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Workplace health promotion: results of a combined multidisciplinary intervention over a long period – preliminary results

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Abstract. – OBJECTIVE: Obesity is a multifactorial disease that is one of the major public health problems. It is the result of the interaction between behavioral, social and endocrine-metabolic components. Already in the 80s, it was highlighted by the World Health Organization (WHO) that the workplace is an ideal setting for introducing health promotion programs. The aim of the present study was to implement a health promotion program among healthcare workers (HCWs) operating in an Emergency Hospital in Southern Italy, combining diet, sports activity and motivational support over a 24-month period.

PATIENTS AND METHODS: Participants were HCWs operating in an Emergency Hospital in Southern Italy. The inclusion criteria were as follows: overweight or obesity, i.e., body mass index (BMI) >25 kg/m², or waist circumference >102 cm (males), >88 cm (females); dyslipidemia without pharmacological treatment, i.e., total cholesterol >220 mg/dL, or high-density lipoprotein (HDL) cholesterol <35 mg/dL, or low-density lipoprotein cholesterol (LDL) >130 mg/dL, or triglycerides >200 mg/dL; fasting glucose levels >120 mg/dl and/or reduced tolerance to glucose or diabetes mellitus, without pharmacological treatment was determined through HbA1c.

RESULTS: The analysis was conducted on 36 participants. Follow-up was performed after twelve (T12) and twenty-four months (T24). The average systolic blood pressure (SBP) and diastolic blood pressure (DBP) values decreased during the time period. The average BMI of both male and female HCWs was significantly reduced from T0 to T12 and from T0 to T24. The triglyceride levels gradually decreased, but not significantly, from T0 to T24. The average blood glucose values decreased from T0 to T12 and from T12 to T24. The number of subjects who started to perform physical activity increased significantly between T0 and T12 and between T0 and T24.

CONCLUSIONS: The findings have led to a significant change in HCWs' lifestyles and body perceptions, as well as their ability to work.

Key Words:
Diet, Sport activity, Motivational support, Health care workers.

Introduction

As defined by the World Health Organization (WHO), health promotion is the process of enabling people to increase control over their health and improve it. The action goal is the behavior of individuals, asking for the implementation of a number of social and environmental interventions[1,2]. Many studies[3,4] have shown that the work-

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place is the ideal setting for implementing health promotion measures. The Work Health Promotion (WHP) is a global project that has its roots in the 1986 "Ottawa Charter" where the WHO[5] highlighted the importance of "health promotion" also in the workplace, and which is reflected in the development of Total Worker Health (TWH). One of the major WHP objectives is a correct diet, namely the Mediterranean one, therefore, the fight against obesity[6]. Obesity is a multifactorial disease that is one of the major public health problems[1,7]. It is represented by an imbalance between food intake and energy expenditure, resulting in a diet that is too rich in high-calorie and poorly nutrient foods, together with a sedentary lifestyle[1,7]. It is the result of the interaction between behavioral, social, and endocrine-metabolic components[8]. Obesity and overweight increase the risk of developing many diseases like heart diseases, diabetes, sleep apnea, hypertension, etc.[8]. Also in Italy, over the last twenty years, obesity prevention and treatment policies have been of paramount importance, with a view to reducing the costs that the National Health System supports to care and assist patients with chronic diseases associated with obesity[9]. Italy's national strategy in the 2020-2025 National Prevention Plan (PNP) has developed in line with the objectives of the action plans promoted by the EU and the WHO[7,9].

Recently, our working group observed good health promotion results in a group of healthcare workers (HCWs)[6]. This health multidisciplinary promotion intervention combining diet, sports activity, and motivational support, has led to a significant change in HCWs' lifestyles and body perceptions, as well as their ability to work. However, one of the limits of the previous study[6] was the short period of the intervention and observation which lasted only 12 months. The present study extended the period of intervention and observation to 24 months, in order to observe the long-term effectiveness of the measures taken and then evaluate the persistence or improvement of the parameters.

Patients and Methods

Recruitment

The participants were HCWs operating in an Emergency Hospital in Southern Italy. Participation in the study took place on a voluntary basis during the mandatory health surveillance activities, according to Italian Law Decree (DL) 81/08, from January to May 2019. All HCWs invited to take part in the project were informed about the objectives and procedures of the study. It was not necessary to receive confirmation from the Ethical Committee as the activity is ruled by the Law Decree (DL) 81/08 within the health promotion actions[6,10]. Each participant gave informed written consent. The inclusion criteria were as follows: overweight or obesity, i.e., body mass index (BMI) >25 kg/m^2, or waist circumference >102 cm (males), >88 cm (females); dyslipidemia without pharmacological treatment, i.e., total cholesterol >220 mg/dL, or high-density lipoprotein cholesterol (HDL) <35 mg/dL, or low-density lipoprotein cholesterol (LDL) >130 mg/dL, or triglycerides >200 mg/dL; fasting glucose levels >120 mg/dl and/or reduced tolerance to glucose or diabetes mellitus, without pharmacological treatment was determined through HbA1c. 10 mL of peripheral blood was drawn in the morning after a fasting night to determine hematological parameters.

The exclusion criteria were refusal of written informed consent; diabetes mellitus under pharmacological treatment; dyslipidemia under pharmacological treatment; recent cancer diagnosis; pregnancy; or chronic diseases such as kidney failure, heart disease, and uncompensated endocrine disorders. No age limits were applied.

The following clinical parameters were measured: blood pressure, systolic and diastolic blood pressures (mmHg), these were measured three times using the left arm, with the subject seated and at rest for 5 min. The averages of the second and third readings were recorded. Waist circumference was measured to the nearest centimeter, using a flexible meter, at the end of exhalation, positioning the meter at the navel level. For the BMI, height and weight were measured, with the subject barefoot and lightly dressed, and their body mass index was calculated according to the formula weight (kg) divided by height (m) squared. Waist circumference was measured to the nearest centimeter, using a flexible meter, at the end of exhalation, positioning the meter at the navel level and other anthropometric parameters for a waist/hip ratio (WHR) index assessment[6]. The routine laboratory tests that were performed included liver and kidney function, cholesterol levels, triglycerides, blood sugar, and a protidogram. The body image dissatisfaction (BID) variable was used, calculated by subtracting the current FRS score from the ideal body size FRS score. A BID score ≥1 indicated that the HCWs "wished to be thinner"; a BID score <1 indicat-

ed that the HCWs "wished to be fatter"; a BID score of zero indicated that the HCWs were satisfied with their body. The level of physical activity was classified as low, moderate, or high, based on metabolic energy (MET). The work ability index (WAI) was used to assess work ability at T0, T12 and T24. The WAI scores were calculated according to the standard method provided by the Finnish Institute of Occupational Health (FIOH). The WAI is composed of the following factors: (1) current working ability as compared to the best period of life (0-10 points), (2) ability to work in relation to the demands of a task (2-10 points), (3) number of current diagnoses made by the doctor (1-7 points), (4) reduction in working ability due to disease(s) (1-6 points), (5) absences due to illness in the last 12 months (1-6 points), (6) personal forecast of working ability for the following two years (1.4 and 7 points), and (7) psychological conditions/resources (1-4 points). The total score ranged from 7 to 49. The objective was to detect any changes in working ability in relation to age, gender, pathologies, and the intervention studied (pre- and post-treatment WAI). The WAI was calculated by adding up the individual points. The higher the score, the better the ability to work. There are 4 different levels, i.e., low (score 7-27), moderate (score 28-36), good (score 37-43), and excellent (score 44-49). HCWs with a WAI score lower than 36 were classified as having low working ability, and HCWs with a WAI score higher than 37 were classified as having satisfactory working ability. Therefore, the WAI, with a view to prevention and health promotion, is a screening tool that can give an indication of a worker's state of well-being within a work organization[6]. Further data were collected using a standardized questionnaire aimed at assessing the degree of adherence to the Mediterranean diet, as validated by Martínez-González et al[11]. The higher the score, the closer the respondent's eating habits were to the Mediterranean model, i.e., poor adherence ≤5, average adherence 6-9, and good adherence ≥10. Subjects were tested at time zero (T0), after 6 months (T6), 12 months (T12) as described in the previous study, and after 24 months (T24), as reported[6].

Statistical Analysis

The data were analyzed using SPSS 22.0 software (SPSS-PC IBM Corp., Armonk, NY, USA). Once the normality of the distribution had been assessed, the quantitative variables were processed using the average and the relative standard deviation from the average, while the qualitative variables were assessed in terms of frequency. As to the comparison between the two averages, the Student's *t*-test was used for paired data. To compare several averages, the one-way variance analysis (ANOVA) was used. The frequency comparison was performed with Fisher's exact test. Two-tailed tests were used, with a nominal significance level of $p<0.05$.

Results

The sample was observed for a period of two years. 447 HCWs, who over five months (January-May 2019) underwent health surveillance pursuant to Law Decree 81/08 were selected as the study participants. 396 of the HCWs (88%) were ruled out of the study because they met the exclusion criteria; eight of the HCWs (2%) refused to enter the study; other five HCWs (1%) left the study in the period between T0 and T6, due to lack of time. The eight HCWs who did not agree to participate in the study gave the following reasons: four of them (50%) were already on a low-calorie diet, three (37%) had no time, and one (13%) wanted no lifestyle limitations. During the study period, T12-T24, 2 (1%) HCWs (1 male and 1 female) left the study as they were transferred to another workplace (Figure 1).

The study sample of 36 HCWs (100%) included n=16 (44%) male HCWs. Male and female groups were homogeneous, all of them worked shifts on all three shifts (Tables I, II).

Therefore, 36 HCWs were included in the study who met the inclusion criteria based on the following parameters: 12 HCWs (33%) had a BMI>25 kg/m^2, 22 HCWs (61%) had a BMI>25 kg/m^2 and total cholesterol>220, and 3 HCWs (8%) had a BMI>25 kg/m^2, total cholesterol>220, and increased fasting glucose. The mean values of diastolic blood pressure (DBP) and systolic blood pressure (SBP) were within normal ranges (60>DBP<90 mmHg and 100<SBP<140 mmHg), in both female and male HCWs. The average BMI values fell within the overweight range (BMI 25-29.9 kg/m^2), for both sexes. The average values of the waist-to-hip ratio (WHR) index were above the normal limits (0.95 for males and 0.80 for females). The average total cholesterol levels for males were above the normal range (120-220 mg/dL) as compared to females. The average HDL (40-80 mg/dL) and LDL (70-180 mg/dL) cholesterol levels were within normal ranges, with no difference between the sexes.

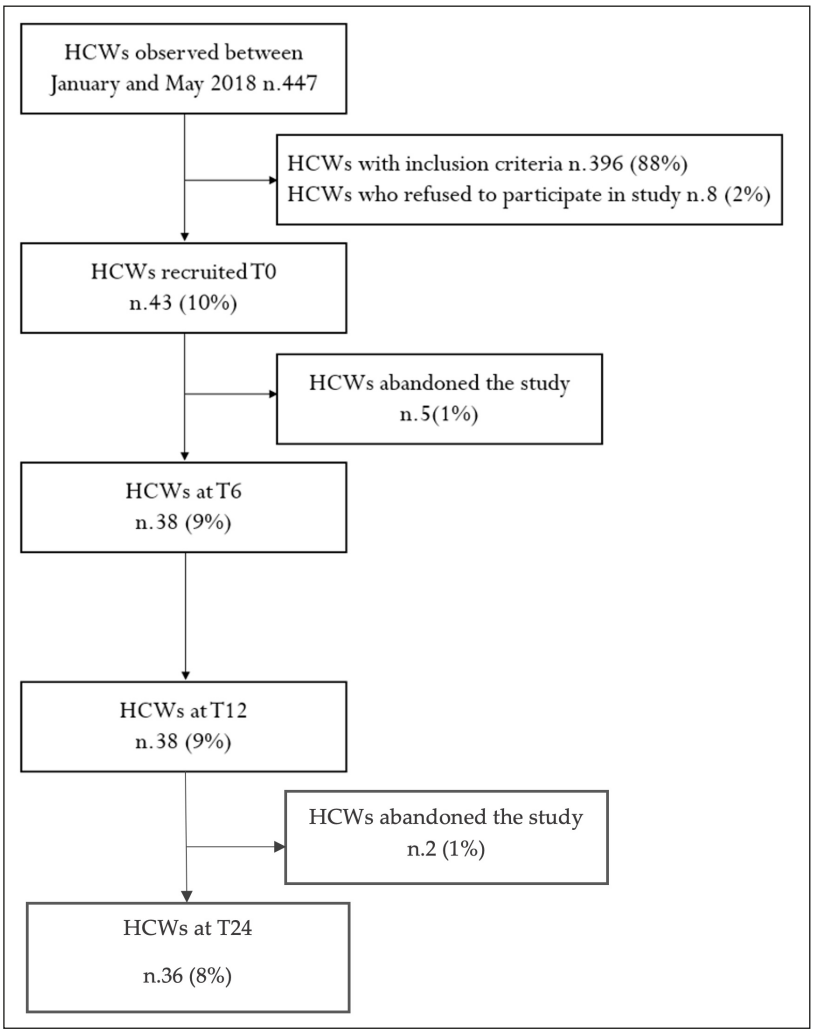

Figure 1. Flowchart of the sample studied.

Triglyceride and blood sugar levels were within normal range, although the average values were high. Finally, total calorie consumption was higher in male than female HCWs, but not significantly higher. It should be noted that only 25% (n=4) of the male HCWs and 30% (n=6) of the female ones practiced sports activity. Follow-up was performed after twelve (T12) and twenty-four months (T24).

Table I. Features of the sample at T0, divided by gender.

	Males (n=16)	Females (n=20)	*p*-value
Age (years)	48.1±7.1	48.9±8.1	n.s.
Cigarette Packages/year	5.1±10.6	4.7±9	n.s.
Medical doctors	3 (19%)	4 (20%)	n.s.
Technicians	4 (25%)	3 (15%)	n.s.
Nurses	9 (56%)	13 (65%)	n.s.
Working seniority	13.4±4	14.1±4.7	n.s.
Area of involvement	clinical (n=6) surgical (n=7) services (n=3)	clinical (n=6)	n.s.
		surgical (n=7)	n.s.
		services (n=5)	n.s.

Significance was assessed through Student's *t*-test and Fisher test.

Table II. Results observed at T0, T12 (after 12 months) and T24 (after 24 months), broken down by gender.

	T_0 (n=36)			T_{12} (n=36)				T_{24} (n=36)					
	Males (n=16)	Females (n=20)	Gender Differences	Males (n=16)	Females (n=20)	Males T0 *vs.* T12	Females T0 *vs.* T12	Males (n=16)	Females (n=20)	Males T12 *vs.* T24	Females T12 *vs.* T24	Males T0 *vs.* T24	Females T0 *vs.* T24
SBP (mmHg)	138.2±13.18	132.7±11.9	n.s.	128.1±12	126.2±10.8	**<0.05***	n.s.	127.9±11.9	126.4±9.7	n.s.	n.s.	**<0.05***	n.s.
DBP (mmHg)	88.3±7.1	86.1±6.2	n.s.	85.6±6	82.6±4.7	n.s.	**<0.05***	85.2±6.5	82.4±5	n.s.	n.s.	n.s.	**<0.05***
Waist circumference (cm)	97.4±7.6	88.4±9.2	**<0.05***	95±4.6	86.1±6.6	n.s.	n.s.	94.8±4.2	85.1±5.2	n.s.	n.s.	n.s.	n.s.
BMI (kg/m²)	26.8±3.8	26.7±5.2	n.s.	24.1±3.6	24.1±2.9	**<0.05***	**<0.05***	24±2.7	22.4±2.2	n.s.	**<0.05***	**<0.05***	**<0.05***
WHR index	0.97±0.11	0.92±0.09	n.s.	0.90±0.81	0.88±0.86	n.s.	n.s.	0.89±1.01	0.87±1.2	n.s.	n.s.	n.s.	n.s.
Total cholesterol (mg/dL)	221.2±30.5	218.1±23.9	n.s.	203.1±20.1	204±19.4	**<0.05***	**<0.05***	201.2±19.8	199.8±16.6	n.s.	n.s.	**<0.05***	**<0.05***
HDL cholesterol (mg/dL)	56.2±13.4	60.2±15.5	n.s.	56.9±11.3	61.9±14.3	n.s.	n.s.	57.1±10.1	62.9±14.4	n.s.	n.s.	n.s.	n.s.
LDL cholesterol (mg/dL)	147.6±21.1 .	146.7±23.1	n.s.	140.1±20.1	140.6±20.5	n.s.	n.s.	139.1±22.6	135.8±25.2	n.s.	n.s.	n.s.	n.s
Triglycerides (mg/dL)	161.4±75.7	155.5±66.6	n.s.	148.8±77.5	148.2±57.1	n.s.	n.s.	148.2±79.2	146.4±62.1	n.s.	n.s.	n.s.	n.s.
Blood glucose (mg/dL)	98.8±11.7	96.6±11.1	n.s.	93.2±9.5	89.4±9.6	n.s.	**<0.05***	92.4±10.4	89.1±5.4	n.s.	n.s.	n.s.	**<0.05***
Physical activity (n. sub.)	4 (25%)	6 (30%)	n.s.	16 (100%)	20 (100%)	**<0.05***	**<0.05***	16 (100%)	20 (100%)	n.s.	n.s.	**<0.05***	**<0.05***
Metabolic Equivalent (MET)	486.7±322.1	299.7±104.3	**<0.05***	615.6±345.1	417.9±230.3	n.s.	**<0.05***	618.2±356.2	420.7±220.1	n.s.	n.s.	n.s.	**<0.05***

SBP, systolic blood pressure; DBP, diastolic blood pressure; WHR, waist/hip ratio; *Statistically significant difference between two groups.

The average SBP and DBP values decreased during the time period, i.e., SBP significantly in males from T0 to T12 and from T0 to T24, and DBP significantly in females from T0 to T12 and from T0 to T24, while no significant difference was observed between T12 and T24 regarding blood pressure values, in both groups. Waist circumference was significantly different between males and females at T0, but no significant reduction for males and females during the study period (T12-T24) was observed. The average BMI of both male and female HCWs was significantly reduced from T0 to T12 and from T0 to T24. A significant reduction was observed in BMI values in females from T12 to T24. The HCWs were not obese (BMI>30 kg/m^2) but were mainly overweight (BMI>25 kg/m^2). No significant changes were observed regarding the WHR index.

As regards metabolic variables, the intervention led to a significant reduction in total cholesterol for both male and female HCWs from T0 to T12 and from T0 to T24. Also, between T12 and T24, a reduction of this level was observed, though not a significant one. From T0 to T24, the HDL levels increased, while the LDL levels decreased progressively, but not statistically significantly. The triglyceride levels gradually decreased, but not significantly, from T0 to T24. The average blood glucose values decreased from T0 to T12 and from T12 to T24 and were statistically significant for females from T0 to T12 and T0 to T24.

Finally, as far as sports activity was concerned, everyone took up a sporting activity, changing their lifestyle. The number of subjects who started to perform physical activity increased significantly between T0 and T12 and between T0 and T24, with a result of a 100% adherence to physical activity of the study participants both in T12 and in T24. As to metabolic equivalent (MET) levels, measured in energy consumption, they turned out significantly different between males and females at T0. Furthermore, a statistically significant increase in females, compared to males, was observed from T0 to T12 and from T0 to 24. No significant difference was detected in the period from T12 to T24.

As reported in Table III, the adherence to the Mediterranean diet, evaluated at T0 and T12, significantly (p=0.001) increased both in male and female HCWs. Furthermore, continuous adherence to the Mediterranean diet was observed among HCWs at T24. No significant difference was observed between T12 and T24. The average results of the WAI showed a significant shift from "low work performance" at T0 to "good work performance" at T12 and T24. No significant difference was observed between T12 and T24 (Table III).

The analysis of self and body dimensions enabled us to observe at T0 the "desire to be thinner", in the entirety (100%) of the sample. At T12, 75% (n=12) of males and 60% (n=12) of females were "satisfied with their bodies", while the rest remained in need of losing more weight although no adverse physical results were observed. At T24, 87.5% (n=14) of male and 80% (n=16) of female workers were significantly "satisfied with their bodies", observing, therefore, significantly higher values than at T0. From T12 to T24, no significant difference was observed (data not shown in Table III).

Discussion

Work represents a major aspect of life for people and, with sleeping hours, takes up a significant part of the day[4,6,12,13]. Like school in developmental age, the workplace is a microcosm for adults, full of aspects that can promote health or, vice versa, damage it[14]. This makes the workplace an ideal setting for improving health and addressing many of the key factors of the obesity epidemic[14,15].

Considering the aging population in many Western countries, prolonging the working period has become a pressing need; therefore, prevention of chronic diseases is essential[6]. In the present study, we proposed a health promotion program, with a particular focus on diet and physical well-being. The health promotion intervention provided for the HCWs was characterized by working on diets and physical activity evaluation with the outcomes including work

Table III. Features of the sample at T0, divided by gender.

	T_0 Males	T_{12} Males	T_{24} Males	p-value	T_0 Females	T_{12} Females	T_{24} Females	p-value
Adherence to diet	4.3±2.6	7.8±2.1	7.8±1.8	**0.001***	4.7±2.1	7.9±1.7	8.2±1.6	**0.001***
WAI index	28.2±7.5	38.2±8.2	38.4±6.9	**0.001***	26.7±7.1	37.8±6.1	38.2±6.3	**0.001***

*Statistically significant difference between two groups.

performance and perception of one's own image. A sample with eligibility characteristics were 10% (n=43) of the entire population studied (n=447). These data were in line with that of Southern Italy[16]. Out of 43 (100%), 38 (88%) participated in the study until T12. Only, 36 (83%) participated in the study from T0 to T24 because two subjects (1 male and 1 female) left the study after T12 as they were transferred to another hospital. Although the values of blood pressure at T0 were within the normal range for SBP (<140 mmHg) and DBP (<90 mmHg), a reduction in SBP levels for the males was still detected between T0 and T12 and between T0 and T24 which was statistically significant, though not significant between T12 and T24. As to the female sample, a significant reduction in DBP was observed between T0 and T12 and between T0 and T24. This is in line with previous studies[17,18] that show a reduction in blood pressure values among subjects who play sports and adopt a controlled diet, with respect to those who follow a sedentary lifestyle.

Overall, all parameters relating to the lipid profile decreased, except for the HLD cholesterol parameter which increased. Of all, in particular, a significant reduction in total cholesterol levels was observed for T12 and T24 compared to T0. This may be related to two reasons: the first is that 100% (n=20) of females and males (n=16) continued to carry out physical activity throughout the study period. The second reason is related to a full adherence to the Mediterranean of males and females during the study period. As is known, the Mediterranean diet intervention in overweight and obese subjects reduce plasma cholesterol levels[19]. Also, the average blood glucose values decreased from T0 to T12 and from T0 to T24 significantly for females as compared to male HCWs.

These data are very positive as both females and males have continued to carry out physical activity, despite the pandemic. Indeed, during the pandemic period, outdoor activities were restricted to a minimum[20]. During the first pandemic period, gyms, swimming pools and places where to practice sports in Italy were closed[10,21]. Although the activity consulting was carried out only in the first 12 months of the study, its impact helped to maintain high levels of motivation among study participants. In fact, it was possible to observe that at 24 months, 100% of the participants kept on doing physical activity. In consequence of diet and physical activity customized for each worker, a significant reduction in BMI at T12 and T24 was observed, whereas there were no significant reductions in waist size and WHR index at T12 and T24, as compared to T0. As to females, a significant reduction in BMI level was also observed between T12 and T24. As regards the WAI index, the results were significantly better in time T12 and T24 than in T0.

Body image satisfaction (BID) parameters were also significantly higher at T12 and T24 than at T0, with the females more satisfied with their appearance than males. This is an important parameter to be taken into account, as it can be considered an indicator of the effect of the dietary and physical program. In fact, previous studies[22,23] have shown lower BID levels in relation to increased BMI levels. Strengths of the study are the long period of observation and the low cost of the study. Weaknesses concern the small sample size and the BMI of the participants. In particular, no obese subjects were recruited for the study. Furthermore, it cannot be excluded that during the pandemic period, workers paid more attention to their diet, being obliged by current regulations to stay at home.

Conclusions

The study conducted on a group of HCWs with sedentary lifestyles over 24 months of observation showed excellent results on most of the parameters examined. The introduction of the Mediterranean diet and regular physical activity brought BMI values within the normal range, in line with the objectives of the Italian PNP 2020-25 and WHO program. This highlights how a combined intervention of personalized diets, counselling and physical activity incentives have led to stable results over long periods of observation. In conclusion, the workplace proved to be an ideal setting for the adoption of health promotion policies. Future studies on larger populations and on different work sectors may help give strength to this kind of programs.

Authors' Contributions

Conceptualization, Serena Matera, Venerando Rapisarda, Karolina Kaźmierczak-Siedlecka and Lucia Rapisarda; Data curation, Serena Matera; Formal analysis, Venerando Rapisarda, Karolina Kaźmierczak-Siedlecka, Lucia Rapisarda and Giuseppe Musumeci; Funding acquisition, Venerando Rapisarda; Investigation, Veronica Filetti and Ermanno Vitale; Methodology, Venerando Rapisarda, Federico Roggio and Ermanno Vitale; Project administration, Venerando Rapisarda; Software, Veronica Filetti, Lucia Rapisarda, Michele Vecchio, Giuseppe Musumeci and Ermanno Vitale; Supervision, Venerando Rapisarda; Validation, Serena Matera and George Dounias; Visualization, Veronica Filetti, George Dounias, Michele Vecchio, and Federico Roggio; Writing – original draft, Federi-

co Roggio and Ermanno Vitale; Writing – review and editing, Serena Matera, George Dounias and Giuseppe Musumeci. All authors have read and agreed to the published version of the manuscript.

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Informed Consent
Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest
The authors declare no conflict of interest.

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Ethics Approval
It was not necessary to receive confirmation from the Ethical Committee as the activity is ruled by the Law Decree (DL) 81/08 within the health promotion actions.

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