Obesity Comorbidity/Treatment

Nurse delivered lifestyle interventions in primary health care to treat chronic disease risk factors associated with obesity: a systematic review

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Summary

Nurses in primary health care (PHC) provide an increasing proportion of chronic disease management and preventive lifestyle advice. The databases MEDLINE, CINAHL, EMBASE and PsychINFO were searched and the articles were systematically reviewed for articles describing controlled adult lifestyle intervention studies delivered by a PHC nurse, in a PHC setting. Thirty-one articles describing 28 studies were analysed by comparison group which revealed: (i) no difference of effect when the same intervention was delivered by a PHC nurse compared to other health professionals in PHC ($n = 2$); (ii) the provision of counselling delivered by a PHC nurse was more effective than health screening ($n = 10$); (iii) counselling based on behaviour change theory was more effective than the same dose of non-behavioural counselling when at least three counselling sessions were delivered ($n = 3$). The evidence supports the effectiveness of lifestyle interventions delivered by nurses in PHC to affect positive changes on outcomes associated with the prevention of chronic disease including: weight, blood pressure, cholesterol, dietary and physical activity behaviours, patient satisfaction, readiness for change and quality of life. The strength of recommendations is limited by the small number of studies within each comparison group and the high risk of bias of the majority of studies.

Keywords: Chronic disease prevention, lifestyle intervention, nursing, primary health care.

Introduction

The international rise in obesity rates over the last three decades has been accompanied by an increase in preventable chronic diseases, such as type 2 diabetes, cardiovascular disease, stroke, arthritis and some cancers (1). Internationally, chronic diseases are managed in a variety of health care settings and their prevention is increasingly

becoming a priority for primary health care (PHC) which is the first point of contact with the health system.

Nurses are an integral part of any multidisciplinary PHC team and have roles that continue to develop and expand in response to financial incentive, medical practitioner shortages and an imperative to decrease pressure on hospitals (2–5). Nurses in PHC are assuming an increasing proportion of the chronic disease management and preventive health advice (6). A systematic review of the literature of PHC nursing interventions provides strong international evidence to support the effectiveness of PHC nurses in a diverse range of roles including chronic disease

management, illness prevention, health promotion and achievement of good patient compliance in treating chronic conditions, when assessed using quality of care measures (mortality, quality of care, compliance, knowledge, satisfaction), and use of resources (7).

Lifestyle change interventions focus on increasing healthy behaviours at the individual level and reducing chronic disease risk by controlling physiological variables known to be associated with chronic disease onset. Systematic reviews provide strong evidence that lifestyle interventions are effective in: preventing weight gain in adults who are obese (8), decreasing hypertension (8,9), positively affecting lipid levels (9), and reducing the onset of type 2 diabetes and the metabolic syndrome (8).

Little is known to inform the components of PHC nursing interventions for the prevention and management of chronic diseases associated with obesity. This is the first systematic review to compile the evidence regarding lifestyle change intervention effect, when delivered by PHC nurses, without restricting outcomes to those of cardiovascular disease risk (10). The aims of this research were to: (i) review the evidence of intervention effectiveness to change lifestyle risk factors when delivered by PHC nurses in a PHC setting; and (ii) inform the direction of future research to evaluate PHC nursing interventions to reduce lifestyle risk factors associated with overweight, obesity and preventable chronic diseases in adults.

Methods

This systematic review was conducted and reported in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (11,12).

Key question

The key question informing this systematic review was: What does the published literature report on the effectiveness of interventions for adults which aim to affect change in lifestyle risk factors for chronic diseases that are associated with overweight and obesity, when these are delivered by a PHC nurse in a PHC setting?

Eligibility criteria

Articles were eligible if they: described interventions with a lifestyle change component, were delivered to adults by a PHC nurse in a PHC setting, and reported quantitative outcomes on risk factors associated with obesity including: anthropometric, physiologic, behavioural or psychosocial. Randomized and non-randomized controlled trials (RCTs and non-RCTs) were included.

Papers were limited to primary sources, published in English. Articles were excluded if they: did not report

outcomes for adults; involved treatment of severe mental health disorders; involved pharmaceutical treatment or if participants were using medications that were likely to affect primary outcomes (e.g. anti-hypertensive when blood pressure was a primary outcome); or involved surgical treatment. Studies reporting effect on smoking cessation or alcohol intake were excluded where this was the main focus of intervention, and included, if there were lifestyle change outcomes of interest, as interventions focused on smoking cessation have been reported elsewhere (13). Articles that did not clearly describe the involvement of either a PHC setting or PHC nurse delivery were excluded. No restrictions were placed on the primary outcome measure, the year of publication, length of intervention, follow-up period or format of the comparison group. To the best of our knowledge, all articles were peer reviewed.

Information sources

Major health and medicine databases of published literature, MEDLINE, CINAHL, PsychINFO and EMBASE, were searched in September 2010. The bibliographies of included articles were hand searched to locate articles not catalogued in these databases.

Search strategy

The database search strategy (Supporting Information Table S1) was constructed with the assistance of a specialist librarian, using medical subject headings (MeSH), and five groups of keywords. Articles retrieved by the search strategy had at least one term from each of the five groupings: (i) PHC setting (including general practice, family practice, primary care, medical staff, nursing staff, physician's office or community health); (ii) nurse delivery (including nurse practitioners, practice nurses, occupational health nurses and public health nurses, community nurses or health visitors); (iii) intervention evaluation studies (including treatment, therapy, intervention, management assessment or delivery); (iv) lifestyle change interventions (including dietary, physical activity, behaviour, health education or chronic disease management); and (v) evaluation of outcomes associated with obesity treatment (anthropometric or behavioural). A sixth group limited results by excluding articles outside the scope of the review. Word truncation and wildcards allowed for variations in spelling and word endings. Database limits for English full text were applied. Search terms were adjusted slightly for each database.

Study selection

A reference management program (EndNote X1.0.1, Thomson™) was used to manage the included articles and remove book chapters and theses. The search function was

used to exclude articles when the title contained the following keywords that were outside the scope of this review: dialysis, urinary, eating disorder, HIV, oncology, haemodialysis, ulcer, literature review or guideline.

Using an inclusion/exclusion criteria checklist, two reviewers (LF and GS) independently screened the title and abstracts of articles resulting in 87% reviewer concordance. Non-concordant articles were resolved by consensus or retained for full-text review if agreement was not reached. Full-text articles were reviewed (GS and LF) using an eligibility checklist. If clarification was necessary, the article was independently reviewed by a second reviewer (RP, LF or GS). Further library searches were conducted using the names of authors of included studies to identify subsequent or preliminary papers for those studies. The paper reporting the post-intervention outcome measures was regarded as the primary source.

Data extraction

Data from publication describing included studies were extracted systematically by one reviewer (GS) into a database described elsewhere (14,15). No further information was sought from the authors. Data describing interventions that were reported in more than one article were extracted together. A second reviewer (LF) verified outcome tables.

Data items

The following components of each intervention were recorded for comparative purposes: study design, intervention setting, setting recruitment, the involvement of PHC nurse/s in intervention delivery, personnel training as part of the intervention, behaviour change targets, target participants, participant recruitment, group treatment (comparison and intervention groups), number of contacts, treatment duration and outcomes.

Risk of bias in individual studies

The risk of bias was assessed for individual studies according to adequate control of: selection bias or allocation bias, detection bias, attrition bias and reporting bias (15,16). Each study was scored for methodological limitations and risks of bias during data extraction (Table 1 and Supporting Information Table S2). An overall indication of quality according to the methodological limitations and risk of bias is also indicated. Randomized and non-randomized trials were assessed using the same criteria and studies were not excluded on the basis of risk of bias.

Synthesis of results

Comparison groups were often recorded within group changes; however, the outcomes reported here are restricted to outcome measures that were significantly ($P < 0.05$) different from the comparison group. Outcomes reporting smoking cessation and change in alcohol consumption were not extracted.

Because of the heterogeneity of outcome measures, neither a meta-analysis nor evidence profile on outcomes was appropriate. Results are instead synthesized, presented and discussed according to comparison group. The methodological limitations and risk of bias are presented for each study in the outcome tables and are discussed descriptively.

Results

The database search identified 3,491 papers. The review process identified 31 articles describing 28 studies that were eligible for inclusion (Fig. 1). These studies involved a total of 10,759 participants and took place in the United Kingdom ($n = 9$), United States ($n = 13$), Finland ($n = 4$), the Netherlands ($n = 1$) and New Zealand ($n = 1$).

Twenty-two of the studies were RCTs, and the remaining six were non-RCTs. Three studies reported strong methodological rigour with no serious limitations and a low risk of bias (17–20). The remainder was assessed to have serious limitations and at least moderate ($n = 5$) or high ($n = 20$) risk of bias (Table 1).

About 14 of the 28 studies described nurses delivering behavioural counselling in an appointment between 5 and 30 min using theoretically based behaviour change techniques such as stage matching, motivational interviewing to enhance readiness for change or goal setting. Most of these described providing training prior to intervention delivery.

Intervention delivery by primary health care nurses compared with other health professionals in primary health care

One study with no serious limitations and a low risk of bias (17) and one study with serious limitations and a high risk of bias (21) directly compared delivery of the same intervention by different health professionals in a PHC setting (Table 2). The interventions involved either two (17) or nine (21) contacts with a health professional. Significant changes were seen within all six treatment groups for anthropometric outcome measures over the short term with no adverse effects reported. There was no evidence that delivery by a PHC nurse, following brief training, affected outcomes differently compared to delivery by a dietitian (17), a psychologist or a social worker (21) (each with prior experience in delivering weight reduction counselling).

Primary health care nurse counselling for lifestyle change compared with screening

There is good evidence (Table 3) from one high-quality study with a low risk of bias that behavioural counselling

Table 1 Summary of methodological limitations and risk of bias (full information is available as Supporting Information online)

First author and year	Validated measures adequacy	Randomization	Risk of selection or allocation bias	Blinding adequacy	Risk of performance and detection bias	Risk of attrition bias	Evidence of outcome measure reporting bias	Overall rating
Balch 1976 (21)	Unclear	Adequate	X	Not done	X	X X	Nil	X X
Baron 1990 (28)	Adequate	Adequate	X X	Inadequate	X	✓	Yes	X
Gemson 1990 (38)	Unclear	Adequate	X	Unclear	X	X	Yes	X X
Beresford 1992 (30)	Adequate	Adequate	X X	Not done	X	X	Yes	X X
Karvetti 1992 (26)	Adequate	Adequate	X X	Not done	X	X X	Nil	X X
Robertson 1992 (42)	Adequate	Adequate	X	Adequate	✓	X	Yes	X
Neil 1995 (17)	Adequate	Adequate	✓	Adequate	✓	✓	Nil	✓
Sander 1996 (45)	Unclear	Adequate	X X	Inadequate	X	X X	Nil	X X
Bakx 1997 (27)	Adequate	Adequate	X X	Not done	X	X X	Nil	X X
Roderick 1997 (35)	Adequate	Adequate	X X	Unclear	X		Yes	X X
Anderson 1999 (39)	Adequate	Adequate	X X	Not done	X	X X	Nil	X X
Naylor 1999 (34)	Adequate	Adequate	X X	Not done		X X	Nil	X X
Sims 1999 (36)	Adequate	Not done	Non-RCT X X	Adequate	✓	X	Nil	X X
Steptoe 1999 (33)	Unclear	Adequate	✓	Not done	X	X	Yes	X X
Gold 2000 (24)	Adequate	Not done	Non-RCT X X	Not done	X	X X	Nil	X X
Dubbert 2002 (41)	Adequate	Adequate	X	Adequate	✓	✓	Nil	X
Ammerman 2003 (44)	Adequate	Adequate	X	Not done	X	X	Yes	X X
Aittasalo 2004 (23)	Adequate	Adequate	X X	Not done	X	X	Nil	X X
Little 2004 (22)	Adequate	Adequate	✓	Inadequate	X	✓	Yes	X
Little 2004 (43)	Adequate	Adequate	✓	Not done	X	✓	Nil	X
Purath 2004 & 2005 (37,75)	Adequate	Adequate	X	Not done	X	X	Yes	X X
Kinnunen 2007 (32)	Adequate	Not done	Non-RCT X	Not done	X	✓	Nil	X X
Kinnunen 2007 (31)	Adequate	Not done	Non-RCT X X	Not done	X	X	Nil	X X
Speck 2007 (29)t	Adequate	Not done	Non-RCT X	Not done	X	X	Yes	X X
Lawton 2009 & Rose 2007 (18,19)	Adequate	Adequate	✓	Adequate	✓	✓	Yes	✓
McTigue 2009 (25)	Adequate	Not done	Non-RCT X X	Not done	X	X	Yes	X X
Whittemore 2009 (20)	Adequate	Adequate	✓	Adequate	✓	✓	Nil	✓
Faucher 2010 (40)	Unclear	Adequate	X	Inadequate	X	X X	Nil	X X

✓ No serious limitations and low risk of bias; X Serious limitations and some risk of bias; X X Very serious limitations and high risk of bias.
RCT, randomized controlled trial.
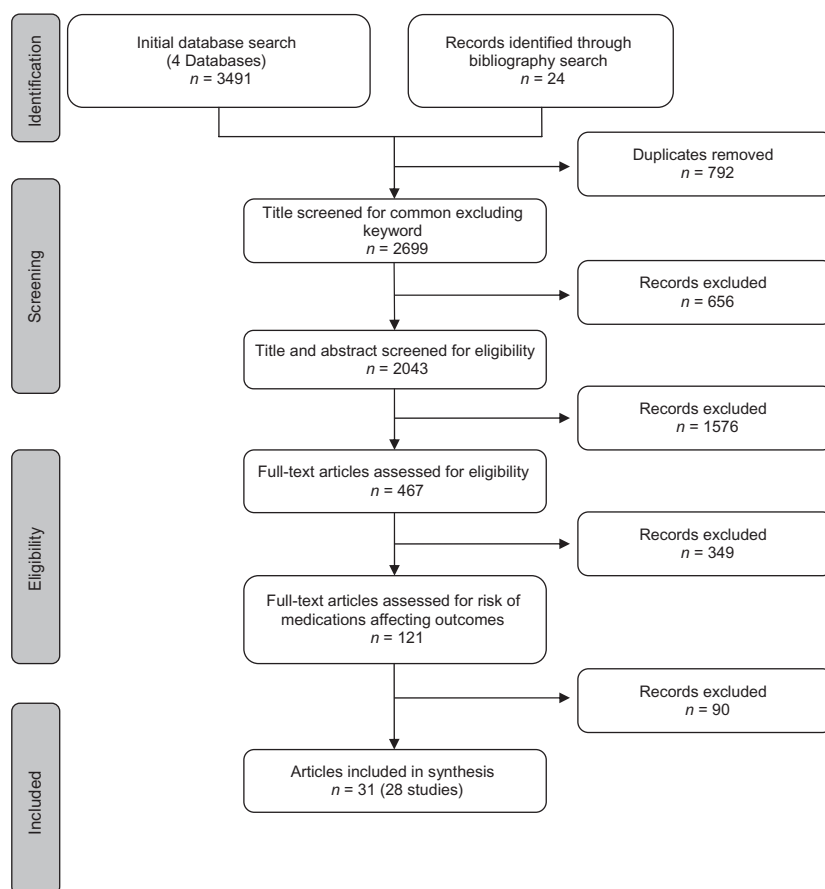
Figure 1 Flow of papers through selection process using Preferred Reporting Items for Systematic Reviews and Meta-Analyses format (11).

delivered by a nurse is significantly more effective than screening alone to increase physical activity levels and improve quality of life over a 1-year intervention, and that these may be maintained at a 2-year follow-up (18,19). This study did however observe more falls and injuries in the group of participants that undertook more physical activity and did not record significant anthropometric or physiological outcomes. One study with moderate risk of bias (22) indicated that 1 month of behavioural counselling may significantly affect positive changes in readiness and intent for physical activity when compared with screening alone. Two further studies, with a high risk of bias, offer supporting evidence that behavioural counselling is more effective than screening alone across a variety of outcomes (23,24).

Six studies with a moderate ($n = 1$) to high ($n = 5$) risk of bias investigated the effect of traditional counselling (without the use of theoretical behaviour change strategies) compared with screening alone (Table 4). Interventions involved between 1 (5 min) and 20 counselling sessions and follow-up measures were taken between 3 months and 17 years from baseline. All intervention arms that involved nurse counselling following screening demonstrated significantly higher post-intervention changes in anthropometric, physiological or behaviour change out-

comes, compared to screening. Significant changes were reported for: weight reduction (25,26), systolic and diastolic blood pressure reduction (26,27), cholesterol profile improvements ($n = 3$) (26–29), favourable dietary intake by self-report (26,28,30) and quantitative biomarkers ($n = 3$) (28). Significant intervention effect was not maintained at 17-year follow-up (27).

PHC nurse lifestyle counselling based on behaviour change theories compared to traditional counselling

Four studies with a high risk of bias reported testing PHC nurse delivery of the same dose of counselling comparing traditional counselling with counselling based on behaviour change theory (31–34). Three interventions were delivered in three to five contacts, each reported significantly greater intervention effect for participants who received behavioural counselling than traditional counselling (Table 5). No intervention effect was reported when 5 min of counselling tailored to the participants' stage of change was compared to usual care or provision of written material only (34).

Table 2 Delivery by PHC nurses compared with other health professionals in PHC: intervention description, participant characteristics and outcomes of studies that compared effects. Results presented according to risk of bias, with lowest risk of bias first

First author and year, study design, country, sample*, risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Neil 1995 (17) RCT in one group general practice, England *n* = 309 (90% at 6-month FU), 35–64 years, 47% female ✓	**Aim:** To compare efficacy of dietary advice given by a dietitian, a practice nurse or a dietary leaflet **Target:** Men and women of European origin, aged 35–64 years, with elevated total serum cholesterol (6.5–9.0 mmol L⁻¹) **Background:** Baseline screening was undertaken by five practice nurses. All participants were advised to reduce total and saturated fat and increase dietary fibre and complex carbohydrate intake. **Duration:** 6 months	**Group 1:** FFQ and 30-min counselling with practice nurse, further 10 min at 2 months **Group 2:** Standard diet history and 30 min with dietitian, further 10 min at 2 minutes **Control group:** Posted leaflet containing dietary guidance, additional advice posted 2 months later and received usual care	Nil	BMI, HDL cholesterol, total cholesterol, triglycerides and antioxidants
Balch 1976 (21) RCT in a university student health centre, United States *n* = 50 (73% at 13-week FU), average age 22.4 years (range 16–37), 94% female ✗✗	**Aim:** To compare intervention delivery by primary care nurses (with brief training), a social worker or a psychologist **Target:** University students, 10% or more overweight (for height), willing to deposit $23.50 (in 1970s) **Background:** Nine sessions of group behavioural counselling to enhance diet and exercise knowledge and problem-solving skills using self-monitoring techniques **Duration:** 9 weeks (FU at 13 weeks)	**Groups 1 and 2:** The primary care nurses each delivered the same intervention to one group **Group 3:** Delivered by a social worker **Control group:** Delivered by a psychologist experienced in running these sessions and received usual care	Nil	Percentage overweight, change in bodyweight

✓No serious limitations and low risk of bias; ✗Serious limitations and some risk of bias; ✗✗Very serious limitations and high risk of bias.
*Sample size at baseline, target age (actual mean and distribution when available).
†Significant outcomes within group not presented.
BMI, body mass index; FFQ, food frequency questionnaire; FU, follow-up; HDL, high-density lipoprotein; PHC, primary health care; RCT, randomized controlled trial.

Four studies with a low (20) and high (35–37) overall risk of bias compared a low dose of traditional counselling with a higher dose of behavioural counselling (Table 6). High-quality evidence with a low risk of bias supports the use of a high dose (13 contacts) of behavioural counselling to improve patient satisfaction (20). The studies with a high risk of bias indicate that higher doses of counselling based on theories of behaviour change may result in significantly higher changes than low doses of traditional counselling, and these are evidenced by changes in: anthropometry (32,35), blood pressure (33), cholesterol profile (35), physical activity (33,37),

dietary intake (31,32,35), stage of readiness and intention for behaviour change (37).

Low dose of counselling compared to high dose

Four studies tested the effect of a low dose of counselling (one or two contacts) compared with a higher dose (≥3, Table 7) of traditional counselling (38–40) or behavioural counselling (41). Self-reported dietary intake was significantly improved when three additional brief (3–5 min) counselling sessions were delivered (38). Adherence to recommendations and self-reported physical activity were

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significantly higher when up to 20 additional contacts were delivered (41).

Use of prompts or diagnostic tools

A prescription for physical activity was delivered by a nurse in one study with a low risk of bias (18) (group 1). However, the treatment effect may not be attributable to this prescription component, hence this group was excluded from further analysis.

One intervention, with a moderate risk of bias, reported that the immediate provision of cholesterol readings using point-of-care equipment did not result in significantly different cholesterol readings at 3-month follow-up (42) (Table 8). Another supports the provision of a written prompt regarding high-fibre dietary choices and reduced fat options to improve fruit and vegetable intake and reduce weight (43) (group 3). The provision of high potassium, low sodium table salt to encourage reduction of sodium chloride intake resulted in adverse side effects and was not recommended (43) (group 2). A RCT with a high risk of bias supported dietary counselling by nurses, providing some evidence that training nurses in the use of a dietary risk assessment tool resulted in significant effects on dietary intake and weight change of participants over 3 months, with changes in dietary intake maintained over 12 months (44). Another study with a high risk of bias reported that nurse delivery of a written prompt did encourage participants to seek health-related information from their general practitioner (45).

Discussion

This is the first systematic review to synthesize the international evidence regarding the effectiveness of non-pharmaceutical lifestyle interventions for adults with the aim of reducing risk factors for preventable chronic diseases associated with obesity that were delivered by PHC nurses in a PHC setting. This synthesis contributes to the existing knowledge regarding the effectiveness of: nursing interventions in PHC to achieve changes in lifestyle risk factors for cardiovascular disease (10,46–49); lifestyle interventions to prevent cardiovascular disease (9,50,51) and manage obesity (8,52,53); lifestyle interventions in PHC (54,55); and prevention and health promotion in nursing (56).

The U.S. Preventive Services Task Force (USPSTF) concludes that changes in physiological measures such as glucose metabolism, lipid levels, blood pressure, as well as weight loss provide indirect evidence of intervention effect on long-term health outcomes (57), and these diverse measures are reflected in the interventions included in this review. The significant outcomes indicate that healthy lifestyle interventions delivered by PHC nurses can be effective over a variety of anthropometric, physiological and behavioural risk factors for chronic diseases associated with obesity.

The effectiveness of lifestyle interventions delivered by nurses, given appropriate training, is comparable to delivery by other PHC professionals with no adverse effects (17,21). This is consistent with existing literature regarding the effectiveness of nurses in PHC when compared to a PHC physician (7,9,58–62).

The USPSTF was unable to locate evidence regarding the effectiveness of screening for obesity alone (63,64). However, the provision of coronary risk information, with or without counselling, has proven effective in increasing intent to commence therapy (65). In any prospective controlled trial, the process of data collection and screening for eligibility is likely to act as an intervention in itself; hence, it is very difficult to assess the effect of an intervention compared with no intervention. Screening for risk is an essential antecedent to intervention in PHC (55), hence an essential component of lifestyle intervention to prevent chronic diseases associated with obesity. However, evidence in this review, although of mixed quality, consistently supports the provision of some dose of counselling (1–20 contacts) by nurses compared to screening alone.

The USPSTF recommends that clinicians offer high intensity counselling (≥2 contacts per month for 3 months, or a total of 6 h) and behavioural interventions to achieve weight loss in obese adults (57) and reduce cardiovascular risk factors in adults (50), or medium intensity counselling (between 31 min and 6 h) to affect significant changes in dietary and physical activity behaviours (50,55). The results of this systematic review support this, as results indicate that delivery of counselling in three or more contacts may result in significantly higher change in self-reported behaviour change for dietary and physical activity behaviours. However, there was insufficient evidence to support the use of a higher dose of intervention when assessed using anthropometric or physiological outcomes such as weight, blood pressure, cholesterol profile or fitness. There was little evidence to support low intensity counselling; however, take-home written prompts may be a useful adjunct to nurse counselling interventions in PHC.

Counselling for lifestyle change in PHC has traditionally taken the form of advice regarding recommendations to meet guidelines. More recently, behavioural counselling in lifestyle interventions has been based on psychological theoretical frameworks such as the theory of planned behaviour (66), concepts such as the transtheoretical model of health behaviour change (67), and the use of strategies such as motivational interviewing (68) and goal setting (69). Results of this review indicate that behavioural counselling strategies delivered by nurses in PHC have an effect on increasing participants' readiness for change and estab-

Table 3 PHC nurse delivered behavioural counselling for lifestyle change compared with screening: intervention description, participant characteristics and outcomes of studies that compared effects. Results presented according to risk of bias, with lowest risk of bias first

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Lawton 2009 & Rose 2007 (18,19) RCT in seven primary care practices in Wellington, New Zealand. *n* = 1,089 (93% at 12 months), average age 58.9 years (SD 7), 100% female ✓	**Aim:** To assess the effectiveness of nurse-led motivational counselling to increase PA for relatively inactive women **Target:** Women aged 40–74, with ≤30 min of moderate PA ≥5 d per week **Background:** Primary care nurses conducted baseline interviews and measures for all participants. Nurse and exercise specialist were experienced in using MI. **Duration:** 12 months (FU at 24 months)	**Group 1:** A primary care nurse delivered 7–13 min of MI and 'exercise on prescription' repeated at 6 months. Also referred to an exercise specialist who delivered 15-min motivational telephone calls over 9 months. **Control group:** Told that their health would be monitored over the next 2 years and received usual care	**PA adherence at 12 months:** group 1 = 43% compared with control = 30%, *P* < 0.001; **at 24 months:** group 1 = 39% compared with control = 33%, *P* < 0.001. **QOL SF-36:** Physical functioning group 1 increased compared with control, *P* = 0.03; mental health group 1 increased compared with control, *P* < 0.05; role physical scores group 1 decreased compared with control, *P* < 0.01. **Physical falls at 12 months:** group 1 = 32% increased compared with control = 25%, *P* < 0.001; **at 24 months:** group 1 = 37% increased compared with control = 29%, *P* < 0.001. **Physical injuries: at 12 months:** group 1 = 18% increased compared with control = 17%, *P* = 0.03; **at 24 months:** group 1 = 19% increased compared with control = 14%, *P* = 0.03.	At 12 and 24 months: weight, waist circumference, lipid profile, diastolic BP, systolic BP, pulse, Hb1Ac, insulin, triglycerides, HDL cholesterol
Little 2004 (22) RCT in four general practices, England *n* = 151 (number at FU not clear), average age 58 years (SD 13), 56% female ✗	**Aim:** To assess efficacy (self-report and fitness measures) of three approaches to increase PA to 30 min d⁻¹, 5 d per week. **Target:** Sedentary, adult patients with CVD RF **Background:** Participants were randomized to eight groups (2 × 2 × 2 factorial design) and received 0–3 components **Duration:** 1 month	**Group 1:** Provided the booklet, 'Getting active, feeling fit' **Group 2:** Behavioural counselling by PN **Group 3:** GP delivered PA prescription for brisk exercise **Control group:** Did not receive comparison intervention (but may have received others)	See Table 8 for group 1 outcomes. **SOC:** group 2 increased compared with group 1 = 0.79 (95% CI 0.41–1.16), *P* < 0.001 **Cholesterol/HDL ratio:** group 3 increased compared with control = 0.25 (95% CI 0.02–0.49)	Fitness and physical activity, cholesterol/HDL ratio

Table 3 *Continued*

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Aittasalo 2004 (23) RCT in seven OHCs, covering nine companies, Finland $n = 155$ (99% at 12-month FU), average age 44 years (SD 9), 56% female XX	**Aim:** To assess the effect of behavioural counselling intervention (increasing self-efficacy, using goal setting and written weekly PA plan) delivered by occupational health nurse on fitness and self-reported LTPA **Target:** Adult employees with low level of PA (moderate PA < twice per week) and self-reported readiness to increase PA in the near future **Background:** All participants completed questionnaires, 7-d PA diary and 7-d pedometer record at baseline, 6 and 12 months **Duration:** 12 months	**Group 1:** 60–90 min goal-oriented counselling, 30–45 min FU at 8 weeks, 6 and 12 months **Group 2:** Fitness assessment plus counselling by physiotherapist at baseline, 6 and 12 months, in addition to counselling received by group 1 **Control group:** Received 'no counselling actions'	**Minutes sitting during non-work day:** group 2 less compared with control: mean difference = 28.5% (95% CI 7.5–43.9), $P = 0.006$ **Health status:** group 2 improved compared with group 1, $P = 0.043$ **Fitness status:** group 2 improved compared with group 1, $P = 0.027$; groups 1 and 2 improved compared with control, $P = 0.012$.	Time spent in LTPA
Gold 2000 (24) Non-RCT in six work sites, United States $n = 1,741$ (number at FU not clear), average age 45 years, 44% female XX	**Aim:** To evaluate the long-term impact of telephone-based behavioural counselling (SOC, goal setting, barriers to change, monitoring) that targets high-risk, ready-to-change individuals to maintain lifestyle change **Target:** Adult employees at work sites that reported ≥3 high-risk areas on a HRA **Background:** One nurse health educator delivered HRA and all intervention contacts and telephone support **Duration:** Up to 26 months	**Group 1:** Those who requested risk-reduction program information. Written information, 3× monthly 10-min calls, FU call at 6 and 12 months (some at 18 and 24 months) of tailored counselling. **Control group:** Received HRA results but did not agree to participate	**Number of health risks:** group 1 = 5.17 compared with control = 6.36, $P < 0.01$ **Weight control:** group 1 reduced risks = 25% compared with control = 14%, OR 1.9, $P = 0.03$ **Back care:** group 1 reduced risks = 44% compared with control = 25%, OR 3.5, $P < 0.001$ **Eating habits:** group 1 reduced risks = 46% compared with control = 28%, OR 1.8, $P = 0.05$ **Exercise and activity:** group 1 reduced risks = 45% compared with control = 27%, OR 2.2, $P < 0.001$ **Stress management:** group 1 reduced risks = 38% compared with control = 23%, OR 2.0, $P = 0.04$	Cholesterol control

✓No serious limitations and low risk of bias; XSerious limitations and some risk of bias; XXVery serious limitations and high risk of bias.

*Sample size at baseline, target age (actual mean and distribution when available).

†Significant outcomes within group not presented.

BMI, body mass index; BP, blood pressure; CI, confidence interval; CVD, cardiovascular disease; FU, follow-up; GP, general practitioner; HDL, high-density lipoprotein; HRA, health risk assessment; LDL, low-density lipoprotein; LTPA, leisure time physical activity; MI, motivational interviewing; OHC, occupational health centre; OR, odds ratio; PA, physical activity; PHC, primary health care; PN, practice nurse; QOL, quality of life; RCT, randomized controlled trial; RF, risk factor; SD, standard deviation; SOC, stage of change.

Table 4 PHC nurse counselling (non-behavioural) for lifestyle change compared with screening: intervention description, participant characteristics and outcomes of studies that compared effects. Results presented according to risk of bias, with lowest risk of bias first

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Baron 1990 (28) RCT in 1 general practice, England n = 368 (91% at 12-month FU), average age 41 years (SD 1), 49% female X	**Aim:** To assess the effectiveness of nurse-led dietary advice to decrease serum lipid levels and thereby decrease the incidence of ischaemic heart disease **Background:** Dietary advice to decrease total fat intake, substitute polyunsaturated fat with saturated fat and increase dietary fibre intake **Target:** Patients aged 25–60 years, not receiving treatment for hyperlipidaemia or CVD **Duration:** 3 months (FU at 12 months)	**Group 1:** Written material and three counselling sessions by the same nurse (individually or in small groups) with 'optimal body weight', PA, salt (alcohol and smoking) and dietary advice **Control group:** Told they were part of a nutrition survey, FU by nurse, no dietary advice	**LDL cholesterol at 3 months:** men: group 1 = −0.39 ± 0.08 mM compared with control = −0.04 ± 0.085 mM, $P < 0.05$ **Biomarkers of unsaturated : saturated fat intake at 12 months: triglyceride linoleic acid:** men: group 1 = +1.39 ± 0.63% compared with control = −0.34 ± 0.60%, $P < 0.05$; women: group 1 = +0.90 ± 0.62% compared with control = +0.17 ± 0.60%, $P < 0.05$. **Cholesterol ester:** men: group 1 = +5.90 ± 0.79% compared with control = +1.71 ± 0.82%, $P < 0.05$; women: group 1 = +6.28 ± 0.83% compared with control = +1.93 ± 0.95%, $P < 0.05$. **Self-reported efforts to increase polyunsaturated fat intake at 12 months:** men: group 1 = 22% compared with control = 1%, $P < 0.001$; women: group 1 = 30% compared with control = 1%, $P < 0.001$. **Self-reported efforts to increase fibre intake at 12 months:** men: group 1 = 52% compared with control = 3%, $P < 0.001$; women: group 1 = 42% compared with control = 3%, $P < 0.001$. **Self-reported efforts to decrease fat intake at 12 months:** men: group 1 = 55% compared with control = 5%, $P < 0.001$; women: group 1 = 38% compared with control = 0%, $P < 0.001$.	At 3 months: weight, total cholesterol, HDL cholesterol At 12 months: LDL cholesterol

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Table 4 *Continued*

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
McTigue 2009 (25) Non-RCT in one primary care clinic, United States n = 154 (86% at 12-month FU), average age 49.91 years (range 20–79), 84% female XX	**Aim:** To trial the DPP efficacy to achieve 7% weight loss **Target:** Patients with a BMI ≥ 25 kg m⁻², referred by a physician **Background:** Advised to do 150 min of moderate PA per week, restrict fat and calorie intake. Involved behavioural techniques such as goal setting, self-monitoring and problem solving. **Duration:** 12 months	**Group 1:** Group-based program delivered by a nurse educator over 12 weekly sessions. Offered eight monthly FU sessions. **Control group:** Eligible patients who did not accept invitation to enrol in the program	**≥7% weight loss:** group 1 = 27% compared with control group = 6%, P = 0.001 **Weight loss** 4.38 times more likely in group 1 compared with control group (CI 1.84–10.41) **Weight change:** group 1 = –5.19 kg (95% CI –7.71 to –2.68) compared with control = +0.21 kg (CI –1.50 to 1.93), P < 0.001	Nil
Speck 2007 (29) Non-RCT in a community centre, United States n = 79 (100% at 6-month FU), average age 39.6 years (SD 12.8), range 18–63, 100% female XX	**Aim:** To test a nurse-led (NP) intervention aimed at reducing environmental barriers to PA in low-income women **Target:** Women aged 18–64 **Background:** Six opportunities for PA were offered each week at the church-sponsored community centre that served three urban low-income neighbourhoods. Centre offered food program, gym, exercise room, weight room and established NP clinic. **Duration:** 6 months	**Group 1:** The NP provided education and support, in person and by telephone, to promote participant involvement in PA opportunities. **Control group:** Women could access PA opportunities at the centre, but received no encouragement by the nurse to attend.	**Total cholesterol:** mean change score: control = +18.4 (SD 23.2) compared with group 1 = +3.5 (SD 24.9), P = 0.007 **Total benefits and barriers of PA:** mean change score: control = –2.1 (SD 10.5) compared with group 1 = 3.4 (SD 12.5), P = 0.033	PA, BMI, WC, systolic BP, diastolic BP, steps taken per day, perception of support or self-efficacy

Table 4 *Continued*

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Bakx 1997 (27) RCT in six family practices, the Netherlands n = 1,337 (70% at 17-year FU), average age 56 years (range 39–68), % female not clear XX	**Aim:** To assess maintenance of effects, 17 years after a nurse delivered intervention of dietary advice for patients with hypertension or a family history of premature CVD **Target:** Patients aged 20–50 years at high risk (highest 20%) of CVD **Background:** Advice to increase polyunsaturated fat intake and decrease intake of saturated fat, energy and salt **Duration:** 12 months (FU at 17 years)	**Group 1:** Participants were given health education every 2 months for 1 year by trained practice nurses. **Control group:** Usual care by family physician who provided unsupported advice with no additional resources	**BP and serum cholesterol at 1 year:** significant group 1 effect (details not reported) **Systolic and diastolic BP at 17 years:** greater decrease in control compared with group 1, *P* value not reported **Fat intake at 17 years:** lower in those at 'maintenance' SOC than any others stage (*P* < 0.0004)	At 17 years: BMI, systolic BP, diastolic BP or serum cholesterol
Beresford 1992 (30) RCT in two primary care clinics, United States n = 242 (79% at 3-month FU), average age 43 years, % female not clear XX	**Aim:** To assess the opportunistic introduction of self-help materials to reduce fat consumption and increase fibre consumption by a primary care nurse. **Target:** Adults, prior to an appointment with physician **Background:** All participants interviewed at baseline in the clinic, and over telephone at 3-month follow-up. The research nurse was employed specifically for project. **Duration:** 3 months	**Group 1:** The nurse introduced self-help materials (folder with 15 cards) in 5 min or less (approach not described), and reinforced this with a FU telephone call 10 d later. **Control group:** Received no self-help material or advice	**Use of low-fat cooking technique:** group 1 +18% compared with control (95% CI 5–32) **Chose whole grain substitute:** group 1 +14% compared with control (95% CI 1–28) **Daily fat intake:** for subgroup 'Those who had some responsibility for preparation of meals': group 1 –6.9 g compared with control (95% CI –13.2 to –0.6) **Calorie-adjusted fat:** for subgroup 'Those who had some responsibility for preparation of meals': group 1 –3.8 g compared with control (95% CI –7.1 to –0.4)	Daily fibre intake

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Table 4 *Continued*

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)[†]	Outcome measures taken with no significant outcomes[†]
Karvetti 1992 (26) RCT in health centres, Finland n = 243 (78% at 12-month FU), average age 48 years, 78% female XX	**Aim:** To assess the effect of a weight reduction course delivered by public health nurses in PHC on short-term weight loss, maintenance and decreases in health risks **Target:** Aged 17–65 years, BMI ≥27 kg m^{-2} **Background:** Seven PHNs attended training. Recommended diet: 1,200 kcal (5 MJ) low fat, low sugar, high vegetable diet over three meals and two snacks per day. **Duration:** 12 months (FU at 7 years, control merged with treatment group)	**Group 1:** 6 × 1.5 h weekly sessions (4× monthly, 2× bimonthly) of group nutrition education and dietary counselling. One lecture delivered by a physician, a psychologist and a physiotherapist. **Control group:** Wait-listed to a later weight reduction course and given no instructions	**Weight reduction:** group 1: men = −10.9 kg, women = −5.4 kg compared with control: men = +0.9 kg, women = +0.2 kg, $P < 0.001$ **Systolic BP:** women: group 1 = −6 mmHg compared with control = no change, $P < 0.05$ **HDL cholesterol:** women: group 1 = 0.14 mmol L^{-1} compared with control = no change, $P < 0.001$. Men: group 1 = 0.23 mmol L^{-1} compared with control = no change, $P < 0.01$. **Nutrient intake:** women: group 1 significantly decreased compared with control dietary intake of sucrose ($P < 0.001$), total energy, carbohydrates and saturated fatty acids ($P < 0.05$): men: group 1 significant improvement compared with control of saturated fatty acid intake ($P < 0.05$).	Diastolic BP, total cholesterol

✓No serious limitations and low risk of bias; XSerious limitations and some risk of bias; XXVery serious limitations and high high risk of bias.

*Sample size at baseline, target age (actual mean and distribution when available).

[†]Significant outcomes within group not presented.

BMI, body mass index; BP, blood pressure; CI, confidence interval; CVD, cardiovascular disease; DPP, diabetes prevention program; FU, follow-up; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NP, nurse practitioner; PA, physical activity; PHC, primary health care; PHN, public health nurse; RCT, randomized controlled trial; SD, standard deviation; SOC, stage of change; WC, waist circumference.

Table 5 Same dose of PHC nurse delivered lifestyle counselling based on behaviour change theories, compared to traditional counselling: intervention description, participant characteristics and outcomes of studies that compared effects. Results presented according to risk of bias, with lowest risk of bias first, then reversed chronologically

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Kinnunen 2007 (31) Non-RCT in six maternity clinics (three controls) in PHC, Finland n = 132 (80% at 9 months), average age 28 years (SD 4.5), 100% female XX	**Aim:** To measure the effect of individual behavioural counselling for pregnant women at five routine visits to PHN on change of diet, LTPA and prevention of excessive gestational weight gain **Target:** Pregnant adult women with no earlier deliveries (primiparas) **Background:** All participants attended routine visits (11–15) with PHN. **Duration:** 9 months	**Group 1:** Five behavioural counselling prior to 37 weeks gestation, delivered by nine PHNs following training. Goal setting to achieve minimum of five PA sessions per week, regular meals, ≥5 servings of F&V a day, eat high-fibre bread and limit high-sugar snacks. Option of attending supervised weekly group exercise session. **Control group:** Standard maternity care delivered by six PHNs (without counselling training)	**F&V intake:** group 1 increased compared with control: mean difference = +0.8 portions per day (95% CI 0.3–1.4), P = 0.004 **Dietary fibre intake:** group 1 increased compared with control: mean difference +3.6 g d⁻¹ (95% CI 1.0–6.1), P = 0.007 **Proportion of high-fibre bread:** group 1 decreased less compared with control: mean difference = +11.8 units (95% CI 0.6–23.1), P = 0.04	Weight gain, BMI, PA, adverse effects of low-birth-weight infants, or in the other pregnancy or fetal outcomes
Kinnunen 2007 (32) Non-RCT in six public maternity/child health clinics in PHC, Finland n = 92 (92% at 10 months), group 1 average age 29.5 years (SD 3.9), control: 28.3 (SD 4.4), 100% female XX	**Aim:** To measure the effect of individual behavioural counselling for post-partum women at five routine visits to PHN on change of diet, LTPA and proportion of new mothers returning to their pre-pregnancy weight **Target:** Post-partum primiparas (adult women following first delivery) **Background:** All participants attended five routine visits (pre-existing schedule for check-up and immunization) to PHN when child is 2, 3, 5, 6 and 10 months old. **Duration:** 10 months	**Group 1:** Behavioural counselling and goal setting to achieve minimum of five PA sessions per week, regular meals, ≥5 servings of F&V a day, eat high-fibre bread and limit high-sugar snacks. Option of attending supervised weekly group exercise session. **Control group:** Brief dietary and PA advice at each visit (average of 4 min total)	**Return to pre-pregnancy weight:** group 1 3.89 times more likely to return to pre-pregnancy weight compared with control (95% CI 1.16–13.04) **Proportion of high-fibre bread:** group 1 increased compared with control: mean difference = +16.1 units (95% CI 4.3–27.9), P = 0.008	WC, PA, sugar intake, F&V intake
Naylor 1999 (34) Non-RCT in four general practices, England n = 294 (44% at 6-month FU), average age 42.4 years (SD 15.1), 77% female XX	**Aim:** To assess the effectiveness of stage-based counselling and materials to increase PA when delivered by a PN at a health check **Target:** Adults attending health checks **Background:** Each practice had between two and five PNs. SOC assessed by questionnaire prior to health check. **Duration:** 2 months (FU at 6 months)	**Group 1:** Stage-based exercise materials and 5 min of PA counselling by PN **Group 2:** Stage-based exercise materials, no counselling **Group 3:** Non-stage-based exercise materials and 5 min of PA counselling by PN **Control group:** PN delivered usual care advice about exercise according to current practice standards	Nil	PA, SOC, self-efficacy

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Table 5 *Continued*

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)[†]	Outcome measures taken with no significant outcomes[†]
Steptoe 1999 (33) RCT in 20 general practices, England *n* = 883 (71% at 4 months, 59% at 12-month FU), average age 46.7 years (SE 0.4), 54% female XX	**Aim:** To measure the effect of behaviourally oriented counselling to reduce dietary fat intake (and smoking) and to increase regular PA **Target:** Adults at increased risk of CHD measured by regular cigarette smoking, high serum cholesterol (6.5–9.0 mmol L^{-1}) or BMI between 25 and 35 kg m^{-2}, combined with low PA **Background:** All participants were advised to reduce dietary fat intake, increase F&V consumption and/or increase their levels of PA. One PN at each non-control practice received training in behavioural counselling and healthy behaviours. **Duration:** 4 months (FU at 12 months)	**Group 1:** PNs delivered two to three face-to-face and up to six telephone sessions no longer than 20 min. **Control group:** Counselling advice from nurses using own usual methods (no specific training provided)	**Systolic BP at 4 months:** group 1 decreased compared with control = 2.4 mmHg (95% CI 0.1–4.8) **Exercise (no. of sessions) at 4 months:** group 1 increased compared with control = 3.7 (95% CI 1.3–6.2). **At 12 months:** group 1 increased compared with control = 3.9 (95% CI 1.0–6.8) **Dietary fat intake score at 4 months:** group 1 reduction compared with control = 4.8 (95% CI 1.6–8.0). **At 12 months:** group 1 reduction compared with control = 2.8 (95% CI 0.1–5.5) **Odds of moving to action/ maintenance SOC at 4 months:** group 1 compared with control, SOC for PA = 2.15 (95% CI 1.30–3.56) and SOC for fat reduction = 1.89 (95% CI 1.07–3.36)	Weight, BMI, diastolic BP, PA

✓No serious limitations and low risk of bias; XSerious limitations and some risk of bias; XXVery serious limitations and high risk of bias.
*Sample size at baseline, target age (actual mean and distribution when available).
[†]Significant outcomes within group not presented.
BMI, body mass index; BP, blood pressure; CHD, coronary heart disease; CI, confidence interval; F&V, fruit and vegetable; FU, follow-up; LTPA, leisure time physical activity; PA, physical activity; PHC, primary health care; PHN, public health nurse; PN, practice nurse; RCT, randomized controlled trial; SD, standard deviation; SE, standard error; SOC, stage of change; WC, waist circumference.

Table 6 PHC nurse delivering a low dose of non-behavioural counselling compared with higher dose of behavioural counselling: intervention description, participant characteristics and outcomes of studies that compared effects. Results presented according to risk of bias, with lowest risk of bias first, then reversed chronologically

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Whittemore 2009 (20) RCT in four primary care practices, United States *n* = 58 (88% at 6 months), average age group 1: 48.2 years (SD 12.4), control: 43.2 years (SD 13.2), 90% female ✓	**Aim:** To examine the efficacy of a lifestyle program implemented in primary care by NPs. **Target:** Patients ≥21 years with RF for developing T2D, IGT or MetS (overweight, ≥65 years, history of gestational diabetes, hypertension or lipid abnormalities) **Background:** Both groups had the same goals: to eat a healthy diet (lower energy, fat and processed foods), partake in 30 min of moderate exercise 5 d a week and lose 5–7% weight. **Duration:** 6 months	**Group 1:** Further to control condition, participants offered six in-person plus five telephone behavioural counselling sessions by a NP following brief training. Strategies used included motivational interviewing, goal setting and problem solving. **Control group:** Written information about diabetes prevention, a 45-min session with a nutritionist and a 20- to 30-min session with NP on the importance of healthy lifestyle	**Satisfaction:** group 1 increased compared with control (t = 0.06; P = 0.048)	Weight, BMI, WC, LDL cholesterol, HDL cholesterol, total cholesterol, glucose, insulin, HOMA, PA, nutrition, depression scale
Roderick 1997 (35) RCT in eight general practices in England and Wales *n* = 956 (79% at 12 months), average age 47 years, 50% female XX	**Aim:** To compare the effectiveness of structured dietary advice by PNs with standard health education following attendance at a nurse health check. **Target:** Patients aged 35–59 attending a GP appointment **Background:** Practices matched by geographical location and Jarmin score of social deprivation. All patients received four health education leaflets on RF for CHD. If fasting cholesterol >6.5 mmol L^{-1} (men) or >7.0 mmol L^{-1} (women) patients were asked to return for fasting cholesterol at 6 weeks and 6 months, if >7.8 mmol L^{-1}, then GP was informed. **Duration:** 12 months	**Group 1:** Further to control condition, received dietary advice from PNs (following training) based on negotiated change principles, reinforced at 6-week FU. Patients with BMI > 27.5 kg m^{-2} or ≥2 other CHD RFs (male, smoker, hypertensive, family history) were asked to return at 3 and 6 months. Dietary sheets and other leaflets supplied were appropriate. **Control group:** Usual care and written information (one on each: healthy eating, not smoking, heart disease and exercise)	**Weight:** group 1 decreased compared with control: mean difference = −0.56 kg (95% CI −1.04 to −0.07) **Serum cholesterol:** group 1 decreased compared with control: mean difference = −0.20 mmol L^{-1} (95% CI −0.38 to −0.03) **Fat as percentage of energy intake:** group 1 decreased compared with control: mean difference = −1.4% (95% CI −2.2 to −0.7) **Saturated fat as percentage of energy intake:** group 1 decreased compared with control: mean difference = −0.9% (95% CI −1.5 to −0.2) **Polyunsaturated–saturated fat ratio:** group 1 increased compared with control: mean difference = 0.05 (95% CI 0.0007–0.106)	BMI, systolic BP, diastolic BP, fibrinogen factor VIIc (biomarker for dietary fat intake), level of vigorous exercise, dietary intake of: fibre, wholemeal or brown bread, fruit, vegetables, high-fibre cereal, alcohol

Table 6 Continued

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Sims 1999 (36) RCT in one suburban general practice (eight GPs and one PN), England n = 20 (number at FU not clear), average age 72.2 years (SD 4.26), 35% female XX	**Aim:** To determine if motivational advice delivered by a PN can improve patient adherence to guidelines to achieve the recommended five sessions of 30 min of moderate exercise each week. **Background:** Heart rate monitor used to verify self-reported PA data. **Target:** Patients over 65 years of age. **Duration:** 8 weeks	**Group 1:** PN delivered counselling using motivational interviewing, developed an individualized activity schedule with patient. Followed-up by telephone at 2 and 6 weeks. **Control group:** PN delivered single session of standard advice regarding the benefits and types of PA.	Nil	PA, pulse, fitness, QOL (SF-36), SOC, self-efficacy
Purath 2004 & 2005 (37,75) RCT in a university, academic nursing centre, United States n = 287 (94% at 6-week FU), average age 43.9 years (SD 10.4), 100% female XX	**Aim:** To determine if brief, tailored nurse counselling based on the transtheoretical model is effective to increase PA in sedentary women when delivered by a NP in the workplace. **Target:** Sedentary female university employees, aged 18–65, attending a free annual health check. **Background:** All participants received health promotion screening. **Duration:** 6 weeks	**Group 1:** Further to control condition, received brief stage-matched advice from NP to increase PA with a FU telephone call at 2 weeks. **Control group:** Brief tailored counselling from nursing and health promotion students	**SOC:** group 1 = +1.34 compared with control = +0.72, $P = 0.001$ **Distance walked per day (blocks):** group 1 = +7.31 compared with control = +1.54, $P = 0.033$ **Weekend vigorous and moderate activity (hours):** group 1 = +0.77 compared with control = +0.36, $P = 0.008$ **Time walked for exercise per week (minutes):** group 1 = +77.9 compared with control = +32.9, $P = 0.001$ **Total time walking per week (minutes):** group 1 = +103.1 compared with control = +76.2, $P = 0.001$	Self-efficacy (weight and BMI outcomes not reported)

✓No serious limitations and low risk of bias; ✗Serious limitations and some risk of bias; ✗✗Very serious limitations and high risk of bias.
*Sample size at baseline, target age (actual mean and distribution when available).
†Significant outcomes within group not presented.
BMI, body mass index; BP, blood pressure; CHD, coronary heart disease; CI, confidence interval; FU, follow-up; GP, general practitioner; HDL, high-density lipoprotein; HOMA, homeostatic model assessment; IGT, impaired glucose tolerance; LDL, low-density lipoprotein; MetS, metabolic syndrome; NP, nurse practitioner; PA, physical activity; PHC, primary health care; PN, practice nurse; QOL, quality of life; RCT, randomized controlled trial; RF, risk factor; SD, standard deviation; SOC, stage of change; T2D, type 2 diabetes; WC, waist circumference.

Table 7 Low dose of counselling compared to high dose: intervention description, participant characteristics and outcomes of studies that compared effects. Results presented according to risk of bias, with lowest risk of bias first

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)[†]	Outcome measures taken with no significant outcomes[†]
Behavioural counselling				
Dubbert 2002 (41) RCT in Department of Veterans Affairs Medical Centre, United States *n* = 212 (number at FU not clear), average age 68.7 years (SD 4.7), 1% female X	**Aim:** To establish dose of individualized nurse counselling required to increase walking time and fitness in sedentary older adults **Target:** Free-living veterans who were 60–80 years old, walking <40 min per week, following a satisfactory 6-min walking test **Background:** All participants set the goal of reaching 20-min walking at least 3 d per week. **Duration:** 12 months	**Group 1:** Further to control condition, participants received 10 individual telephone calls from nurse (4× weekly then less frequent) and 10 motivational brief messages pre-recorded by nurse from second month **Group 2:** received 20 individual telephone calls from nurse (4× weekly then less frequent) **Control group:** Three baseline assessment sessions, one video and one session of individualized nurse counselling including goal setting and action planning	**Walking:** group 1 spent more time walking compared with control (*P* = 0.002) **Adherence to walking guidelines:** groups 1 and 2 better adherence compared with control, *P* = 0.004 and *P* = 0.06, respectively	Weight, BMI, WC, hip circumference, fitness (6-min walking test), QOL (using SF-36), SOC, readiness for physical activity, adverse outcomes including illness or injury
Non-behavioural counselling				
Faucher 2010 (40) RCT in a community centre clinic, United States *n* = 19 (63% at 6-month FU), average age 34.89 (SD 4.8), 100% female XX	**Aim:** To trial effect on weight of two different doses of intervention (individual or group counselling) delivered by a nurse in collaboration with *promotoras de salud* (lay health educator) **Target:** Low-income Mexican-American women attending a health clinic run by *promotoras de salud* with BMI ≥ 25 and wanting to lose weight **Background:** *Promotoras de salud* trained in health education, basic health assessment and diagnostic skills. All participants received written information, two postcards and advice to use portion control to affect weight loss **Duration:** 5 months	**Group 1:** 4 × 2 h group dietary education counselling with nurse and *promotoras de salud.* Received a gift at each session. **Control group:** Individual physical examination, and dietary counselling on portion control from nurse and *promotoras de salud.* One FU appointment.	Nil	Weight

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Table 7 *Continued*

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Anderson 1999 (39) RCT in eight work sites, United States $n = 234$ (71% at 6 months, 52% at 12 months), age between 18 and 64, 45% female ✗✗	**Aim:** To assess if four intervention sessions (group or self-care) would be more effective than single nurse counselling at lowering lifestyle RF for CHD **Target:** Employees with a serum cholesterol >200 mg dL^{-1} **Background:** All participants received health screening plus 20 min of individual counselling regarding CHD RF delivered by a nurse. Participants randomized to intervention were given the choice of attending group sessions (group 1) or self-care (group 2). Those 'at risk' were referred to see a physician and cholesterol measured again at 6 and 12 months. **Duration:** 6 months (FU at 12 months)	**Group 1:** Four group sessions of Healthy Heart Program in which participants chose to attend group sessions delivered by a dietitian. The four intervention modules addressed risk factors and modification of food: fat, cholesterol, fibre and sodium. **Group 2:** Four sessions of Healthy Heart Program (modules same as group 1) in which participants chose to use materials in their own time (self-care). **Control group:** Screening plus 20 min of individual counselling on CHD RF	**Attitude and behavioural change score at 12 months:** agreement that **'eating no meat is healthier'**, group 2 +14.5% compared with control = +8.2%, group 1 = −5.1%, $P < 0.05$; agreement that **'less fat is important'**, group 2 +39.8% compared with control = −6.2%, group 1 = +1.7%, $P < 0.05$; agreement that **'less fat decreases cholesterol'**, group 2 + 16.8% compared with control = −0.7%, group 1 = +4.3%, $P < 0.05$	Weight, BMI, serum cholesterol, self-reported sedentary behaviour, dietary intake
Gemson 1990 (38) RCT in a large financial services firm over several sites, United States $n = 295$ (58% at 6-month FU), average age 40 years, 43% female ✗✗	**Aim:** To examine the impact of FU frequency of brief (3–5 min) nurse counselling on cardiovascular RF, following cholesterol screening **Target:** Men and women employees with borderline high cholesterol (between 5.2 and 6.2 mmol L^{-1}), fewer than two CHD RFs and no history of CHD **Background:** In a 15-min appointment, all participants received the same cholesterol check (point-of-care fingerstick test), RF assessment (questionnaire and physical measures), and written information followed by brief tailored nurse counselling (3–5 min) on RF and cholesterol reducing diet. **Duration:** 6 months	**Group 1:** Further to control condition, were asked to attend further three appointments (at 2, 4 and 6 months) for FU screening and brief counselling (same format as baseline counselling) **Control group:** Cholesterol and RF screen, with 3–5 min of tailored counselling by nurse	**Self-reported extent of dietary change 'a lot':** group 1 (24%) compared with control (10.3%), $P = 0.05$ **Type of dietary change:** group 1 significantly decreased intake compared with control for **red meat** ($P = 0.02$), **cheese** ($P = 0.04$), **butter** ($P = 0.03$) and **fast foods** ($P = 0.05$)	Weight, systolic BP, diastolic BP, cholesterol, physical activity

✓No serious limitations and low risk of bias; ✗Serious limitations and some risk of bias; ✗✗Very serious limitations and high risk of bias.

*Sample size at baseline, target age (actual mean and distribution when available).

†Significant outcomes within group not presented.

BMI, body mass index; BP, blood pressure; CHD, coronary heart disease; FU, follow-up; HDL, high-density lipoprotein; LDL, low-density lipoprotein; PA, physical activity; QOL, quality of life; RCT, randomized controlled trial; RF, risk factor; SD, standard deviation; SOC, stage of change; WC, waist circumference.

Table 8 PHC nurse's use of prompts or diagnostic tools: intervention description, participant characteristics and outcomes of studies that compared effects. Results presented according to risk of bias, with lowest risk of bias first

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)[†]	Outcome measures taken with no significant outcomes[†]
Little 2004 (22) RCT in four general practices, England *n* = 151 (number at FU not clear), average age 58 years (SD 13), 56% female ✗	**Aim:** To assess the efficacy (self-report and fitness measures) of three approaches to increase PA to 30 min d⁻¹, 5 d per week **Target:** Sedentary, adult patients with CVD RF **Background:** Participants randomized to eight groups (2 × 2 × 2 factorial design) and received 0–3 components **Duration:** 1 month	**Group 1:** Provided booklet, 'Getting active, feeling fit' **Group 2:** Behavioural counselling by PN **Group 3:** GP delivered PA prescription for brisk exercise. **Control group:** Did not receive comparison intervention (but may have received others)	See Table 3 for groups 2 and 3 outcomes. **Depression:** group 1 decreased compared with control = −0.47 (95% CI −0.93 to −0.01), *P* = 0.046.	Fitness or PA
Little 2004 (43) RCT in six general practices, England *n* = 296 (83% at 6-month FU), average age 55 years (SD 10), 44% female ✗	**Aim:** To assess the effect of brief nurse-led interventions compared to brief verbal advice at nurse-delivered checks in nurse-run hypertension clinics **Target:** Mildly hypertensive adults (systolic BP 160–200 mmHg or diastolic BP 90–120 mmHg) during the 'watchful waiting' period prior to medication for hypertension **Background:** Participants randomized to eight groups (2 × 2 × 2 factorial design) and received 0–3 components **Duration:** 1 month (FU at 6 months)	**Group 1:** Booklet 'Understanding High Blood Pressure' used to structure patient counselling **Group 2:** Patients were asked to replace table salt with low-sodium high-potassium salt (provided). **Group 3:** Patients were asked to use two prompts: (i) 'fatty food swap sheet' and (ii) daily prompt sheets for fruits, vegetables and fibre intake. **Control group:** Received brief advice and monitoring	**Weight at 6 months:** group 3 decreased compared with all other groups: mean = −1.17 (95% CI −2.25 to −0.1), *P* = 0.03. **Fruit and vegetable intake g d⁻¹:** group 2 decreased compared with all other groups **at 1 month:** mean = −61 (95% CI −5 to −116), *P* = 0.03; **at 6 months:** mean = −70 (95% CI −13 to −126), *P* = 0.015. **Sodium : potassium intake at 1 month:** group 2 decreased compared with all other groups: mean = −0.32 (95% CI −0.56 to −0.08), *P* = 0.01. **Anxiety at 1 month:** group 2 increased compared with all other groups: mean = 0.45 (95% CI 0.11–0.8), *P* = 0.009.	Diastolic BP, systolic BP, LDL cholesterol, LDL : HDL ratio, carotenoid concentration, dietary intake (using validated FFQ) of fat, energy from fat, non-starch polysaccharides
Robertson 1992 (42) RCT in five general practices, England *n* = 578 (88% at 3-month FU), age range 25–64, 49% female ✗	**Aim:** To assess the effect of providing patients with their cholesterol levels during health checks on total cholesterol **Target:** Adults at 'opportunistic health check'. If serum cholesterol >10 mmol L⁻¹ they were excluded and referred to GP. **Background:** Both groups received the same 30-min health check for cardiovascular RF and dietary advice by PNs. A blood sample was taken and cholesterol was measured using POC equipment. **Duration:** 3 months	**Group 1:** Received immediate feedback regarding serum cholesterol level at time of health check **Control group:** Received no feedback regarding serum cholesterol levels until FU	Nil	Total cholesterol

Table 8 *Continued*

First author and year, country, study design, sample* and risk of bias	Lifestyle intervention description Aim and background	Group treatment	Significant outcomes (between group, post-intervention)†	Outcome measures taken with no significant outcomes†
Ammerman 2003 (44) RCT in a variety of primary care settings, United States *n* = 468 (87% at 3-month FU and 75% at 12-month FU), average age 55 years, 71% female XX	**Aim:** To assess the effectiveness of a DRA tool in an intervention to facilitate dietary counselling **Target:** Patients with high cholesterol (LDL cholesterol 100–300 mg dL⁻¹) and CHD RF when screened by rural PHNs **Background:** Patients referred to nutritionist if cholesterol remained high after 3 months or to physician if very high at any time **Duration:** 3 months (FU at 12 months)	**Group 1:** Following training in use of the DRA tool, PHNs delivered 3× monthly individual counselling sessions on diet using the DRA tool and appropriate written educational materials. FU included three nutritionist visits, one letter and one telephone contact. **Control group:** The DRA tool was 'made available' to PHN (no training). Number of contacts not clear.	**Weight:** group 1 reduction compared with control **at 3 months:** = 0.86 kg (95% CI 0.14–1.55). *P* = 0.022; **at 6 months:** = 0.95 kg (95% CI 0.1–4.1). *P* = 0.04. **Reduced meat intake:** group 1 reduction compared with control: mean difference **at 3 months** = 1.7 units (95% CI 0.8–2.5); **at 12 months** = 1.1 units (95% CI 0.3–1.8). **Reduced side dishes intake at 3 months:** group 1 reduction compared with Control: mean difference = 0.9 units (95% CI 0.1–1.6). **Reduced oil intake:** group 1 reduction compared with control: mean difference **at 3 months** = 0.8 units (95% CI 0.4–1.2); **at 12 months** = 0.6 units (95% CI 0.2–1.0). **Reduced total dietary risk intake:** group 1 reduction compared with control: mean difference **at 3 months** = 3.7 units (95% CI 1.9–5.5); **at 12 months** = 2.1 units (95% CI 0.8–3.5).	At 3 months: BMI, LDL cholesterol, HDL cholesterol, total cholesterol, triglycerides At 12 months: weight, BMI, LDL cholesterol, HDL cholesterol, total cholesterol, triglycerides
Sander 1996 (45) RCT in outpatient clinic of family practice, United States *n* = 163 (% at FU not clear), average age 35 years, ~70% female XX	**Aim:** To assess a nurse intervention using a brief tool to identify health risks and encourage patient to seek support from a physician during subsequent visit **Target:** Adults with a physician appointment for an acute or chronic problem **Background:** The acronym 'LPN' was not defined in the paper. **Duration:** 6 weeks	**Group 1:** Patient initially saw 'LPN', then a NP delivered 5-min individual counselling prior to physician appointment. **Control group:** Patient initially saw 'LPN' as usual to prepare for subsequent physician appointment.	**Patient requests for health maintenance information:** group 1 = 54% compared with control = 8%, *P* < 0.001 **Patient recall:** group 1 = 54% increased compared with control = 31%, *P* = 0.018.	Lifestyle behaviour change

√No serious limitations and low risk of bias; XSerious limitations and some risk of bias; XXVery serious limitations and high risk of bias.
*Sample size at baseline, target age (actual mean and distribution when available).
†Significant outcomes within group not presented.
BMI, body mass index; BP, blood pressure; CI, confidence interval; CVD, cardiovascular disease; DRA, dietary risk assessment; FFQ, food frequency questionnaire; FU, follow-up; GP, general practitioner; HDL, high-density lipoprotein; LDL, low-density lipoprotein; PA, physical activity; PHC, primary health care; PHN, public health nurse; PN, practice nurse; POC, point of care; QOL, quality of life; RCT, randomized controlled trial; RF, risk factor; SD, standard deviation; SOC, stage of change.

lishing intent for behaviour change. Those interventions that conducted a sub-analysis on participant stage of change reported that the greatest benefit was gained in the subgroup of participants that moved from an early stage of change (pre-contemplation of contemplation) to a later stage (action or maintenance). This review lends further support to the building literature describing the outcomes of counselling in PHC (50,54,70–72).

Limitations of included articles

Many articles did not sufficiently report the methods of randomization, allocation concealment, blinding of outcome assessment, or describe conducting a power calculation to determine target sample size. This may indicate that either of these were not performed, or that they were not reported adequately. Only three of the included articles were considered to have no serious methodological limitations and a low risk of bias. It is necessary to acknowledge the difficulties involved in running RCTs with a low risk of bias in free-living populations, especially those that aim to test the effectiveness of non-pharmaceutical preventive healthcare interventions such as dietary, physical activity or other lifestyle change (73).

Small numbers of participants and high attrition rates may have limited the ability of some studies to reach significance for some outcomes and result in over-reporting of outcomes in the absence of intention to treat analyses. The included studies mainly recruited participants with high motivation to participate and few studies indicated that they used process measures to monitor the realization of intervention delivery. Short intervention duration, lack of long-term follow-up and low variety of outcome measures limited the ability of some interventions to evaluate intervention effect.

Limitations of this systematic review

The heterogeneity of the included studies limited the opportunity for quantitative synthesis of outcome effect. The strength of recommendations is limited by the small number of studies within each comparison group analyses and the high risk of bias of the majority of studies. Authors were not contacted for extra information; hence missing information may reflect reporting bias, not necessarily limitations in the implementation rigour.

Conclusions

The evidence supports the effectiveness of lifestyle intervention delivered by nurses in PHC to affect positive changes on a variety of outcomes associated with the prevention of chronic disease associated with obesity including weight, blood pressure, cholesterol, dietary and physical activity

behaviours, patient satisfaction and quality of life. Outcomes were significantly higher if nurses provided at least one counselling session following initial screening for health risk.

This systematic review synthesizes the best available evidence in the context of informing future lifestyle interventions delivered by nurses in PHC. Further research is needed that: (i) has a low risk of bias; (ii) uses a variety of outcome measures that reflect known risk factors for chronic disease including anthropometric, physiological, behavioural and psychosocial intervention effects; (iii) explores training requirements for effective nurse delivery of lifestyle interventions; (iv) explores the efficacy of counselling using theoretical frameworks for behaviour change; and (v) examines the effect of dose.

Conflict of Interest Statement

There are no conflicts of interest for any of the three authors.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. MEDLINE (OVID) search strategy conducted 13-9-10, highlighting the six groupings of search terms.
Table S2. Risk of bias of included articles (Supporting Information for Table S1). Each category scored as Adequate (A), Inadequate (I), Not done (N) or Unclear (U).

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