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Original article

Prevention and treatment of obesity with lifestyle interventions: review and meta-analysis

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Summary

Objective: To assess the mid- to long-term effectiveness of lifestyle interventions in the prevention and treatment of obesity.

Methods: A systematic literature review with meta-analysis was performed. Electronic databases, reference lists, books and reports covering topic of obesity were searched. The included studies were randomized clinical trials of lifestyle interventions in overweight and obese subjects that had a minimum observation period of one year. Outcomes evaluated were measurements of body weight, body mass index, waist circumference, systolic and diastolic blood pressure, blood lipids: total cholesterol, low density lipoprotein, high density lipoprotein, triglyceride, blood glucose control: two-hour plasma glucose, fasting plasma glucose, and glycosylated haemoglobin.

Results: Thirteen studies have been selected in the prevention and seventeen in the treatment of obesity. Compared with standard care, lifestyle intervention reduced significantly body weight, body mass index, waist circumference, blood pressure, blood lipids and blood glucose in overweight and obese people. The favorable effects were maintained up to three years.

Conclusions: Lifestyle interventions were efficacious in the mid- to long-term prevention and treatment of obesity leading to a significant reduction in body weight and cardiovascular risk factors.

Key words: Systematic review – Meta-analysis – Overweight – Prevention – Obesity – Treatment.

Obesity is a chronic disease whose prevalence is reaching epidemic proportions around the world (World Health Organization 2000). Obesity is associated with a high risk of morbidity, mortality as well as reduced life expectancy. The major health consequences of overweight and obesity are type 2 diabetes mellitus, hypertension, coronary heart disease, gallbladder disease, psychosocial problems and certain types of cancers (Fontaine 2003).

The increasing prevalence of overweight and obesity highlight the need for improved prevention strategies to overcome this significant public health problem. Many government initiatives and awareness campaigns have been initiated worldwide to help obesity i. e. International Obesity TaskForce (IOTF). The best strategies to prevent and treat obesity have not been settled yet. A wide variety of obesity treatments are available, including diet, exercise, behavioral modification, pharmacological treatment and surgery. Among several strategies, lifestyle intervention has been documented to lead safely to improvements in metabolic abnormalities such as increased body weight, dyslipidemia, elevated blood pressure, glucose control, pro-coagulant and pro-inflammatory activity that are linked to the development of obesity, diabetes, metabolic syndrome and cardiovascular disease (Pritchett 2005). Lifestyle programs are multi-factorial interventions that are designed for each patient or group of patients according to their risk factor status and the needs of the subjects. These include promoting healthy lifestyle habits, dietary counseling, physical exercise training, and behavioral change targets. Individuals at risk for obesity, diabetes and cardiovascular disease may be influenced trough learning process to allow the lifestyle changes to control risk factors such as body weight, blood pressure, blood cholesterol and blood glucose levels. Several individual lifestyle interventions proved to be efficacious in the prevention of diabetes (Pan 1997, Lindström 2003). The aim of the present study was to systematically assess the mid- to long-term effectiveness (1–6 years) of lifestyle interventions in the prevention and treatment of obesity.

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Methods

Titles and abstracts were obtained from systematic searches of electronic databases: Medline, CINHAL, MBASE, and PubMed. The searches were carried out using search terms "obesity prevention", "overweight treatment", "obesity treatment", "lifestyle intervention", "weight change", "weight control", "body mass index", "cardiovascular disease", and "diabetes mellitus". The search was restricted to the period from 1995 to 2005 due to advancements in research towards conducting high quality studies and/or better reporting. The rapid changes in the obesity environment made the last ten years more suitable for study selection. Books and reports covering the topic of obesity were searched. The reference lists of all included studies were checked and all potentially appropriate studies were obtained and assessed for additional evidence to be used in this study. In addition, several individual-based studies that focused on prevention of type 2 diabetes and cardiovascular disease were reviewed.

For the purpose of this study, we defined "prevention of obesity" as interventions that target overweight individuals with body mass index (BMI) between 25 and 29.9 kg/m^2 aiming to prevent the transition from overweight to obesity and "treatment of obesity" as interventions that target obese individuals with a BMI ≥ 30 kg/m^2 aiming to reduce the progression of obesity and associated co-morbidities.

The inclusion criteria consisted in: randomized controlled trials of lifestyle interventions performed in overweight or obese subjects over 18 years of age that had a minimum observation period, including treatment and follow-up, of at least one year. Lifestyle intervention had to include dietary counseling and physical exercise associated or not with behavioral modification techniques. The goals of lifestyle intervention were to achieve and maintain a weight reduction through consumption of a healthy low-calorie, low-fat diet and to engage in regular physical activities.

The study population was classified according to the type of intervention: lifestyle intervention and control group regarded as standard care. The common characteristic of all selected studies is that interventions were carried out in overweight or obese people with or without associated co-morbidities. Additional subgroup analyses were performed in overweight subjects with cardiovascular risk factors and overweight or obese subjects with impaired glucose tolerance at risk of developing type 2 diabetes.

For studies that fulfilled the inclusion criteria, the following outcomes were evaluated: body weight, BMI, waist circumference, systolic blood pressure (SBP) and diastolic blood pressure (DBP), blood lipids: total cholesterol (TC), low density lipoprotein cholesterol (LDL), and high density lipoprotein cholesterol (HDL), triglyceride (TG), and blood glucose control: two-hour plasma glucose (2h-PG), fasting plasma glucose (FPG), and glycosylated haemoglobin (HbA1c). Meta-analysis technique was used to combine the results from distal follow-up (the last follow-up reported) from independent studies (Glass 1977). The summary outcome measure calculated was the difference in means between lifestyle intervention and standard care. Effects were combined using a random effects model. The pooled estimates of the effect were obtained using Comprehensive Meta-Analysis software (CMA 2005).

Methodological quality of the selected studies was assessed by an adjusted Jadad scale (Jadad 1996). Since lifestyle interventions are usually not blinded, an adjustment in the five point Jadad scale was made excluding the double blinding score. A quality checklist assessed the overall quality of the study including the sample size, the conduct of the study, the follow-up, the analysis and the interpretation of the results (Avenell 2004). Sensitivity analysis was performed in high quality studies i.e. Jadad score ≥2 points and quality score >80 points, to test the robustness of the study results. One reviewer abstracted the relevant study population and intervention characteristics using a standardized template. Two reviewers assessed the methodological quality of evaluated studies independently. Discrepancies were resolved by consensus discussion.

Results

Thirteen studies were selected for evaluation of the prevention of obesity approach and 17 studies investigated the treatment of obesity approach. The flowchart provides an overview of all included and excluded studies (Fig. 1).

Prevention of obesity

Tab. 1 presents the descriptive data of the 13 studies selected investigating the prevention of obesity. Lifestyle intervention components of each study are presented in Appendix 1.[1*] The studies included a total of 3566 participants with an average BMI of 28 kg/m^2 and an average body weight of 81 kg. The study participants had a mean age of 49 years and were predominantly of female gender. The results of the meta-analysis are summarized in Tab.2. At an average follow-up of three years, the pooled effect size showed significance in favor of the lifestyle intervention compared with standard care in re-

[1*] Appendices 1, 2, and 3 are available online only – see www.birkhauser.ch/IJPH

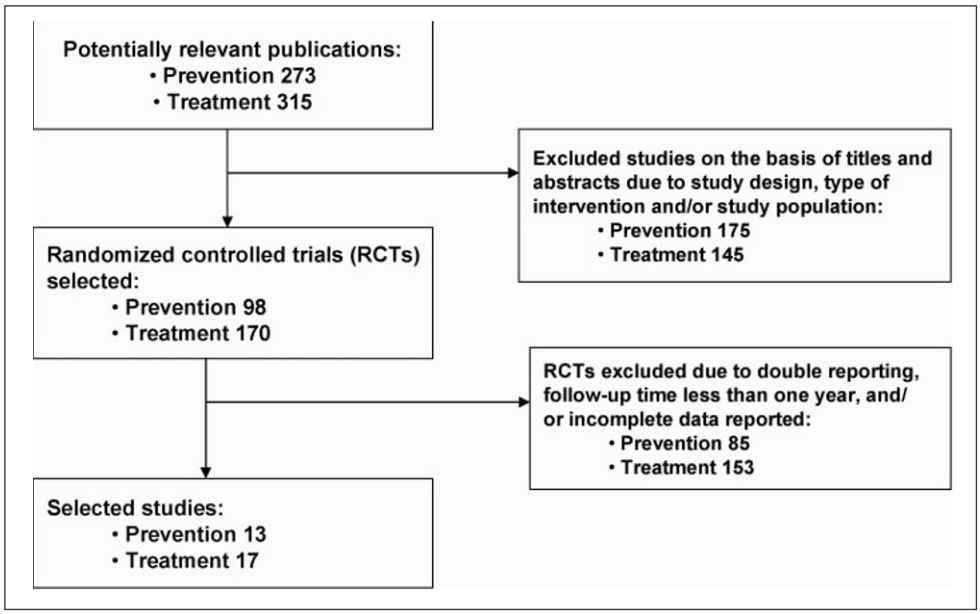

Figure 1 Flowchart

Table 1 Characteristics of included studies in overweight people

Study author, year	Country	Population	Duration (years)	Number participants	N[e] Follow-up	Age	BMI	Adj. Jadad score[a]	Quality score[b]
Anderssen 1996	Norway	Overweight with cardiovascular risks	1	219	95 %	45	28.8	1	68
Burke 2005	Australia	Overweight with hypertension	1	241	85 %	56	29.9	2	73
Carr 2005	USA	Overweight with IGT[c]	2	64	97 %	56	26.2	1	73
Dyson 1997	England, France	Overweight at risk of diabetes	1	227	50 %	50	28.5	2	70
He 2000	USA	Overweight at risk of hypertension	7	208	87 %	43	28.9	2	75
Kastarinen 2002	Finland	Overweight with hypertension	2	715	82 %	43	28.7	1	78
Ketola 2001	Finland	Overweight with cardiovascular risks	2	150	95 %	-	27.8	3	65
Liao 2002	USA	Overweight with IGT[c]	2	74	72 %	54	26.1	3	70
Mensink 2003ab	Netherlands	Overweight with IGT[c]	2	114	77 %	57	29.7	3	85
Pan 1997	China	Overweight with IGT[c] and diabetes	6	530	92 %	45	25.8	2	60
Simkin-Silverman 2003	USA	Healthy overweight, premenopausal	4.5	535	95 %	47	25	2	83
Stefanick 1998	USA	Overweight at risk of CHD[d]	1	377	97 %	52	28	2	83
Trento 2001	Italy	Overweight with diabetes	4	112	71 %	62	28.9	3	88

[a] Adjusted Jadad score: 1 Low, 2 Moderate, 3 High
[b] Quality score: 1–50 Low, 51–80 Moderate, 81–100 High
[c] Impaired glucose tolerance
[d] Coronary heart disease
[e] N – percentage of subjects finishing the study

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Table 2 Meta-analysis results in overweight people

Outcome	Number studies	Number articipants	Difference in means	Standard error	95 % CI Lower limit	95 % CI Upper limit	p-Value
Weight (kg)	11	2373	–2.19	0.32	–2.81	–1.57	<0.0001
BMI (kg/m^2)	5	926	–1.11	0.23	–1.56	–0.66	<0.0001
Waist (cm)	3	208	–2.12	0.23	–2.56	–1.68	<0.0001
SBP (mmHg)	9	2239	–2.08	0.61	–3.28	–0.89	0.001
DBP (mmHg)	9	2239	–1.59	0.55	–2.67	–0.51	0.004
TC (mmol/l)	7	1516	–0.26	0.07	–0.41	–0.12	<0.0001
HDL (mmol/l)	7	1875	0.01	0.01	–0.22	0.04	0.640
LDL (mmol/l)	5	1690	–0.16	0.06	–0.28	–0.03	0.013
TG (mmol/l)	7	1875	–0.23	0.08	–0.38	–0.08	0.003
HbA1c (%)	3	397	–0.50	0.52	–1.52	0.52	0.339
FPG (mmol/l)	6	804	–0.28	0.09	–0.45	–0.11	0.001
2h-PG (mmol/l)	2	284	–0.63	0.24	–1.10	–0.16	0.009

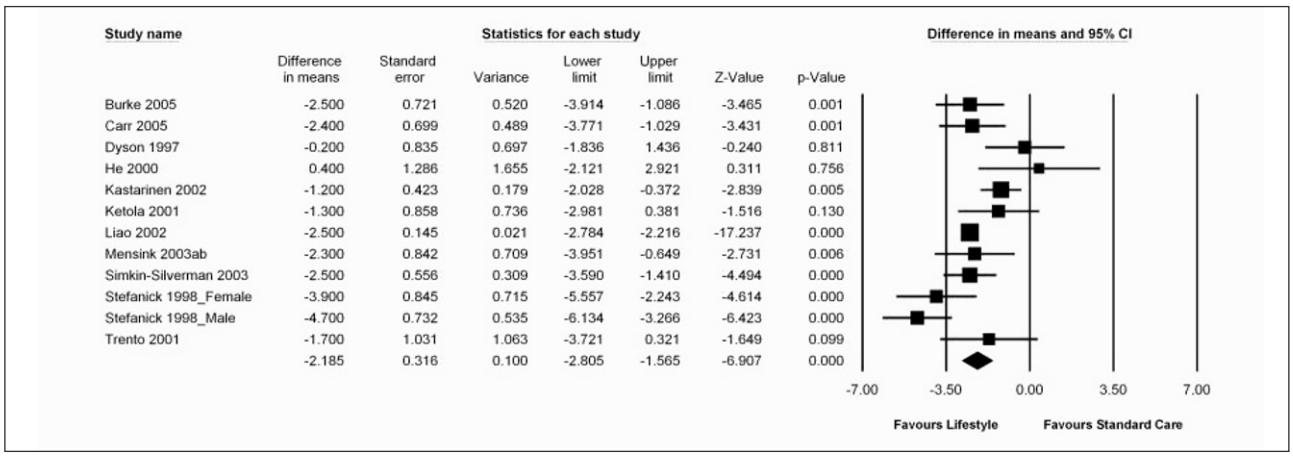

Figure 2 Meta-analysis weight change (kg) in overweight people

ducing body weight (–2.2 kg, Fig.2.) and cardiovascular risk factors with the exception of HDL and HbA1c.

A funnel plot of the mean difference in body weight reduction plotted against the study size, represented by standard error, is shown in Fig.3. The vertical line indicates the pooled mean difference of all trials (–2.2 kg). Usually, studies with larger sample size appear toward the top of the graph and a distributed symmetrically around the combined effect size. Smaller studies usually appear toward the bottom of the graph, and since there could be more sampling variation in the effect size estimates in the smaller studies, they are dispersed across a range of values. Visual inspection implies that the evaluated lifestyle intervention studies participated equally to the pooled mean difference i. e. the studies are dispersed symmetrically around the combined effect size.

A sensitivity analysis was performed on high quality studies (Mensink 2003ab, Simkin-Silverman 2003, Stefanick 1998, Trento 2001). The studies included a total of 1168 participants with an average age of 51 years and an average BMI of 27 kg/m^2. The results of the sensitivity analysis confirmed the results of the main analysis: compared with standard care, lifestyle intervention reduced significantly body weight and cardiovascular risk factors in overweight people with the exception of SBP, HDL and HbA1c. The difference in means was –3.1 kg in body weight (p=0.0001), –1.6 mmHg in SBP (p=0.068), –2 mmHg in DBP (p=0.03), –0.32 mmol/l in TC (p=0.0001), 0.001 mmol/l in HDL (p=0.96), –0.22 mmol/l in LDL (p=0.006), –0.21 mmol/l in TG (p=0.002), –0.75 % in HbA1c (p=0.37), and –0.35 mmol/l in FPG (p=0.002).

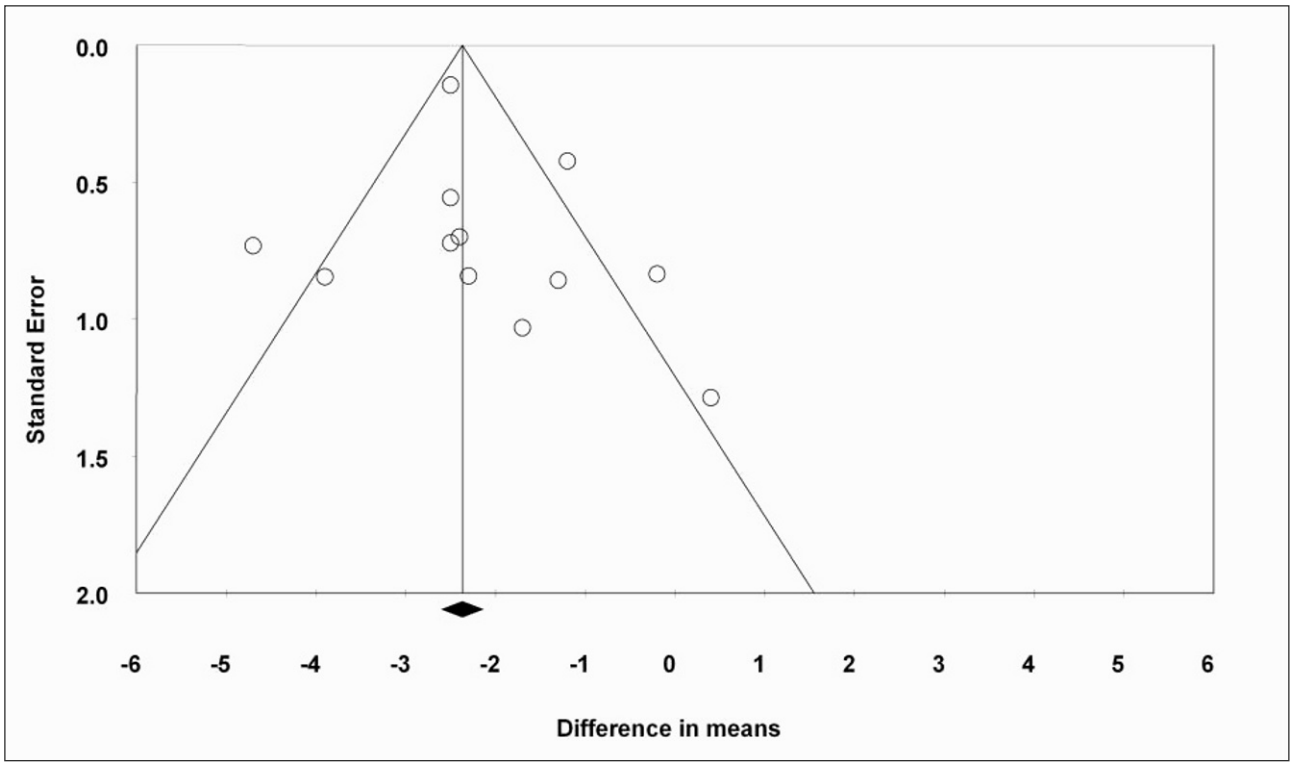

Figure 3 Funnel plot of the mean difference in body weight in overweight people plotted against standard error

Table 3 Subgroup analysis in overweight people with cardiovascular risk factors

Outcome	Number studies	Number participants	Difference in means	Standard error	95 % CI Lower limit	95 % CI Upper limit	p-Value
Weight (kg)	5	1343	–2.30	0.70	–3.67	–0.92	0.001
SBP (mmHg)	6	1419	–2.43	0.78	–3.96	–0.91	0.002
DBP (mmHg)	6	1419	–2.16	0.77	–3.67	–0.67	0.005
TC (mmol/l)	4	1120	–0.35	0.09	–0.53	–0.16	<0.0001
TG (mmol/l)	3	970	–0.24	0.14	–0.52	0.04	0.087
HDL (mmol/l)	3	970	0.01	0.02	–0.04	0.05	0.798
LDL (mmol/l)	2	897	–0.27	0.08	–0.43	–0.43	0.001

A subgroup analysis was performed in overweight people with cardiovascular risk factors (Anderssen 1996, Burke 2005, He 2000, Kastarinen 2002, Ketola 2001, Stefanick 1998). The studies included a total of 1 910 participants with an average BMI of 27 kg/m^2. The results of the meta-analysis are presented in Tab.3. At an average follow-up of three years, compared with standard care, lifestyle intervention reduced significantly body weight and cardiovascular risk factors in overweight people with identified cardiovascular risk with the exception of TG and HDL.

Treatment of obesity

Tab. 4 presents the descriptive data of the 17 studies selected in the treatment of obesity. The lifestyle intervention components of each study are presented in Appendix 1. The studies included 8013 participants, predominantly females, with an average age of 49 years and an average BMI of 34 kg/m^2. The meta-analysis results are presented in Tab.5. Compared with standard care, lifestyle intervention reduces significantly body weight and cardiovascular risk factors in obese people with the exception of FPG and HbA1c. The average follow-up time of interventions was three years.

Table 4 Characteristics of included studies in obese people

Study author, year	Country	Population	Duration (years)	Number participants	N[c] Follow-up	Age	BMI	Adj. Jadad score[a]	Quality score[b]
DPP 2005ab	USA	Obese at risk of diabetes	2.8	2161	93 %	51	34	2	93
Esposito 2003	Italy	Obese pre-menopausal	3	120	93 %	35	35	2	85
Harvey-Berino 2004	USA	Obese	1	255	76 %	46	32	2	58
Jeffery 1995	USA	Obese	2.5	202	88 %	37	31	1	53
Lindhal 1999	Sweden	Obese at risk of diabetes	1	186	96 %	56	30	2	78
Lindstrom 2003	Finland	Obese at risk of diabetes	3	522	83 %	55	31	2	95
Messier 2004	USA	Obese with knee osteoarthritis	1.5	316	80 %	69	34	2	73
Moore 2003	UK	Obese	1.5	991	62 %	48	37	2	65
Narayan 1998	USA	Obese	1	98	95 %	34	35	1	55
Sbrocco 1999	USA	Obese	1	24	88 %	42	33	2	60
Stevens 2001	USA	Obese at risk of hypertension	3	1191	92 %	43	31	1	68
Tate 2003	USA	Obese at risk of diabetes	1	92	84 %	49	33	3	63
Wylie-Rosset 2001	USA	Obese with cardiovascular risk	1	588	81 %	52	36	1	75
Whelton 1998	USA	Obese with hypertension	2.5	886	86 %	46	36	2	85
Wing 1998	USA	Obese at risk of diabetes	2	154	84 %	46	36	1	83
Wolf 2004	USA	Obese with type 2 diabetes	1	147	80 %	53	37	3	58
Yeh 2003	USA	Obese	2	80	66 %	50	37	2	75 %

[a] Adjusted Jadad score: 1 Low, 2 Moderate, 3 High;
[b] Quality score: 1–50 Low, 51–80 Moderate, 81–100 High
[c] N – percentage of subjects finishing the study

Table 5 Meta-analysis results in obese people

Outcome	Number studies	Number participants	Difference in means	Standard error	95 % CI Lower limit	95 % CI Upper limit	p-Value
Weight (kg)	12	5124	–3.49	0.62	–4.70	–2.27	<0.0001
BMI (kg/m^2)	7	3522	–1.33	0.31	–1.93	–0.72	<0.0001
SBP (mmHg)	6	4182	–2.78	0.82	–4.38	–1.18	0.001
DBP (mmHg)	6	4063	–1.42	0.43	–2.23	–0.57	0.001
TC (mmol/l)	5	893	–0.14	0.05	–0.24	–0.03	0.011
HDL (mmol/l)	4	2778	0.04	0.02	0.004	0.08	0.028
TG (mmol/l)	4	2964	–0.15	0.06	–0.27	–0.04	0.011
FPG (mmol/l)	5	2934	–0.15	0.08	–0.31	0.02	0.079
2h–PG (mmol/l)	2	692	–0.54	0.16	–0.84	–0.24	0.001
HbA1c (%)	2	497	–0.09	0.03	–0.40	0.23	0.599

Table 6 Subgroup analysis in overweight and obese people at risk of diabetes

Outcome	Number studies	Number participants	Difference in means	Standard error	95 % CI Lower limit	95 % CI Upper limit	p-Value
Weight (kg)	8	3150	–2.93	0.72	–4.35	–1.52	<0.0001
BMI (kg/m^2)	6	2890	–1.29	0.33	–1.94	–0.64	<0.0001
SBP (mmHg)	5	3115	–3.45	0.68	–4.78	–2.13	<0.0001
DBP (mmHg)	5	3115	–1.83	0.34	–2.50	–1.17	<0.0001
TC (mmol/l)	5	867	–0.13	0.06	–0.25	–0.02	0.027
HDL (mmol/l)	5	2842	0.02	0.01	0.00	0.04	0.030
LDL (mmol/l)	3	357	–0.05	0.08	–0.22	0.12	0.555
TG (mmol/l)	6	3028	–0.20	0.07	–0.33	–0.07	0.002
HbA1c (%)	4	682	–0.04	0.09	–0.21	0.14	0.686
FPG (mmol/l)	6	3029	–0.23	0.05	–0.33	–0.14	<0.0001
2h-PG (mmol/l)	3	608	–0.57	0.25	–1.05	–0.09	0.021

A sensitivity analysis was again performed on high quality studies (DPP 2005ab, Esposito 2003, Lindstrom 2003, Whelton 1998, Wing 1998). The studies included a total of 3023 participants with an average BMI of 33 kg/m^2 and a mean age of 52 years. The results of the sensitivity analysis confirmed the results of the main analysis: compared with standard care, lifestyle intervention reduced significantly body weight and cardiovascular risk factors in obese people with the exception of FPG. The difference in means was –5.1 kg in body weight (p<0.0001), –1.8 kg/m^2 in BMI (p=0.001), –3 mmHg in SBP (p=0.0001), –2 mmHg in DBP (p=0.0001), –1.15 mmol/l in TC (p=0.01), 0.04 mmol/l in HDL (p=0.02), –0.17 in TG (p=0.02), and –0.13 in FPG (p=0.24).

A subgroup analysis was performed in overweight and obese people subjects with impaired glucose tolerance in the prevention of diabetes studies. Nine such studies were identified, in four studies participants had a BMI of <30 kg/m^2 (Carr 2005, Dyson 1997, Liao 2002, Mensink 2003ab) and in the other five studies participants had a BMI of >30 kg/m^2 (DPP 2005ab, Lindahl 1999, Lindstrom 2003, Tate 2003, Wing 1998). The studies included a total of 3 502 participants, predominantly females, with an average BMI of 33 kg/m^2. Meta-analysis results are presented in Tab.6. Compared with standard care, lifestyle intervention reduced significantly body weight and cardiovascular risk factors with the exception of LDL and HbA1c.

The data input of the meta-analyses performed are provided in the Appendix 2 and the graphical representation of all analyses are presented in Appendix 3.[1*]

[1*] Appendices 1, 2, and 3 are available online only – see www.birkhauser.ch/IJPH

Discussion

The global rise in obesity prevalence continues to be a threat to people's health. Although health policies have aimed to raise public awareness to prevent obesity, its increasing prevalence implies that successful solutions have not been yet identified. The present systematic review provides new information on the effectiveness of lifestyle interventions by assessing the mid- to long-term effects on weight and cardiovascular risk profile in overweight and obese people. Our findings suggest that – at an average follow-up time of three years – lifestyle interventions reduce significantly body weight and cardiovascular risk factors in overweight and obese people. To estimate whether these results are of clinical relevance we searched the medical literature for studies that have linked the intermediate physiological endpoints i. e. HbA1c, FPG, with hard outcomes such as reduced incidence of diabetes, reduced cardiovascular events and morbidity, and reduced mortality risk.

Several individual studies in obese people designed to prevent diabetes (DPP 2002, Lindstrom 2003) demonstrated that lifestyle intervention was associated to a 58 % reduction in the incidence of diabetes in a three years program compared with a control group. A large trial (UKPDS 34) specifically designed to address the hypothesis that glucose lowering therapies may reduce the risk for cardiovascular morbidity or mortality in overweight individuals with type 2 diabetes, demonstrated that relatively small reductions in HbA1c (<1 %) were associated with reduced microvascular complications. It has been estimated that each 1 % reduction in HbA1c level was associated with a 14 % reduction in the incidence of fatal and nonfatal myocardial infarction and 37 % reduction in the microvascular complications (Stratton 2000). In our study, life-

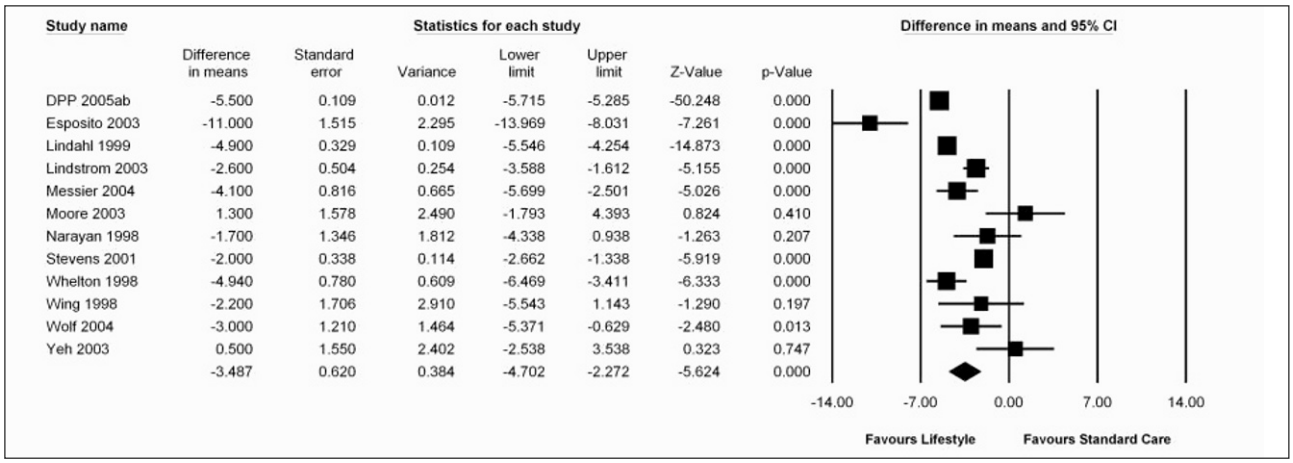

Figure 4 Meta-analysis weight change (kg) in obese people

style intervention reduced HbA1c by 0.5 % more compared to standard care in overweight people; however, the difference between groups was not significant. This may be partially explained by the small number of studies available with HbA1c as a reported outcome and, in addition, our main analysis was not stratified for individuals with high risk for developing Type 2 diabetes.

Observational analyses using data from a large clinical trial (UKPDS 61) demonstrated that individuals with intermediate FPG values (7.8 to 10 mmol/l) compared with individuals with low FPG values (<7.8 mmol/l) had a significantly lower risk of diabetes related deaths and myocardial infarction. In our analysis, lifestyle intervention reduced significantly FPG in overweight subjects but not in obese subjects. However, when the analysis was performed in obese people at risk of developing diabetes, lifestyle intervention significantly reduced FPG (Fig. 5).

Our analysis showed a significantly greater decrease in waist circumference in the lifestyle intervention group in comparison to standard care. It has been documented that waist circumference is more closely correlated with the volume of visceral adipose tissue than the waist-to-hip ratio or total body fat mass (Despres 1993, Lemieux 1996). It may be hypothesized that a greater loss of visceral adipose tissue, as reflected indirectly by the observed decrease in waist circumference, contributed to the improvement in glycemic status (significant decrease in 2h-PG and FPG) in the lifestyle intervention group. Central obesity, which is measured as increased waist circumference, is also an important component of atherogenic dyslipidemia, which has been identified as predictor of the metabolic syndrome and plays a major role in the pathogenesis of cardiovascular disease (Vinik 2005).

Evidence from epidemiological studies and clinical trials indicate that dyslipidemia is one of the most important modifiable risk factors for coronary heart disease (Ferdinand 2004, Meagher 2004). Dyslipidemia is generally characterized by increased fasting concentrations of TC, LDL and TG, in conjunction with decreased concentrations of HDL (NCEP 2001). Thus, decreasing TC, LDL, TG and increasing HDL represent an important clinical target (Pyorala 1997). For example, analyzing the data from the Scandinavian Simvastatin Survival Study, the authors estimated that each additional 1 % reduction in LDL would generate a 1.7 % reduction in the risk of major coronary events (Pedersen 1998). In our study lifestyle intervention was associated with a significant decrease in TG, TC and LDL and an increase in HDL in overweight people, as well as with a decrease in TG and TC in obese people. When a subgroup analysis was performed in overweight people with cardiovascular risk factors, the difference in means between lifestyles intervention and standard care was not significantly different with respect to TG and HDL. The observed results pointed in the expected direction but showed no statistically significant difference. A possible explanation for these small changes is the fact that the control group often showed moderate weight loss and TG reductions, minimizing between-group differences.

The association between obesity and cardiovascular disease is well established and up to 60 % of overweight and obese patients are hypertensive (Dentali 2005). Cardiovascular complications may, to a large extent, be prevented by lowering blood pressure in patients at risk of developing cardiovascular disease. The Heart Outcome Prevention Study showed that a decrease in systolic blood pressure of 2–3 mmHg in patients with diabetes and one other risk factor for cardiovascular

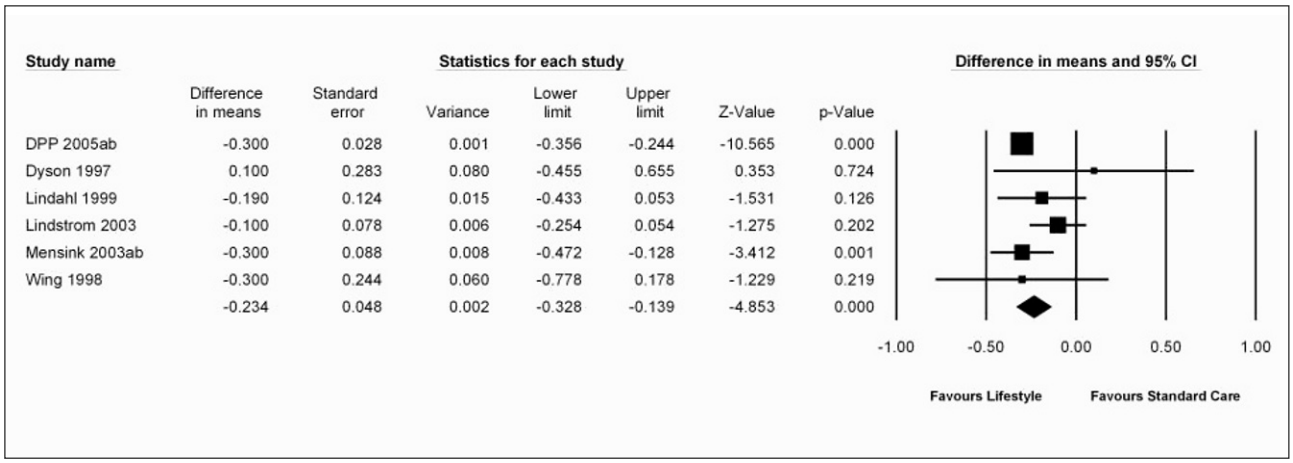

Figure 5 Subgroup analysis fasting plasma glucose change (mmol/l) in overweight/obese at risk of diabetes

morbidity was associated with a 25 % reduction in risk of myocardial infarction, stroke, or cardiovascular death (Gerstein 2002). Another major trial (UKPDS 38) compared tight with less tight blood pressure control i. e. mean 144/82 mmHg versus 154/87 mmHg. The tight blood pressure control demonstrated considerable benefits reducing heart failure by 56 %, stroke by 44 % and combined myocardial infarction, sudden death, stroke, and peripheral vascular disease by 34 %. According to our analysis, lifestyle intervention reduced significantly systolic and diastolic blood pressure in overweight and obese people.

The present study established the mid- to long-term effectiveness of lifestyle intervention in overweight and obese people by combining the beneficial effects on body weight and cardiovascular risk factors at distal follow-up. The actual lifestyle intervention in all evaluated studies included dietary counseling and physical exercise and lasted from one to six years including an average follow-up time of three years. The question now arise weather the observed beneficial effects of lifestyle interventions are maintained over lifetime. Such information is presently not available. However, the extended follow-up of the Finish Diabetes Prevention Program (Lindstrom 2006) which lasted 7 years resulted in sustained lifestyle changes and a reduction in diabetes incidence that was maintained long after the lifestyle counseling had stopped. The study reported a 43 % reduction in the relative risk from developing diabetes related to the success in achieving the intervention goals of weight loss, reduced intake of total and saturated fat, increased intake of dietary fibre and increased physical activity. Nevertheless, continued research in overweight and obese people is required to evaluate the effect of lifestyle interventions over lifetime.

Our analysis has several limitations. We may not have identified all relevant literature on this topic given the large applicability of lifestyle interventions in obesity related diseases. However, our search strategies of literature identification was comprehensive, capturing many of the published studies on lifestyle intervention in overweight and obese people independent of the associated co-morbidities. We cannot exclude the possibility of publication bias i. e. small studies with positive results are more likely to be published although the funnel plot suggests no such publication bias. Our results are limited by the poor quality of data reported on the outcome evaluated i. e. BMI, HDL, LDL, HbA1c, as well as the lack of subgroup analysis on different patient population i. e. gender difference, stratification according to different co-morbid conditions. We also observed qualitative and quantitative heterogeneity across studies on sample size, study population, and types of lifestyle intervention.

Questions may arise whether a lifestyle program could accomplish equivalent beneficial effects in different countries and ethnically diverse populations. Socio-cultural factors can influence the efficacy of lifestyle program in different countries, young or older adults, men or women, and the presence of different co-morbidities. Evidence based on the studies selected for the present review strongly suggest that lifestyle intervention programs performed in different countries that target overweight and obese people with different co-morbidities are effective in reducing weight and cardiovascular risk factors. However, further research should adapt lifestyle interventions for the need of each patient population taking into consideration different dietary and physical activity background.

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Conclusion

In summary, the results of the present systematic literature review suggest that lifestyle intervention is efficacious in the mid- to long-term prevention and treatment of obesity leading to a significant reduction in body weight and cardiovascular risk factors. Lifestyle intervention may be considered an effective prevention tool that can be applied across different disease areas including obesity, diabetes and cardiovascular disease with beneficial effects maintained for more than three years.

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Zusammenfassung

Prävention und Behandlung der Adipositas durch Verhaltensänderung („lifestyle" interventions): systematischer Überblick und Metaanalysen

Zielsetzung: Ziel dieser Arbeit war es, die Wirksamkeit von Interventionen zur Verhaltensänderung („lifestyle interventions") in der Prävention und Behandlung von Adipositas zu untersuchen.
Methoden: Zu diesem Thema wurde ein systematischer Überblick über die relevante Literatur und entsprechende Meta-Analysen durchgeführt. Elektronische Datenbanken, Referenzlisten von Publikationen, Bücher und weitere Berichte zu Adipositas wurden nach klinischen Studien durchsucht, die den Einfluss von Verhaltensänderungstherapien bei Übergewicht und Adipositas untersuchten. Die evaluierten Studien waren randomisierte klinische Studien, die Interventionen zur Verhaltensänderung (lifestyle interventions) bei Übergewicht und Adipositas auf ihre längerfristige Wirksamkeit (minimum 1 Jahr Beobachtungszeit) beinhalteten. Untersuchte Endpunkte waren Körpergewicht, BMI (body mass index), Taillenumfang, systolischer und diastolischer Blutdruck, Lipidwerte (Gesamtcholesterin, Lipoproteine (LDL, HDL), Triglyceride) und die Blutglukoseinstellung: Nüchternblutglukose, 2-Stunden postprandiale Glukose und glykolysiertes Haemoglobin (HbA_1).
Resulte: Zum Thema Prävention wurden 13 Studien, zum Thema Behandlung 17 Studien gefunden und evaluiert. Im Vergleich zu einer Standardbehandlung war eine Verhaltensänderungstherapie in der Lage sowohl das Körpergewicht, den BMI, den Taillenumfang, die Blutfette als auch die Blutglukosewerte statistisch signifikant zu reduzieren. Diese positiven Auswirkungen wurden über einen Zeitraum von bis zu drei Jahren beibehalten.
Schlussfolgerungen: Therapien zur Verhaltensänderung (lifestyle interventions) sind wirksam in der längerfristigen Prävention und Behandlung von Übergewicht und Adipositas und führen zu einer signifikanten Abnahme des Körpergewichtes sowie zu einer Reduktion von kardiovaskulären Risikofaktoren.

Schlüsselbegriffe. Systematischer Überblick – Meta-Analyse – Übergewicht – Prävention – Adipositas – Behandlung.

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