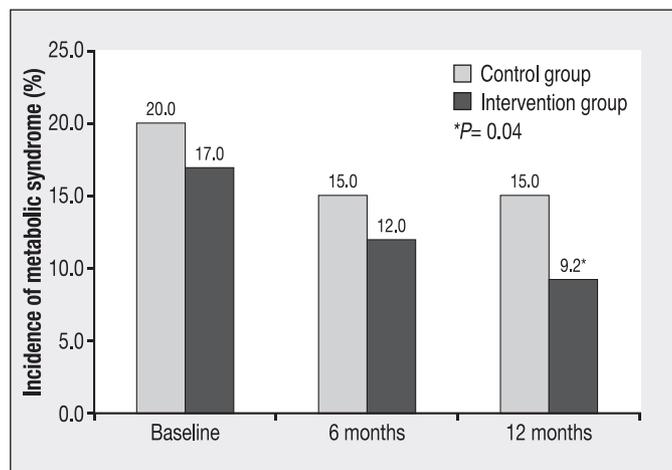


Fig. 1. Incidence of the metabolic syndrome. □: Control group; ■: Intervention group; \* $P=0.04$ , absolute reduction in the intervention group at 12 months.

the intervention participants lost weight, 30% stayed the same weight and 10% gained body weight. Also, significant waist-circumference changes were observed, but only at 12 months, with a mean reduction of 1.4 cm ( $P < 0.01$ ). Fat mass measured by the bioimpedance method showed a significant reduction of 1.1% ( $P < 0.01$ ) at 6 months and 0.6% ( $P < 0.05$ ) at 12 months compared with baseline.

The control group also showed significant weight loss at 6 months (−1.02 kg;  $P < 0.05$ ), but this was not maintained at 12 months. However, waist circumference in controls was significantly decreased at 12 months (−2.1 cm;  $P < 0.01$ ).

Systolic blood pressure was reduced in both groups. In the intervention group, an average reduction of 3.9 mmHg ( $P < 0.01$ ) was observed at 6 months and 5.9 mmHg ( $P < 0.01$ ) at 12 months. No effect was observed on diastolic blood pressure. In the control group, systolic blood pressure was reduced at 12 months (−6.4 mmHg;  $P < 0.01$ ), but diastolic pressure showed an increase of 3.4 mmHg ( $P < 0.01$ ).

Lipid profile was also improved among the intervention group participants. LDL cholesterol showed a decrease

at both 6 and 12 months versus baseline values ( $P < 0.01$ ). In the controls, no modifications of LDL cholesterol were observed during the survey (Fig. S1; see supplementary material associated with this article online). In the intervention group, there was an improvement in HDL cholesterol (+0.22 mmol/L;  $P < 0.01$ ) at 12 months and, as a consequence, these changes significantly reduced the total/HDL cholesterol ratio ( $P < 0.01$ ). However, triglycerides remained unchanged and a moderate fasting glucose reduction was observed at 12 months ( $P < 0.05$ ). In addition, incidence of the MetS was reduced from 17% to 12% at 6 months and to 9.2% at 12 months, giving an absolute reduction of 7.8% at 12 months ( $P = 0.04$ ; Fig. 1).

In the control group, no significant changes in biological parameters were observed during the survey (Table 2).

### 3.2. Quality of life and self-reported health status

All participants answered the Health Survey SF-36 questionnaire. Scores were in the middle range and did not vary throughout the observation period. They also did not significantly differ between the intervention and control groups at any time during the study.

### 3.3. Food intake

Table 3 summarizes the evaluation of food intakes and physical exercise on a daily basis. In the intervention group, total calorie intake decreased significantly over time, achieving an average reduction of 226 kcal/d at 6 months ( $P < 0.05$ ) and a reduction of 391 kcal/d at 12 months ( $P < 0.001$ ). However, despite the fact that the percentage of food lipids tended to decrease over time, this trend did not reach significance ( $P = 0.07$  at 12 months).

The control group showed a significant increase in lipid consumption at 6 months compared with baseline. On comparing the intervention and control groups, the former group showed a reduced fat intake at 6 months (−1.1% vs +2.0%,

Table 2  
Biological parameters in the study participants.

	Intervention group			Control group		
	Baseline	Change at 6 months	Change at 12 months	Baseline	Change at 6 months	Change at 12 months
LDL-C (mmol/L)	3.28 (0.42–5.84)	−0.37**	−0.36**	3.37 (1.31–6.86)	+0.04	+0.0
HDL-C (mmol/L)	1.48 (0.60–2.59)	+0.10**	+0.22**	1.52 (0.66–2.56)	+0.06	+0.06
Total C/HDL-C	2.37 (0.30–7.38)	−0.41**	−0.57**	2.41 (0.76–5.59)	−0.14	−0.17
Triglycerides (mmol/L)	1.41 (0.36–7.34)	+0.0	+0.1	1.51 (0.56–7.34)	−0.05	+0.16
Fasting glucose (mmol/L)	6.2 (3.3–24)	+0.1	−0.4*	6.4 (3.9–11.4)	+0.2	−0.1

Data are expressed as mean (range); LDL-C/HDL-C: low-density/high-density lipoprotein cholesterol.

\*  $P \leq 0.05$ .

\*\*  $P \leq 0.01$  vs baseline.

respectively;  $P < 0.05$ ; Fig. S2; see supplementary material associated with this article online).

### 3.4. Physical activity (PAFQ) and pedometer measurements

Self-declared physical activity increased in the intervention group over time. The amount of low-intensity physical activity tended to increase at 6 months and was significantly different at 12 months versus baseline (Table 3). Moderate-intensity exercise tended to increase at 6 months as well, but this change was not sustained, while intense exercise did not appear to differ during the survey. In the intervention group, the rate of sedentary decreased from 53% at baseline to 38% at 6 months and 51% at

12 months ( $P = 0.049$ ). In the control group, the rate of sedentary did not change over time. In fact, on comparing the two groups, the controls showed a higher proportion of people doing moderate physical activity at baseline than in the intervention group (8% vs 5%, respectively;  $P < 0.05$ ).

## 4. Discussion

The present study aimed to evaluate the impact of a multifaceted interventional programme on lifestyle and medical outcomes in healthcare providers in a home-care nursing setting. Our findings showed improvement of health status in nursing agency employees in terms of weight loss and modification of several metabolic parameters. In particular, significant

Table 3  
Food intake and physical activity according to the Physical Activity Frequency Questionnaire (PAFQ).

	Intervention group			Control group		
	Baseline	Change at 6 months	Change at 12 months	Baseline	Change at 6 months	Change at 12 months
Rest metabolism (RM) <sup>a</sup> (kcal/min)	0.98 (0.96–0.99)	−0.002	+0.003	1.00 (0.96–1.03)	−0.001	−0.011
Total caloric intake (kcal/d)	1988 (1803–2172)	−226 <sup>c,*</sup>	−391 <sup>c,***</sup>	1873 (1652–2095)	−259	−337
Protein intake (%)	16 (15–17)	+0.4	+0.5	16 (15–17)	0	0
Lipid intake (%)	35 (33–36)	−1.1	−1.3	35 (33–37)	+2.0 <sup>b,*</sup>	+1.0
Carbohydrate intake (%)	48 (46–50)	+0.6	+0.4	48 (46–50)	−1.0 <sup>b,*</sup>	+1.0
Low-intensity physical activity (3–3.9 × RM; %)	28 (26–31)	+1.5	+3.4 <sup>a,*</sup>	27 (22–31)	+5.0	+4.0
Moderate physical activity (4–4.9 × RM; %)	8 (6–10)	+1.9	+0.4	5 (3–7) <sup>b,*</sup>	+2.0	+4.3
Intense physical activity (≥ 5 × RM; %)	4 (2–6)	+0.6	−1.0	4 (3–6)	−1.1	−3.0

Data are expressed as mean (range).

<sup>a</sup> Adjusted for gender, age, body weight and height.

<sup>b</sup> Control vs intervention group.

<sup>c</sup> Intervention group vs baseline.

\*  $P \leq 0.05$ .

\*\*\*  $P \leq 0.001$ .

reductions of body weight, BMI and fat mass as well as waist circumference were observed during the survey among participants who followed the specific educational workshops. They also improved their systolic blood pressures, lipid profiles and fasting glucose levels, and incidence of the MetS was markedly reduced by nearly 50% by the end of the 12-month follow-up (17% vs 9.2% at baseline).

These observations may reflect food intakes, which were progressively reduced throughout the follow-up, and the increase in physical activity among participants. The percentage of subjects engaging in physical activity in the intervention group increased at 12 months. Furthermore, objective modifications correlated with self-reported changes, particularly for nutritional adaptations. Moreover, self-reported changes were consistent with specific educational items proposed for participants (such as lower lipid intakes, more low-intensity physical activity and less sedentarity).

On the other hand, it is of interest that the employees not following the educational workshops and assigned to the control group showed improvements in some anthropometric parameters (weight loss, waist circumference and systolic blood pressure) similar to those in the intervention group. Thus, it appears that the control group participants also changed their behaviour and certain parameters during the survey. It might be speculated that participants from the intervention group were in contact with the controls and so may have influenced their behaviour (shared advice, educational content description and material, and encouragement). Another explanation might be that the lifestyle interventions proposed for some employees and the fact that all participants were evaluated (for anthropometric and biological parameters, and lifestyle) had effects independent of the study group assignment. The possibility of the 'Hawthorne effect' described in the literature should also be mentioned. This effect may be defined as the unexpected and unexplained reaction to experimentation in human subjects who are aware of participating in a study [18]. In fact, the Hawthorne effect could be considered beneficial for an interventional educational programme, as it constitutes an easy way to extend the effects of the programme to non-participants [19,20].

On analyzing the differences between the control and intervention groups, there were no statistically significant differences during the follow-up. This might have been due to the study power being insufficient to detect any differences between the groups.

However, the strength and originality of our study are based on the high quality of the training method (educational workshops) developed by an institution specializing in patient education and research in the field. Repeated measures and the use of widely recognized and validated lifestyle questionnaires are another strength of the study. To our best knowledge, this is the first study to focus on healthcare providers with the aim of modifying their behaviour to implement healthy lifestyle counselling for their patients.

There were no changes noted in quality of life between the intervention and control groups at any time. Indeed, changes in quality of life are dependent on many aspects, including health, personal, psychological, familial, economic and

environmental factors. However, despite the apparent changes in quality of life that were indirectly observed (positive comments of participants), again there may not have been sufficient power to detect changes in quality of life related to the educational programme based on the questionnaires, as this effect might have been attenuated by other, unmeasured, confounding factors.

The present study has several other limitations that should also be mentioned, including a small sample size, lack of randomization, a non-blinded design and no objective measures of food intake or physical activity. In addition, selection bias could have partly influenced our results, as only the most motivated subjects agreed to participate. On the other hand, such a bias is frequently present, and would be difficult to eliminate in the majority of studies evaluating educational programmes.

The small number of subjects in the control group should also be acknowledged. However, our goal was to measure whether the control group was affected indirectly by the educational group rather than to measure differences between the intervention and control groups. Transforming and spreading individual education to the wider community is an efficient way to affect the greater population.

In conclusion, our present results support the hypothesis that important lifestyle changes in healthcare providers are possible with relatively modest behavioural education and a relatively short period of time. Educational strategies and workshops are effective and easy to carry out. Healthcare providers are also important targets on which to focus lifestyle modifications because of their close contact with patients, and the ready transfer of information through concrete and personal practice counselling to their patients.

### Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

### Acknowledgement

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### Appendix A. Supplementary data

Supplementary material (Figs. S1 and S2) associated with this article can be found at <http://www.sciencedirect.com>, at <http://dx.doi.org/10.1016/j.diabet.2012.07.003>.

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