sustainability

MDPI

Article

Effects of a Yoga Program in Reducing Cardiovascular Disease Risk Factors in Workers of Small Workplaces: A Pilot Test

Won Ju Hwang [1], Jin Ah Kim [2,*] and Ji Sun Ha [1]

[1] College of Nursing Science, Kyung Hee University, Seoul 02447, Korea; hwangwj@khu.ac.kr (W.J.H.); hajs@khu.ac.kr (J.S.H.)

[2] Department of Nursing, Gyeongju University, Gyeongju 38065, Korea

* Correspondence: kimja@gu.ac.kr; Tel.: +82-2-961-0852

Received: 6 October 2020; Accepted: 27 November 2020; Published: 1 December 2020

Abstract: The purpose of this study was to evaluate the effects of a yoga program provided to workers in small businesses to reduce cardiovascular disease (CVD) risk factors. A nonequivalent control group pre/post-test design was used. The experimental group (n = 31) was assigned a yoga program consisting of yoga postures designed for meditation, strengthening, stretching, and balancing, given twice weekly for 12 weeks. The control group (n = 38) was given no other intervention. The mean age was 48.1 years old in the experimental group and 47.7 years old in the control group. Three trained investigators collected the questionnaires and one month after completing the 12-week yoga program, the same questionnaires that were administered at baseline were again administered. Psychosocial variables (depressive symptoms and job stress), health promotion behaviors, and body measurements (weight and waist circumference) were measured for the program evaluation. The yoga program was effective in improving waist circumference (from 81.8 to 79.2, $p < 0.001$) and diastolic blood pressure (from 81.0 to 79.1, $p = 0.004$) as compared to the control group. Furthermore, the experimental group's job stress score decreased from 1.38 to 1.02, but it was not statistically significant ($p = 0.240$). A yoga program could be a useful intervention for workers with CVD risk factors, but it was not effective in psychological factors such as job stress and depression. A long-term intervention approach is important to confirm the psychosocial effect. Therefore, future research is needed to investigate the long-term outcomes of such interventions.

Keywords: blue-collar workers; intervention study; health promotion; cardiovascular disease

1. Introduction

As of 2018, the number of small enterprises in Korea reached 2,649,967, accounting for 99.8% of all enterprises, and the number of workers in small enterprises accounted for 83.0% (15,818,937) of the entire worker pool [1]. Furthermore, the industrial accident rate in small enterprises is 0.60%, which is higher than the rate of 0.24% in medium-sized or larger enterprises with more than 300 workers [1]. The most prevalent problem among workers is conditions related to physically burdening work (32.3%), followed by lower back pain (31.9%), pneumoconiosis (9.7%), and cardiovascular disease (CVD; 6.8%). Statistics data showed that CVD (39%) was the second cause of mortality for work-related accident death in 2013, but it became the first cause among them in 2018 [1]. According to many previous studies [2–4], workers in small workplaces are at high risk of developing cardiovascular disease due to various occupational environmental factors. Firstly, workers in small workplaces suffer from physical fatigue caused by increased physical labor due to incessant physical work and lack of human resources. Moreover, lack of human resources leads to overtime work. For this reason, workers have irregular lifestyles such as late-night meals, poor sleep quality, lack of sleeping time, and lack of exercise [3]. Secondly, workers have a low level of knowledge and risk perceptions for the CVD diseases in small-sized workplaces [3], because of lower educational level and increased age compared with workers in medium- and large-sized workplaces [4]. Thirdly, employers are inclined to pursue company profits over workers' health because of economic difficulties in small-sized workplaces [3]. Finally, despite the vast pool of workers in small enterprises and lots of CVD risk factors in small-sized workplaces, workers' health is currently not managed systematically due to a lack of on-site health managers, which has led to poor health behavior and health status among workers [2]. Therefore, intervention studies to reduce CVD risk factors for workers in small-sized workplaces are needed. Nowadays, research to reduce the risk of CVD among workers in small workplaces is constantly being studied [5,6]. Also, psychosocial factors such as job stress and depression are considered as CVD risk factors [6]. In particular, job stress, a factor found to have an impact on CVD in workers, refers to "the physical and emotional response in workers when their competence, resources, and needs fall short of the work requirements" [7]. Job stress has emerged as a common occupational health problem second only to musculoskeletal diseases. Job stress is a key risk factor that not only induces CVD [8–14], but also contributes to financial loss and reduced productivity as a result of disasters and accidents, which can undermine the competitiveness of local communities as well as the nation. For this reason, job stress is acknowledged as a factor that threatens the development and health of business owners, local communities, and the nation [15]. The Occupational Safety and Health Research Institute (OSHRI) investigated working environments of a sample of Korean workers, and reported that 18.4% and 15.1% of male and female workers, respectively, experience job-related stress [16]. Approximately 95.7% of workers of small enterprises were found to have diseases caused by overtime work and stress [1]. These findings highlight the need of interventions focused on psychosocial aspects to prevent occupational diseases in small enterprises.

Yoga is empirical evidence of the mechanism for reducing stress; three mental mechanisms such as positive affect, mindfulness, and self-compassion and biological mechanisms (posterior hypothalamus, interlecukin-6, c-reactive protein, and cortisol) are presented in the positive effect. The suppression of the hypothalamus and cortisol was confirmed in the relationship between yoga and stress [17,18]. Furthermore, yoga is a type of exercise that corrects imbalances of the body and mind, and facilitates the recovery of humans' innate capacity to maintain balance [19]. The exercise involves practicing physical postures that stabilize the mind, and it relieves depression or physical stress by improving flexibility, facilitating the flow of physical energy, and improving physical functions, such as visceral functions, thereby promoting health [20,21]. Yoga has been found to have diverse physical and emotional effects, including enhancing pulmonary functions, reducing oxygen consumption, regulating blood pressure, reducing cardiovascular risk factors, and reducing pain and anxiety [21–24]. Yoga encompasses complementary and integrative therapy approaches with verified efficacy and stability [25], and it involves easy and physically non-burdening motions, both of which render it an appropriate type of exercise to prevent CVD in workers of small enterprises.

In previous studies, when applied to various participants from children to the elderly [22–25], yoga has been reported to reduce anxiety and depression in hospitalized patients with mental health disorders [22], reduce middle-aged women's stress, cortisol, glucose, resting heart rate, diastolic blood pressure, and mean arterial blood pressure [23], reduce fatigue, pain, stress, and anxiety in patients with multiple sclerosis [24], reduce autonomic nerves, salivary cortisol, immunoglobulin A, and stress index in elementary school students [26], and reduce blood pressure and cholesterol in the elderly with essential hypertension [27]. Meanwhile, studies that have tested the effects of yoga on workers found that yoga lowers job stress, psychological stress, and anxiety in office workers [28], lowers stress responses in professional workers [29], improves physical functions and pain in menopausal female workers [30], promotes weight loss in wellness center workers, lowers diastolic blood pressure, improves range of motion, decreases body fat, and improves quality of life [31]. However, there has been no study that investigated the effects of yoga in reducing CVD risks including psychological factors in workers of small enterprises. The purpose of this study was to investigate the effects of a yoga program to reduce CVD risk factors including psychological factors such as job stress and depression provided to workers in small enterprises.

The study examined the effects of a yoga program provided to workers in small businesses to reduce cardiovascular disease (CVD) risk factors, including psychological health behavior factors, and physical measurements.

2. Materials and Methods

2.1. Study Population

This was a quasi-experimental study with control groups different in number of participants and pre/post-test design that aimed to examine the efficacy of a yoga program in reducing CVD risk factors in workers in small enterprises who have CVD risks. The CVD risk groups were determined based on the CVD risk assessment criteria established by the Korea Occupational Safety and Health Agency (KOSHA) based on the 2003 WHO International Society of Hypertension guidelines (WHO-ISH) (① ≥SBP 140 mmHg or ≥DBP 90 mmHg, ② age (≥55 years in men, ≥65 years in women), ③ current smoking, ④ high cholesterol ≥240 mg/dL, ⑤ early occurrence of CVDs in family members in a direct line (<50 years), ⑥ obesity (≥body mass index 30 kg/m^2), physical inactivity, ⑦ atrial fibrillation) [32]. The participants in the experimental group have had one or more of the above risk factors. Sixty-nine workers in small enterprises based in S and Y city who provided informed consent were enrolled. The experimental group comprised 31 workers of a small audio equipment components manufacturing enterprise located in S city, and the control group comprised 38 workers of three small enterprises which manufactures copper fittings located in Y city, all of which are geographically distant from the experimental group (Control group 1: n = 11, Control group 2: n = 15, Control group 3: n = 12).

Sample size was determined using the G*Power 3.1 program. Based on a test of the means of the two groups, 52 people (26 for each group) were estimated to be required to attain significance $\alpha = 0.05$, with effect size d = 0.08 and power $(1 - \beta) = 0.80$. The effect size was estimated based on the study by Oh and Lee [29], which examined the effects of a yoga program on workers' stress.

Thirty-three participants were selected for the experimental group, and 41 participants who provided informed consents were selected for the control group, in consideration of possible dropouts. After excluding two participants from the experimental group for having a program participation rate of below 80% and three participants from the control group for leaving too many omissions in the questionnaire, a total of 31 and 38 participants from the experimental and control groups, respectively, were included in the final analysis. This study was conducted for six months from March to September 2015.

2.2. Experimental Design

2.2.1. Development of a Yoga Program

The yoga program was developed based on a systematic literature review performed by one nursing professor and two researchers about interventions that lower CVD in workers, with cooperation from a professional yoga instructor.

Figure 1 shows a flow chart of the yoga program intervention procedure. It provides the contents of the yoga program which was structured in three stages: warm-up, yoga poses, and cool-down through breathing and meditation. The first stage, the warm-up, comprised yoga breathing (one minute), meditation (two minutes), and simple stretching exercises (two minutes) for a total of five minutes. The second stage, the yoga pose stage, was designed to proceed for 20 min. During this stage, 11 yoga poses (sun salutation, triangle, cobra, grasshopper, alligator, chair, fish, kneeling, cat, spinal twist, extended puppy) were performed to relax the mind, strengthen muscles, and increase flexibility and balance. The third stage, the cool-down stage, comprised two minutes of yoga breathing and three minutes of meditation to focus the mind on oneself, to promote relaxation and reduce stress (Figure 1).

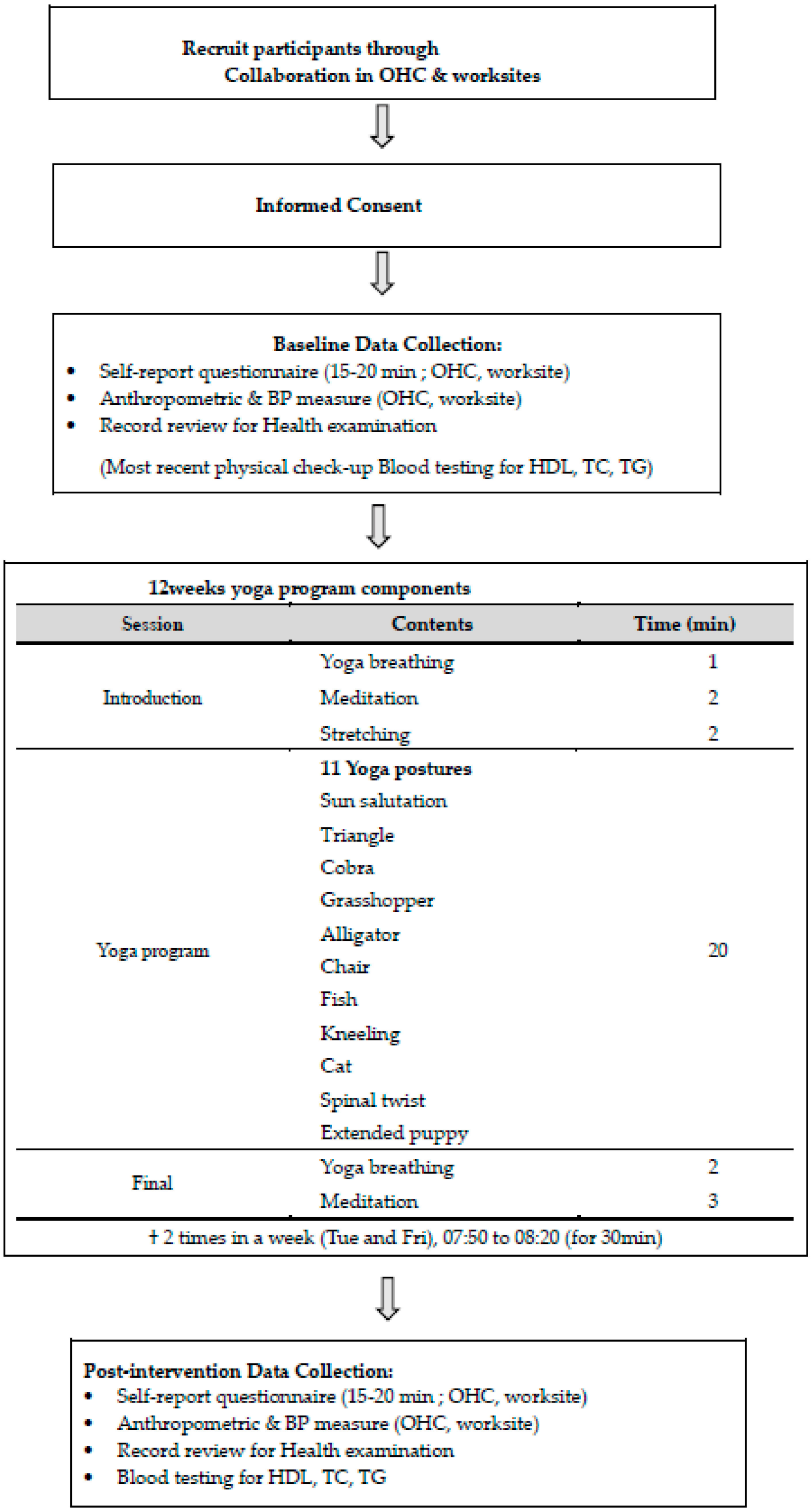

Figure 1. Flow chart of yoga program intervention procedure, OHC = occupational health center; BP = blood pressure; TG = triglycerides; TC = total cholesterol; HDL = high-density lipoprotein.

2.2.2. Baseline Measurement in Experimental and Control Groups

Prior to beginning the study, researchers selected experimental and control groups. Then, the investigator individually met with the owner or health manager of each small enterprise to obtain informed consent and request cooperation. Three trained investigators visited each enterprise in March 2015 to administer the questionnaires. The investigators explained to the workers about study aims, confidentiality, the use of collected data strictly for study purposes, and the contents of the yoga program, and obtained signed consent forms.

Structured questionnaires were administered only to those who provided informed consent to investigate workers' depressive symptoms, job stress, and health-promoting behaviors. It took about 15–20 min for each participant to complete the questionnaires. Height and weight were measured using an electronic measuring scale, and the body mass index (BMI) was computed. Waist circumference was measured around the ilium using a measuring tape. Blood pressure was measured using a manual sphygmomanometer after a 15-min resting period.

2.2.3. Experimental Treatment: Yoga Program

The yoga program, intended to lower job stress and CVD risks, was administered by a professional yoga instructor twice a week for 12 weeks (24 sessions) from 28 April 2015 to 26 August 2015. Each session was performed for 30 min, from 7:50 a.m. to 8:20 a.m., before work start. Yoga took place in a large auditorium, and no dropouts occurred during the 12-week yoga program. In contrast to the yoga group, the participants in the control groups were simply instructed to maintain their normal life without participating in regular physical activity programs.

2.2.4. Post-Intervention Measurement in Experimental and Control Groups

On 21 September 2015 (one month after completing the 12-week yoga program), the same questionnaires that were administered and the weight, waist circumference, and blood pressure that were measured at baseline were again administered and measured for both the experimental and control groups.

2.3. Ethical Considerations

This study was approved by the Institutional Review Board of K University Hospital (IRB No. KMC IRB 1443-06). Prior to recruiting the participants, the investigators visited the enterprises of interest to obtain informed consent and request cooperation from the owner and health managers. Before beginning the program, signed informed consent was obtained from all participants. The consent form included a description and contact information for the investigator, aims and method of the study, and statements noting that personal information would not be exposed and that the participants could withdraw at will at any point in the study. Anonymity of the collected data was ensured by using individualized allocation numbers (ANs), and all collected data were stored in a locked safe. A small gift was given to both the experimental and control groups for participating in the study after the study was completed, and a leaflet describing methods to reduce job stress and prevent and manage CVD was also provided to the control group at no cost after the study was concluded.

2.4. Measurements

2.4.1. Depressive Symptoms

Depressive symptoms were measured with the Korean version of the Center for Epidemiologic Studies Depression (CES-D) Scale, which was originally developed by Radloff [33] and translated and validated by Cho and Kim [34]. A higher score reflects more severe depressive symptoms. The reliability (Cronbach's α) of the Korean version of the CES-D was high (0.90) at the time of the development, but the Cronbach's α of the scale in this study was 0.67 at baseline, and 0.72 at post-intervention.

2.4.2. Job Stress

Job stress was measured using the Korean version of Effort–Reward Imbalance (ERI), which was originally developed by Siegrist et al. [35] and adapted by Eum et al. [36]. The questionnaire is based on the effort–reward imbalance model and consists of 17 items (6 items on effort and 11 items on reward). Each item is rated on a five-point scale from 1 to 5. Job stress is assessed using the ER ratio, obtained by dividing the total effort score by the total reward score. Specifically, the ER ratio is calculated by first adjusting the total reward score with a correction factor, 6/11 (=0.545) to transform the total scores of effort and reward to 1 (as there are 6 and 11 items in each of the subscales, respectively), and by computing the ratio with the transformed reward score as the denominator and the effort score as the numerator. An ER ratio less than 1 indicated low-level job stress, and an ER ratio greater than 1 indicated the presence of high-level job stress. The reliability (Cronbach's α) of the scale in previous studies [35,37] was 0.68 and 0.71, respectively, and that in this study was 0.90 at baseline point and 0.76 at post-intervention.

2.4.3. Health-Promoting Behaviors

Health-promoting behaviors were measured using the Health Promoting Lifestyle Profile II (HPLP II) developed by Walker, Shechrist, and Pender [38] and adapted by Hwang [39]. Each item is rated on a four-point scale: 1 for "not at all", 2 for "sometimes", 3 for "frequently", and 4 for "regularly." The HPLP II consists of 52 items, and the higher the score, the higher the level of health-promoting behavior. The reliability (Cronbach's α) of the overall scale at the time of the development was 0.94. The Cronbach's α values in the present study at baseline (post-intervention) was 0.93 (0.88).

2.5. Data Analysis

The data were analyzed as follows, using SPSS/WIN 22.0 software.

First, the participants' general and disease-related characteristics were analyzed, with results reported as mean and standard deviation or number and percent.

Second, the homogeneity of general characteristics between the experimental and control groups was analyzed with Chi-square tests and F-tests.

Third, the effects of the yoga program intended to reduce the CVD risk factors in workers of small enterprises were assessed using two-way repeated measure ANOVA.

3. Results

3.1. Homogeneity Testing

A total of 69 participants were enrolled, with 31 in the experimental group and 38 in the control group. There were no significant differences between the two groups in gender ($p = 0.354$), educational level ($p = 0.235$), marital status ($p = 0.437$), monthly income ($p = 0.601$), daily working hours ($p = 0.707$), or age ($p = 0.845$), confirming homogeneity between experimental group and control group (Table 1).

Table 1. Homogeneity Test for General Characteristics between Experimental and Control Groups (N = 69).

Characteristics	Categories	† Exp. (n = 31)	‡ Cont. (n = 38) n (%)/Mean ± SD				χ^2 or F	p
		n (%)/Mean ± SD	Group 1 (n = 11)	Group 2 (n = 15)	Group 3 (n = 12)	Total (n = 38)		
Sex	Male	14(45.2)	6(54.5)	6(40.0)	8(66.7)	20(52.6)	0.38	0.354
	Female	17(54.8)	5(45.5)	9(60.0)	4(11.6)	18(47.4)		
Educational level	≤Middle school	3(9.7)	0(0.0)	1(6.7)	2(16.7)	3(7.9)	2.89	0.235
	High school	23(74.2)	6(54.5)	8(53.3)	8(66.7)	22(57.9)		
	≥College	5(16.1)	5(45.5)	6(40.0)	2(16.7)	13(34.1)		
Marital status	Unmarried	8(25.8)	5(45.5)	5(33.3)	4(33.3)	14(36.8)	0.96	0.437
	Married	23(74.2)	6(54.5)	10(66.7)	8(66.7)	24(63.2)		
Monthly income (10.000 won)	≤100	1(3.2)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1.87	0.601
	100~200	13(41.9)	7(63.6)	1(6.7)	5(41.7)	13(34.2)		
	201~300	7(22.6)	2(18.2)	5(33.3)	4(33.3)	11(28.9)		
	≥301	10(3203)	2(18.2)	9(60.0)	3(25.0)	14(36.8)		
Working hours (/day)		55.56 ± 4.71	55.45 ± 4.72	54.87 ± 5.23	55.00 ± 5.22)	55.08 ± 4.96	0.38	0.707
Age (years)		48.15 ± 8.26	49.46 ± 6.25	47.87 ± 8.98	45.92 ± 9.67	47.71 ± 8.41	0.21	0.845

† Exp: experimental group, ‡ Cont: control group.

3.2. Psychosocial CVD Risk Factor

In the control group, job stress was 1.09 ± 0.32 before applying the yoga program, and there was no change to 1.09 ± 0.30 after applying the program. In the experimental group, it was confirmed that it was 1.38 ± 1.80 before applying the yoga program and decreased to 1.02 ± 0.24 after applying the program. However, there was no statistically significant difference in the reduction of job stress between groups at each measurement point in the effect verification ($p = 0.240$). The depressive symptom score did not change significantly before and after the yoga program between groups, but in the effectiveness verification, there was a statistically significant difference in job stress reduction between groups at each measurement point ($p = 0.008$). In the case of health promotion behavior, it was confirmed that scores increased after applying the yoga program compared to before applying the yoga program in both the experimental group (109.13 ± 25.94 to 111.35 ± 15.56) and the control group (97.26 ± 22.85 to 98.82 ± 20.41). The difference score of the experimental group (−2.23 ± 3.08) was greater than that in the control group (−1.55 ± 1.22), and it was statistically significant between groups. However, in the effect verification between groups at each measurement point, there was no statistically significant difference in the decrease in health promotion behavior scores ($p = 0.828$) (Table 2).

Table 2. Comparison of Yoga Program's Effects between Experimental and Control Groups (N = 69).

Variables	Group	Pre-Test	Post-Test	Difference	*p*	Source	F	*p*
		Mean ± SD	Mean ± SD	Mean ± SD				
Depressive symptoms	† Exp.	19.44 ± 8.08	19.81 ± 3.61	−0.36 ± 7.97	0.798	Group	1.10	0.298
						Time	0.56	0.457
	‡ Cont.	21.36 ± 6.89	20.18 ± 6.88	1.18 ± 10.83	0.504	Group * Time	7.52	0.008
Job stress	Exp.	1.38 ± 1.80	1.02 ± 0.24	0.36 ± 1.81	0.280	Group	0.53	0.470
						Time	1.43	0.236
	Cont.	1.09 ± 0.32	1.09 ± 0.30	0.00 ± 0.37	0.980	Group * Time	1.40	0.240
Body weight (kg)	Exp.	61.10 ± 12.65	62.07 ± 12.66	−0.97 ± 5.88	0.364	Group	1.54	0.219
						Time	1.18	0.282
	Cont.	64.95 ± 11.15	65.08 ± 10.54	−0.13 ± 2.00	0.688	Group * Time	0.68	0.411
Waist circumference (cm)	Exp.	81.87 ± 8.01	79.21 ± 7.92	2.66 ± 2.47	<0.001	Group	0.51	0.478
						Time	29.21	<0.001
	Cont.	79.13 ± 8.27	79.16 ± 8.22	−0.03 ± 1.55	0.917	Group * Time	30.39	<0.001
Systolic blood pressure (mmHg)	Exp.	128.48 ± 10.38	127.07 ± 10.64	−1.41 ± 4.44	0.086	Group	0.01	0.961
						Time	1.24	0.270
	Cont.	127.47 ± 12.87	127.79 ± 13.14	−0.32 ± 3.77	0.609	Group * Time	3.07	0.084
Diastolic blood pressure (mmHg)	Exp.	81.04 ± 8.57	79.16 ± 8.11	−1.88 ± 3.09	0.002	Group	1.40	0.242
						Time	4.05	0.048
	Cont.	82.29 ± 8.97	82.66 ± 8.09	−0.37 ± 3.11	0.469	Group * Time	8.97	0.004
Total cholesterol (mg/dL)	Exp.	201.19 ± 32.16	201.45 ± 33.81	−0.27 ± 7.35	0.842	Group	2.12	0.150
						Time	0.71	0.402
	Cont.	192.76 ± 34.90	188.03 ± 30.46	−4.73 ± 28.70	0.316	Group * Time	0.89	0.348
Health promotion behavior	Exp.	109.13 ± 25.94	111.35 ± 15.56	−2.23 ± 3.08	0.475	Group	6.01	0.017
						Time	1.50	0.225
	Cont.	97.26 ± 22.85	98.82 ± 20.41	−1.55 ± 1.22	0.210	Group * Time	0.05	0.828
Health responsibility	Exp.	16.39 ± 6.99	16.10 ± 4.69	0.29 ± 5.79	0.782	Group	1.89	0.173
						Time	0.01	0.919
	Cont.	14.55 ± 5.57	14.74 ± 4.67	−0.18 ± 2.54	0.657	Group * Time	0.21	0.651

Table 2. *Cont.*

Variables	Group	Pre-Test	Post-Test	Difference	*p*	Source	F	*p*
		Mean ± SD	Mean ± SD	Mean ± SD				
Physical activity	Exp.	15.06 ± 6.18	17.13 ± 5.92	−2.07 ± 6.99	0.111	Group	3.54	0.064
						Time	3.46	0.067
	Cont.	13.95 ± 4.71	14.16 ± 3.84	−0.21 ± 5.27	0.617	Group * Time	2.29	0.134
Nutrition	Exp.	19.77 ± 4.42	19.16 ± 4.28	0.61 ± 3.78	0.371	Group	12.38	0.001
						Time	1.02	0.317
	Cont.	16.42 ± 3.43	16.34 ± 3.54	0.08 ± 1.76	0.784	Group * Time	0.606	0.439
Spiritual growth	Exp.	20.55 ± 5.22	21.16 ± 5.77	−0.61 ± 4.75	0.478	Group	4.19	0.045
						Time	0.05	0.823
	Cont.	18.58 ± 4.35	18.18 ± 5.41	0.39 ± 3.30	0.466	Group * Time	1.08	0.304
Interpersonal relation	Exp.	20.32 ± 5.22	20.74 ± 4.47	−0.42 ± 2.77	0.405	Group	4.13	0.046
						Time	0.65	0.422
	Cont.	18.42 ± 3.78	18.53 ± 4.17	−0.11 ± 2.62	0.806	Group * Time	0.23	0.630
Stress management	Exp.	17.03 ± 5.04	17.06 ± 2.42	−0.03 ± 4.57	0.969	Group	1.17	0.284
						Time	1.14	0.290
	Cont.	15.34 ± 4.18	16.87 ± 6.11	−1.53 ± 7.01	0.188	Group * Time	1.05	0.310

† Exp: experimental group, ‡ Cont: control group, * interaction.

3.3. Physical CVD Risk Factor

After the yoga intervention, the experimental group showed a significant reduction of waist circumference from 81.87 ± 8.01 cm to 79.21 ± 7.92 cm ($p < 0.001$), but the score of the control group was not changed. Also, there was statistically significant difference in the decrease of waist circumference scores in the effect verification between groups at each measurement point ($p < 0.001$). Furthermore, diastolic blood pressure decreased after applying the yoga program in the experimental group (81.04 to 79.16), but there was no change in the control group. Also, there was a statistically significant difference in the decrease of diastolic blood pressure at each measurement point between groups ($p = 0.004$). On the contrary, there were no significant changes in waist circumference or diastolic blood pressure in the control group. In addition, in the case of body weight or systolic blood pressure, there was no significant change in the experimental group and the control group when comparing before and after applying the yoga program. As a result, the yoga program was found to be effective in reducing waist circumference and diastolic blood pressure ($p = 0.004$) (Table 2).

4. Discussion

This study applied a 12-week (24 sessions) yoga program (warm-up, yoga poses, cool-down) to workers in small enterprises—a pool of workers who are particularly vulnerable in terms of organized health management due to a lack of on-site health managers in small enterprises—in an attempt to lower CVD risk factors including psychosocial factors such as job stress, depression, and health promotion behaviors.

The experimental group who underwent the yoga intervention showed a decrease in job stress score after the intervention, even though it was not statistically significant. This is a similar result to that of a previous study showing a reduction in job stress in the experimental group after providing a yoga program to office workers [28]. In the previous study, the yoga program was designed as a 10-week, 20-session program with two 60-min sessions per week [28]. That program was similar in content to our program, which comprised warm-up, yoga posture, breathing, and meditation, and both programs led to reductions in job stress, though the duration of the sessions differed. A previous study found that yoga programs based on meditation and breathing have positive effects on social and emotional changes, namely providing psychological stability and reducing job stress, by activating the parasympathetic nerves and relaxing tense muscles [26]. Even though the score of job stress was not significantly decreased in this study, we could speculate that our yoga program could possibly lead to positive outcomes in terms of job stress in a future study. Also, we thought that a yoga program tailored to the working patterns of the workers, set to begin before work in the morning, could help relax the workers' minds and invigorate them, increasing their happiness and subsequently reducing job stress.

Depression in workers has been identified as a predictor of "presenteeism", which refers to work and productivity loss, increase of health management expenses, and indirect productivity loss induced by working with a health problem [40,41]. The experimental group that underwent the yoga intervention did not show significant changes in depressive symptom scores after the intervention. In other words, the yoga intervention was found to have no impact on the depression score in this study, which is largely similar to the findings of a previous report stating that a 16-week yoga program did not significantly decrease depression levels—though depression levels dropped at certain time points—in medical students [42]. These findings call for additional studies with longer follow-ups, because it is difficult to establish the effects of interventions on social and emotional factors, such as depression, in the short term [43]. Longer yoga programs are expected to induce significant changes. In contrast to our findings, there was a study reporting that a 12-week yoga program significantly decreased depression scores in women with post-traumatic stress disorders [44]. Such differences in results may be attributable to the limitations of our sample; we speculate that the yoga intervention might have led to significant changes of depression scores if we had screened out the subjects with high depression scores and applied the yoga intervention to this subset of subjects. In the Western countries, the criteria for probable and definite depression are generally 16 and 25 points, respectively. In a depression epidemiological survey on South Koreans by Cho and Kim in 1993 [34], investigators suggested using 21 points as the baseline cut-off for screening for suspected depression and 25 points for screening for definite depression. CES-D scores at baseline in the experimental and control groups were 19.44 and 21.36, respectively. Compared with the level of CES-D (23.2 ± 11.62) of a previous study conducted to find out affecting factors on depression among female workers in small-sized workplaces [45], the level of depressive symptoms of participants in the experimental group in this study was relatively low. Also, these depressive symptoms' level in the study population belonged to the normal range. Thus, replication studies using a sample of participants with high depression scores are needed to investigate whether yoga interventions have a positive effect on workers' depression.

Usually, small enterprises lack an on-site health manager to provide systematic health management for workers, rendering it difficult to apply long-term health promotion programs and consequently hindering efforts to improve workers' health. We speculate that these factors would have contributed to the lack of significant health-promoting behaviors among the workers who underwent our yoga program. Studies on health promotion programs based on participatory action-research are underway in the field of industrial health research to ensure easy and long-term access [2]. This is a bottom-up type of intervention, in which participants proactively discover their health problems, and find and apply solutions with the help of researchers, as opposed to a top-down intervention in which the researcher identifies the problem, plans and designs a program to solve it, and applies the program to the participants. This type of intervention would be appropriate for small enterprises that lack on-site occupational health managers [2,46]. In fact, at least one study verified the effects of a participatory action-oriented training (PAOT)-type of intervention in lowering cholesterol, fasting glucose, body weight, and blood pressure while improving health-promoting behaviors in workers with a CVD risk [47]. The authors pointed out that many health promotion projects conducted in the worksites do not have any practical health benefits for workers because they are relatively short-term and passive, and also argued that methods of applying these health promotion interventions should be changed to address such limitations [2,46]. In addition, numerous studies emphasize the importance of community competency-strengthening projects as a strategy to ensure that enterprises continue to implement health promotion programs on their own even after the conclusion of the study. A previous study reported that taking a community competency-strengthening approach developed leadership and formed partnerships, which improved the self-regulation of health management, ultimately improving each individual participant's health-related quality of life and health promotion behaviors [2,47]. Based on these outcomes, we expect that efforts by small enterprises to foster health leaders for workers as a strategy to strengthen community's competence would also serve as an effective strategy for them to continue implementing health promotion programs on their own, and doing so would ultimately facilitate workers' health-promoting behaviors and improve their health-related quality of life. In light of these findings and suggestions, we are planning to develop and assess the effects of a PAOT-based health promotion program and competence-strengthening projects, such as training health leaders, as a strategy to lower CVD risks in workers of small enterprises. Through these studies, we will develop health promotion program strategies tailored to small workplaces that have low access to health promotion programs and generate long-term effects, contributing to developing policies to reduce CVD in workers of small enterprises. Furthermore, a previous study asserts that assessing the perceptions of the participants is important to improve the quality of clinical research [48]. Unfortunately, we did not collect data on participants' perceptions of this yoga program. Therefore, we propose to investigate the research participants' perception on the program in the follow-up study and use it in the intervention study to improve the quality of the research.

According to a meta-analysis of 61 studies investigating the relationship between blood pressure and mortality [44], a reduction of 2 mmHg of systolic blood pressure reduces mortality caused by ischemic heart disease by 7% and mortality caused by stroke by 10%. We verified that the yoga program developed in this study reduced diastolic blood pressure in workers of small enterprises, who are at higher risk of CVD than are those of medium-sized or larger enterprises, thereby confirming that this program is effective in lowering blood pressure, a critical physiological index related to CVD risks. Furthermore, physical measurement indexes such as waist circumference were significantly decreased in this study. Previous studies asserted that abdominal obesity has been identified as an important risk factor for metabolic syndrome and CVD [49,50]. Also, the other studies have shown that waist circumference was reduced relatively more in women than men [49,51]. Furthermore, Siu and colleges presented that one year of regular yoga training was effective on the improvement of waist circumference in middle-aged and older adults with metabolic syndromes [52]. Although it was analyzed that there was no gender difference between the experimental and the control group in the homogeneity test of this study, the ratio of women in the experimental group was relatively higher than that of the control group. Also, the average age of the participants in this study was 48.15 in the experimental group and 49.46 in the control group, which is considered to be a middle-aged group. Therefore, it was considered that the yoga program was effective in reducing waist circumferences in this study. In order to more reliably confirm the effect of yoga on the reduction of waist circumference, additional studies on workers considering age and gender are needed.

Our study has several limitations. First, sample size was relatively small (experimental group, n = 31; control = 38). Second, this study did not consider the level of individual capacity for the yoga program. Third, the study period was short to expect psychological effects such as depression and job stress. Therefore, a longer period of interventional study is needed in the future.

5. Conclusions

This study investigated whether a 12-week yoga program is effective in lowering psychological and physical measurements related to CVD risks in workers of small enterprises by using a nonequivalent control group design. The findings showed that the yoga program was effective in reducing physical measurements such as waist circumference and diastolic blood pressure in workers of small enterprises. However, this program could be an effective and efficient health program for the blue-collar workers who work in small-sized workplaces. Therefore, these findings provide evidence that a yoga program may serve as a new exercise strategy for feasibility among Korean workers who work in small-sized workplaces.

Author Contributions: W.J.H. and J.A.K. participated in the design of this study. W.J.H. directed this study. J.A.K. and J.S.H. analyzed the data and interpreted the results. W.J.H., J.A.K., and J.S.H. wrote the original manuscript and revision. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science ICT & Future Planning (No. 2017R1A2B4008496) and Korea Health Industry Development Institute (HI18C1317) as well as internal research fund (20201219) by Kyung Hee University. The funding agencies had no role in the study design, the collection, analysis, or interpretation of data, the writing of the report, or the decision to submit the article for publication.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Ministry of Employment and Labor. *Analysis of Industrial Accident Outages*; Ministry of Employment and Labor: Sejong, Korea, 2019. Available online: http://www.moel.go.kr/info/publict/publictDataView.do?bbs_seq=20191201074 (accessed on 20 November 2020).
2. Hwang, W.J.; Kim, J.A. Developing a Health-Promotion Program Based on the Action Research Paradigm to Reduce Cardiovascular Disease Risk Factors among Blue Collar Workers. *Int. J. Environ. Res. Public Health* **2019**, *16*, 4958. [CrossRef]
3. Kim, J.A.; Hwang, W.J.; Jin, J. An Exploration of Contextual Aspects that Influence Cardiovascular Disease Risks Perceived by Workers in a Small–Medium-Sized Workplace. *Int. J. Environ. Res. Public Health* **2020**, *17*, 5155. [CrossRef] [PubMed]
4. Hwang, W.J.; Park, Y. Ecological correlates of cardiovascular disease risk in Korean blue-collar workers: A multi-level study. *J. Korean Acad. Nurs.* **2015**, *45*, 857–867. [CrossRef] [PubMed]
5. Kim, S.L.; Jung, H.S.; Lee, J.E.; Yi, U.J.; Kim, Y.G.; Lee, S.S.; Kim, E.-S. Cardiovascular disease management among workers in small-sized enterprise using community-based approach. *Korean J. Occup. Health Nurs.* **2010**, *19*, 70–77.
6. Hwang, W.J.; Park, Y.; Kim, J.A. A systematic review of interventions for workers with cardiovascular disease risk factors: Using an ecological model. *Korean J. Occup. Health Nurs.* **2016**, *25*, 41–54. [CrossRef]
7. Stress at Work. National Institute for Occupational Safety and Health. 30 December 1999. Available online: http://www.cdc.gov/niosh/docs/99-101/ (accessed on 11 September 2019).
8. Catalina-Romero, C.; Calvo, E.; Sánchez-Chaparro, M.A.; Valdivielso, P.; Sainz, J.C.; Cabrera, M.; Gonzalez-Quintela, A.; Roman, J. The relationship between job stress and dyslipidemia. *Scand. J. Public Health* **2013**, *41*, 142–149. [CrossRef] [PubMed]
9. Hwang, W.J.; Kang, S.J. Interventions to Reduce the Risk of Cardiovascular Disease among Workers: A Systematic Review and Meta-Analysis. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2267. [CrossRef]
10. Vitaliano, P.P.; Scanlan, J.M.; Zhang, J.; Savage, M.V.; Hirsch, I.B.; Siegler, I.C. A path model of chronic stress, the metabolic syndrome, and coronary heart disease. *Am. Psychosomat. Med.* **2002**, *64*, 418–435. [CrossRef]
11. Kim, T.H.; Jung, M.H.; Lee, S.H. A study on correlation between job stress and metabolic syndrome of male employees of electronic goods manufacturer. *Korean J. Occup. Health Nurs.* **2016**, *25*, 55–64. [CrossRef]
12. Hwang, C.K.; Koh, S.B.; Chang, S.J.; Park, C.Y.; Cha, B.S.; Hyun, S.J.; Park, J.H.; Lee, K.M.; Cha, K.T.; Park, W.J.; et al. Occupational stress in relation to cerebrovascular and cardiovascular disease: Longitudinal analysis from the NSDSOS Project. *Korean J. Occup. Environ. Med.* **2007**, *19*, 105–114. [CrossRef]
13. Huh, J.Y.; An, H.J. The effects of yoga performance on mental health in menopause women. *Korean J. Sports Sci.* **2007**, *16*, 361–371.
14. Kim, M.G.; Kim, K.S.; Ryoo, J.H.; Yoo, S.W. Relationship between Occupational Stress and Work-related Musculoskeletal Disorder in Korean Male Firefighters. *Korean J. Occup. Environ. Med.* **2013**, *25*, 9. [CrossRef] [PubMed]
15. Chang, S.J.; Koh, S.B.; Kang, M.K.; Cha, B.S.; Park, J.K.; Hyun, S.J.; Park, J.H.; Kim, S.A.; Kang, D.M.; Chang, S.S.; et al. Epidemiology of psychosocial distress in Korean employees. *Korean J. Prev. Med.* **2005**, *38*, 25–37.

16. Choi, E.S.; Ha, Y.M. Work-related stress and risk factors among Korean employees. *J. Korean Acad. Nurs.* **2009**, *39*, 549–561. [CrossRef] [PubMed]
17. Riley, K.E.; Park, C.L. How does yoga reduce stress? *A systematic review of mechanisms of change and guide to future injury. Health Psychol. Rev.* **2015**, *9*, 379–396. [CrossRef]
18. Michalsen, A.; Grossman, P.; Acil, A.; Langhorst, J.; Ludtke, R.; Esch, T. Rapid stress reduction and anxiolysis among distressed women as a consequence of a three month intensive yoga program. *Med. Sci. Monit.* **2005**, *11*, 555–561.
19. Park, J.G.; Lim, R.H. An effect of the 12 weeks the hatha yoga program for female physical fitness. *Korean J. Phys. Ed.* **2004**, *43*, 959–966.
20. Parhad, O. Role of yoga in stress management. *West Indian J. Med.* **2004**, *53*, 191–194.
21. Donesky-Cuenco, D.; Nguyen, H.Q.; Paul, S.; Carrieri-Kohlman, V. Yoga therapy decreases dyspnea-related distress and improves functional performance in people with chronic obstructive pulmonary disease: A pilot study. *J. Altern. Complement. Med.* **2009**, *15*, 225–234. [CrossRef]
22. Lee, E.N.; An, H.J.; Song, Y.S.; Kim, J.H.; Cho, H.J.; Lee, M.H. The effects of a 4-weeks yoga program on mental III inpatients' anxiety and depression. *J. Korean Acad. Psychiatric Ment. Health Nurs.* **2008**, *17*, 161–170.
23. Ko, J.E.; Kang, C.K.; Lee, M.G. Effects of a 10-week combined program of Hatha and Raja yoga on stress-related variables in middle-aged women. *Korean J. Sports Sci.* **2014**, *23*, 993–1006.
24. Hasanpour-Dehkordi, A.; Jivad, N.; Solati, K. Effects of yoga on physiological indices, anxiety and social functioning in multiple sclerosis patients: A randomized trial. *J. Clin. Diag. Res.* **2016**, *10*, VC01–VC05. [CrossRef]
25. Kligler, B.; Teets, R.; Quick, M. Complementary/integrative therapies that work: A review of the evidence. *Am. Fam. Physician* **2016**, *94*, 369–374. [PubMed]
26. Yun, S.J.; Pack, S.H. The effect of yoga program on the changes in the daily stress the children's. *Off. J. Korean Soc. Dance Sci.* **2014**, *31*, 185–195. [CrossRef]
27. Park, H.S.; Kim, Y.J.; Kim, Y.H. The effect of yoga program on reduced blood pressure in elderly's essential hypertension. *J. Korean Acad. Nurs.* **2002**, *32*, 633–642. [CrossRef]
28. Park, Y.J. The effects of yoga program on stress and anxiety for worker. *Korean Assoc. Mediat. Health* **2013**, *4*, 13–24.
29. Oh, H.S.; Lee, I.S. The effect of a yoga program on the stress levels of professionals. *Perspect. Nurs. Sci.* **2012**, *9*, 36–44.
30. Tsai, S.Y. Effect of yoga exercise on premenstrual symptoms among female employees in Taiwan. *Int. J. Environ. Res. Public Health* **2016**, *13*, E721. [CrossRef]
31. Thomley, B.S.; Ray, S.H.; Cha, S.S.; Bauer, B.A. Effects of a brief, comprehensive, yoga-based program on quality of life and biometric measures in an employee population: A pilot study. *J. Sci. Health* **2011**, *7*, 27–29. [CrossRef]
32. Korea Occupational Safety & Health Agency. *A Study on the Management Strategy of Workers' Health for the Early Prevention of Cerebrocardio -Vascular Disease to Prepare for an Aging Society (2009-43-1084)*; Korea Occupational Safety & Health Research Institute: Incheon, Korea, 2009.
33. Radloff, L.S. The CES-D scale, a self-report depression scale for research in the general population. *Appl. Psychol. Meas.* **1977**, *1*, 385–401. [CrossRef]
34. Cho, M.J.; Kim, K.H. Diagnostic validity of the CES-D (Korean version) in the assessment of DSM-III-R major depression. *J. Korean Neuropsychiatr. Assoc.* **1993**, *32*, 381–399.
35. Siegrist, J.; Starke, D.; Chandola, T.; Godin, I.; Marmot, M.; Niedhammer, I.; Peter, R. The measurement of effort–reward imbalance at work: European comparisons. *Soc. Sci. Med.* **2004**, *58*, 1483–1499. [CrossRef]
36. Eum, K.D.; Li, J.; Lee, H.E.; Kim, S.S.; Paek, D.; Siegrist, J.; Cho, S.-I. Psychometric properties of the Korean version of the effort–reward imbalance questionnaire: A study in a petrochemical company. *Int. Arch. Occup. Environ. Health* **2007**, *80*, 653–661. [CrossRef] [PubMed]
37. Hwang, W.J.; Kim, J.A.; Rankin, S.H. Depressive Symptom and Related Factors: A Cross-Sectional Study of Korean Female Workers Working at Traditional Markets. *Int. J. Environ. Res. Public Health* **2017**, *14*, 1465. [CrossRef] [PubMed]
38. Walker, S.N.; Sechrist, K.R.; Pender, N.J. The health promoting lifestyle profile: Development and psychometric characteristics. *Nurs. Res.* **1987**, *36*, 76–81. [CrossRef] [PubMed]

39. Hwang, W.J.; Hong, O.S.; Rankin, S.H. Predictors of health-promoting behavior associated with cardiovascular diseases among Korean blue-collar workers. *Asia-Pac. J. Public Health* **2015**, *27*, NP691–NP702. [CrossRef]
40. Hilton, M.F.; Scuffham, P.A.; Vecchio, N.; Whiteford, H.A. Using the interaction of mental health symptoms and treatment status to estimate lost employee productivity. *Aust. N. Z. J. Psychiatry* **2010**, *44*, 151–161. [CrossRef]
41. Burton, W.N.; Pransky, G.; Conti, D.J.; Chen, C.-Y.; Edington, D.W. The association of medical conditions and presenteeism. *J. Occup. Environ. Med.* **2004**, *46*, S38–S45. [CrossRef]
42. Simard, A.-A.; Henry, M. Impact of a short yoga intervention on medical students' health: A pilot study. *Med. Teach.* **2009**, *31*, 950–952. [CrossRef]
43. Mitchell, K.S.; Dick, A.M.; DiMartino, D.M.; Smith, B.N.; Niles, B.; Koenen, K.C.; Street, A. A pilot study of a randomized controlled trial of yoga as an intervention for PTSD symptoms in women. *J. Traumatic. Stress* **2014**, *27*, 121–128. [CrossRef]
44. Cramer, H.; Lauche, R.; Haller, H.; Steckhan, N.; Michalsen, A.; Dobos, G. Effects of yoga on cardiovascular disease risk factors: A systematic review and meta-analysis. *Int. J. Cardiol.* **2014**, *173*, 170–183. [CrossRef] [PubMed]
45. Jung, E.S.; Shim, M.S. Affecting factors on depression among female labor workers. *J. Korea Contents Assoc.* **2011**, *11*, 822–831. [CrossRef]
46. Tsutsumi, A.; Nagami, M.; Yoshikawa, T.; Kogi, K.; Kawakami, N. Participatory intervention for workplace improvements on mental health and job performance among blue-collar workers: A cluster randomized controlled trial. *J. Occup. Environ. Med.* **2009**, *51*, 554–563. [CrossRef] [PubMed]
47. Kim, H.S.; Gu, M.O. Effects of community health promotion project for garlic cultivating farmers based on self-efficacy theory and community capacity building framework. *J. Korean Acad. Nurs.* **2011**, *41*, 80–91. [CrossRef] [PubMed]
48. Kost, R.G.; Lee, L.M.; Yessis, J.; Coller, B.S.; Henderson, D.K.; Research Participant Perception Survey Focus Group Subcommittee. Assessing research participants' perceptions of their clinical research experiences. *Clin. Transl. Sci.* **2011**, *4*, 403–413. [CrossRef]
49. Kim, H.Y.; Kim, J.K.; Shin, G.G.; Han, J.A.; Kim, J.W. Association between abdominal obesity and cardiovascular risk factors in adults with normal body mass index: Based on the sixth Korea National Health and Nutrition Examination Survey. *J. Obes. Metab. Syndr.* **2019**, *28*, 262. [CrossRef]
50. Westphal, S.A. Obesity, abdominal obesity, and insulin resistance. *Clin. Cornerstone* **2008**, *9*, 23–29. [CrossRef]
51. Cramer, H.; Thoms, M.S.; Anheyer, D.; Lauche, R.; Dobos, G. Yoga in women with abdominal obesity—A randomized controlled trial. *Dtsch. Arztebl. Int.* **2016**, *113*, 645.
52. Siu, P.M.; Angus, P.Y.; Benzie, I.F.; Woo, J. Effects of 1-year yoga on cardiovascular risk factors in middle-aged and older adults with metabolic syndrome: A randomized trial. *Diabetol. Metab. Syndr.* **2015**, *7*, 40. [CrossRef]

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.