REVUP: Cardiovascular risk outcomes from a healthy lifestyle intervention

Submitted by

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A thesis submitted in total fulfilment of the requirements for the degree of

Master of Exercise Science (Research)

School of Exercise Science (NSW)

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i. Statement of Sources

This thesis contains no material published elsewhere or extracted in whole or part from a thesis by which I have qualified for or been awarded another degree or diploma.

No other person's work has been used without due acknowledgement in the main text of the thesis.

This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

All research procedures reported in the thesis received the approval of the Australian Catholic University Human Research Ethics Committee

Signed: Timothy Watson_____ Date:7/03/2018

Contents

i. Abstract

Title: REVUP: A Randomised Control Trial of A Healthy Lifestyle Program.

Introduction: Workplaces provide researchers and employers with an opportunity to engage in the health behaviours of employees. Despite the number of Australians in employment, many employers do not have meaningful programs to aid in the development of healthy behaviours. Internet delivered programs have advantages of reduced cost, ease of implementation over distance, and reliance on previously existing infrastructure. The Aim of REVUP is to assess the effectiveness of an online delivered, workplace health program on improving health risk factors.

Method: The REVUP study was a single-blind, randomized controlled trial. Targeted participants were aged between 18 and 80 years and engaged in employment with the Uniting Church of Australia. A 12-week program was delivered via two emails per week, containing a video link and newsletter with activities. A range of topics was presented including physical activity, diet, goal setting, smoking cessation, and mental wellness. A comprehensive testing battery was utilised including objective measures of physical activity, blood testing, physical capacity assessments, and questionnaires.

Results: Adoption and adherence to the program was low. Amongst the 36 individuals interested in the program 21 participants were randomised, with 15 completing the program. No significant differences were detected in any outcome measures. Adjusted effect sizes show promising results.

Discussion: Significant barriers exist to the adoption and efficacy of internet delivered workplace health programs. Future programs may benefit from implementation of

technology and structures that aids the development of intrinsic motivation and social support. Substantial integration of psychological theory, particularly in developing autonomous supportive environments is likely needed to support adherence and effective outcomes.

ii. List of figures

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iv. List of abbreviations

1RM: One repetition max

6MWT: Six-minute walk test

ANOVA: Analysis of variance

BIA: Bioelectrical impedance

BMI: Body Mass Index

BP: Blood Pressure

BSI-18: Brief symptom inventory, 18 questions

CRP: C-reactive protein

CSES: Core self-evaluation scale

CVD: Cardiovascular disease

DASS-21: Depression anxiety stress scale, 21 questions

DAYL: Disability-adjusted life years

DPP: Diabetes prevention plan

DQES: Dietary questionnaire for epidemiological studies

FFM: Fat free mass

FFQ: Food frequency questionnaire

FM: Fat mass

FRSTS: Five repetition sit-to-stand

GI: Glycaemic Index

GSLTPQ: Godin-Shepard leisure-time exercise questionnaire

HBA1C: Glycated haemoglobin

HBM: Health belief model

HDL-C: High density lipoprotein cholesterol

LDL: Low density lipoprotein

LDL-C: Low density lipoprotein cholesterol

LFT: Liver function tests

LTPA: Leisure time physical activity

NHMRC: National health and medical research council

PA: Physical activity

RCT: Randomised control trials

SCT: Social cognitive theory

SFA: Dietary saturated fat

T2DM: Type 2 diabetes

TTM: Transtheoretical model of change

UCA: Uniting church of Australia

V02max: Maximal oxygen consumption

vLDL: Very low-density lipid

WHO: World health organisation

WHtR: Waist to height ratio

1 Introduction

1.1 Cardiovascular disease.

Cardiovascular disease (CVD) is a chronic disease that develops throughout life, often reaching advanced stages before symptoms occur. It encompasses all diseases of the heart and blood vessels with the most common in Australia being coronary heart disease, cerebrovascular disease and heart failure (1).

CVD continues to be a major cause of death and disability throughout the world. An estimated 17 million people died prematurely due to CVD globally in 2008 (2). It is projected that by 2020, 150 million disability-adjusted life years (DALYs) will be caused by CVD and related complications (1). Australia does not avoid this global trend (3). The two-leading causes of premature death in 2011 were both forms of CVD- coronary heart disease (14.6% of deaths) and cerebrovascular disease (7.7% of deaths) respectively. 2010 data lists coronary heart diseases as having the greatest burden of disease in Australia with 471 550 DAYLs. In economic terms, between 2008-09, cardiovascular diseases were the costliest in Australia with health expenditure of $7.74 billion, 10.4% of total health funding.

1.1.1 Atherosclerosis

A primary precursor of CVD is atherosclerosis (2). Atherosclerotic induced forms of CVD include cerebrovascular disease, ischemic heart disease/ coronary artery disease, and diseases of the arteries such as hypertension and peripheral vascular disease. CVDs not related to atherosclerosis include rheumatic heart disease, congenital heart disease, cardiomyopathies and cardiac arrhythmias.

Atherosclerosis is a complex pathology relating to a degradation of the lining of major blood vessels. Abnormal deposits of cholesterol, fat and other substances build up on the inside of

arteries and form plaque. Low density lipoproteins (LDLs) are the most atherogenic lipoproteins(4) (accounting for more than 75% of atherogenic lipoproteins). When LDL penetrates the arterial wall, it starts and encourages atherosclerosis through the formation of LDL laden macrophages becoming foam cells. Groups of these foam cells form fibrous plaques, narrowing the lumen of the blood vessels causing an increase in resistance to blood flow and an increase in blood pressure proximal to the narrowing (5). Sections of the plaque build-up can rupture from the wall of the blood vessel causing an embolus. These emboli become lodged in the narrowed arteries blocking or partially occluding the flow of blood. This is the cause of acute coronary symptoms or, if in the carotid or cerebral arteries, causing cerebrovascular disease (5).

1.1.2 Risk factors for CVD

The high burden of CVD in Australia is driven by the prevalence of major disease risk factors. These risk factors- or known determinants of diseases can be broadly broken down into two categories: Modifiable risks and non-modifiable risks (1). Modifiable risk factors for CVD are tobacco use, physical inactivity, unhealthy diet, harmful use of alcohol, hypertension, elevated blood glucose, dyslipidaemia, and excess adiposity (6). Non-modifiable risk factors for CVD also exist, including poverty and low socio-economic status, low education, age, gender, family history and psychological factors (6).

1.1.3 Dyslipidaemia

Elevated blood cholesterol concentrations have a demonstrated continuous positive relationship with CVD risk (4, 7-9). The pathogenesis of this risk is due to elevated LDLs accounting for the majority of atherogenic lipoproteins (4). Australian targets for cholesterol recommend LDL-C to be less than 1.8 mmol/L, HDL-C to be greater than 1.0 mmol/L,

triglycerides to be less than 2.0mmol/L and non-high density lipoprotein cholesterol to be less than 2.5mmol/L (10).

Pharmacology plays a major role in the control of dyslipidaemia, with statins being the primarily first line therapy for elevated LDL and LDL-C (8, 11, 12). Statins are highly effective, reducing major vascular events by 22% (7).

Nutrition, exercise and smoking cessation all play a role in effective lipid therapies. Dietary saturated fats (SFA's) have a strong impact on LDL-C levels (0.02-0.04 mmol/L per 1% of additional energy derived from saturated fat) (8). Advantageously, dietary modification augments drug therapy with statins and is an important tool with few side effects and little harm (11). Control of overweight and obesity is recommended as they are contributing factors to dyslipidaemia. A key clinical target should be caloric restriction and an increase in energy expenditure in those with excess adiposity, however the degree of the effect of weight loss on reducing total cholesterol and LDL-C is small (8). The effect of exercise on dyslipidaemia is discussed in section 1.17, and the effect of smoking cessation in 1.1.8.

1.1.4 Elevated blood sugar

Elevated blood sugar or hyperglycaemia is a chronic elevation of blood glucose levels. Its pathogenesis stems from the inability to utilise or produce sufficient insulin. In its chronic, uncontrolled form, elevated blood sugar is called type 2 diabetes (T2DM). The pathophysiology of T2DM is multifactorial and progresses slowly, but has common features of insulin resistance in peripheral tissue and reduced or defective insulin secretion (13). T2DM is often related to lifestyle changes, particularly those that lead to weight gain and insfficiently physically active behaviour (14), although there is a significant heredity component (15).

Elevated levels of blood glucose that are beyond normal, but under the threshold for T2DM are referred to as pre-diabetes (16). Pre-diabetes in Australia is classed as an impaired fasting glucose range of ≥6.1mmol/L and an impaired glucose tolerance range measured through an oral glucose tolerance test of ≥7.8 and <11.1mmol/L of plasma glucose (13). This pre-diabetic state affects about 16.4% of Australians with this percentage expected to rise (17). Additionally, up to 70% of pre-diabetics progress to a diagnosis of diabetes (18).

Over the long-term, poorly controlled blood glucose is an important predictor of microvascular damage (1) (such as neuropathy, nephropathy and retinopathy) but also of macrovascular damage (1, 19). Chronic hyperglycaemia leads to glycation (the bonding of a glucose molecule with a protein or lipid molecule) and peroxidation of proteins; which causes arterial damage, enhancing atherogenesis (20). This is believed to be the independent factor that leads to the increased CVD risk suffered by diabetics (19-21) however, most diabetics have multiple risks for CVD (21).

A large cohort study (22) of 237 000 participants from the Asia pacific region with significant follow-up demonstrates a positive continuous relationship between usual blood glucose levels and CVD risk. Interestingly, the link extends below the current fasting glucose threshold for diabetes diagnosis. Similar results have been seen in other significant reviews (19, 21). CVD is the leading cause of morbidity and mortality in individuals with T2DM (1), with risk levels being reported of two to three times greater when compared to non-diabetics (13, 21, 22). This increase in risk is independent of other risk factors (21). This level of risk has been described as being similar in people with pre-diabetes (13). Due to the high risk of CVD in diabetes patients, an assessment of CVD risk is an essential part of effective care (23).

Lifestyle modification is the primary treatment for diabetes and pre-diabetes in Australia (13, 23). Lifestyle interventions that target simultaneous nutritional and physical activity goals have been successful in preventing the onset of T2DM in comparison to pharmacological or usual care controls (24). Additionally, overweight and obese individuals with diabetes or at risk of diabetes are recommended to reduce body weight by 5-10% to delay the progression of diabetes, improve glucose control and in some cases, prevent the progression from pre-diabetes to diabetes (13, 23). If lifestyle modification is ineffective, metformin is the first line pharmacological treatment for diabetes. Further agents may be added if glycaemic control is not achieved (23). Metformin has been shown to be effective as a short-term treatment option for pre-diabetes (13).

1.1.5 Obesity

Excess body weight is one of the most visible, yet most ignored medical problems in the modern world (25). Overweight is defined as a body mass index of 25 to 29.9 kg/m^2, and obesity as BMI of 30 kg/m^2 and greater (26).

Since 1995 (3), the percentage of overweight and obese Australians has increased from 56% to 63%. Currently, 35% of Australians are overweight and 28% obese (3). The increasing rates (3, 12) of overweight & obesity in Australia coupled with its major contribution to chronic disease has defined it as a major public health problem (3).

Robust evidence exists showing an association between obesity and a myriad of illnesses such as hypertension, type 2 diabetes, cerebrovascular disease, dyslipidaemia, coronary heart disease, gall bladder disease, sleep apnoea, osteoarthritis, and some cancers. (1, 25-27). Obesity is individually associated with an increase in all-cause and CVD mortality.

Lifestyle intervention is a cornerstone therapy for the treatment of excess adiposity (25, 26, 28). A Cochrane review (29) into the effect of exercise and diet on overweight individuals concluded that exercise alone increased weight loss when compared to no treatment, however diet alone results in greater weight loss than exercise alone. High intensity exercise is superior to lower intensity exercise in weight loss when participants were not on a diet, however when on a diet the intensity of the exercise did not impact the weight loss (29).

Research into combined exercise and diet treatment of overweight and obese individuals has been shown to positively influence risk factors associated with CVD, such as reduced blood pressure, reduced triglycerides and serum cholesterol and reduced fasting glucose (29). When directly compared, combined therapies of diet and exercise are just as effective as diet alone, but not to the combined individual benefit that can be seen in studies trialling exercise alone and diet alone (29). The cause of this is unknown; however it is possible that the effect of diet on CVD risk factors has masked some of the beneficial effect that exercise exhibits (29).

1.1.6 Hypertension

Hypertension or high blood pressure is a clinical systolic blood pressure measure of ≥140mmHg and/or a diastolic blood pressure reading of ≥90mmHg (27). Robust evidence presents a link between increasing blood pressure (BP) and CVD risk (1, 6, 12, 26, 27). The risk of CVD events doubles at every 20/10mmHg rise in BP from a base level of 115/70mmHg (30). In most patients, hypertension is the result of a combination of lifestyle and genetic factors. It can however also be as a result of other diseases (31).

Hypertension has a direct link to CVD risk, however individuals with hypertension are likely to have other risk factors for CVD, and as such have a greater risk than that of hypertension

alone due to the interaction of multiple risk factors, even when the BP elevation may only be mild (1, 27).

Changes in lifestyle habits may be sufficient when treating individuals with mildly elevated BP and should be prescribed for all individuals with BP issues. Additionally, lifestyle interventions may reduce the required dose of antihypertensive drugs necessary to attain BP control (1). Effective lifestyle interventions should target smoking cessation, regular physical activity, reduced alcohol intake, healthy nutrition, sodium restriction and weight reduction (31).

Lifestyle intervention should be offered to individuals who have persistent high normal BP readings, as there is a high rate of progression from high normal to hypertension (27). Antihypertensive drugs are the most common treatment offered for hypertension (32) and are effective at lowering BP, and significantly reduce the risk of CVD mortality and morbidity (1, 12).

1.1.7 Physical inactivity.

Lack of physical activity is an increasing problem worldwide. Strong evidence exists linking lack of physical activity with increased risk of many non-communicable diseases including, all-cause mortality, coronary heart disease, hypertension, metabolic syndrome, cerebrovascular disease, type 2 diabetes, depression and some cancers (33-35).

Substantial evidence exists that physical activity prevents and treats individual risk factors of CVD, especially those related to atherosclerotic risk such as high blood pressure (36), insulin resistance (37), dyslipidaemia (38), and obesity (29). The level of effect of physical activity on these risk factors is influenced by the type of exercise intervention, whether exercise produces associated reduction in weight, and other individual variations (35).

The relationship between physical activity and derived health benefits has been described as direct and curvilinear, with a dose response relationship demonstrated with morbidity, mortality and numerous chronic conditions (39, 40). Individuals who are the least active derive the greatest benefits from increasing their PA to a moderate amount, with 90 accumulated minutes per week of moderate intensity exercise the minimum to provide an all cause risk reduction (41).

In the Australian physical activity guidelines (42) it is recommend that adults achieve 150 to 300 minutes of moderate intensity physical activity or 75 to 150 minutes of vigorous activity, or an equivalent mix of both intensities every week. Additionally, muscle strengthening activities on at least two days each week and to minimise the amount of prolonged sitting and be active on all, if not most days of the week.

1.1.8 Tobacco smoking

Tobacco smoking is a strong and independent risk factor for CVD (1, 4, 43, 44). The risk associated with smoking has dose-response relationship, however, even light and intermittent smoking has harmful effects (45). The primary mechanism for which smoking increases the risk of CVD is through the amplified development of atherosclerosis and the increased risk of thrombotic events(43). The pathology of this increase in atherosclerosis is due to free radicals inhaled from the cigarette smoke causing an oxidisation of low density lipids in the plasma. These oxidised LDLs trigger an inflammatory response in the artery, with increased monocyte adherence to the artery wall that results in increased atherosclerosis (43).

The benefits of smoking cessation are well reported (46-49). As there is no level of smoking where harmful effects are avoided, advice to simply reduce smoking – as opposed to cessation

- cannot be generally recommended (1). Additionally, reducing the amount of tobacco smoked has not been identified to increase the probability of future cessation, and has similar cessation success as abrupt quitting (1, 50).

A recently reported 14.5 year follow up to a RCT smoking cessation trial indicates all-cause mortality is significantly lower in patients that receive a smoking cessation intervention (46). Moreover, death rates for cardiovascular disease and lung cancer were greater in individuals who continued to smoke when compared to sustained and intermittent quitters (44, 46).

Smoking cessation can be a difficult and complex process due to the inherent addictiveness of nicotine, the psychological habit of smoking and environmental factors such as social pressures (51). Smoking cessation advice from health professionals is effective at increasing the rates of quitting, with the primary benefit of the advice to help motivate a quit attempt (12).

1.1.9 Alcohol consumption

In contrast to other risk factors for CVD, alcohol consumption presents a risk reduction effect at lower doses, with a 14-25% (RR 0.75, 0.38 to 0.81 95% CI) reduction in CVD at doses of 2.5 to 14.9grams per day (52). Overall association for alcohol and CVD is j-shaped, with rapidly increasing risk at consumption levels higher than 60g per day (RR1.30, 1.22 to 1.38 95% CI). This trend is continuous with cerebrovascular disease, with greater than 60g presenting a relative risk ratio of 1.62 (1.32 to 1.98 95% CI) in comparison to abstainers.

Moderate levels of consumption are also associated with a reduced risk of T2dm. This is speculated to be due to an increase in insulin sensitivity after alcohol intake (53). However,

similar to CVD and cerebrovascular disease, the risk increases with intakes greater than 60g/day (53).

1.1.10 Depression

Depression is widely prevalent in patients with existing CHD (54), with the primary mechanism likely to poor adherence to other health behaviours, such as PA, medication compliance, and higher rate of tobacco use (54). Investigation into biological mechanisms have identified possible links between increased inflammatory process and autonomic nervous system dysfunction coupled with impaired coronary flow reserve (54). It is unknown however, if depression is a by-product of these or a facilitator. Depression is also associated with increased incident CHD (RR 1.9, 1.49 to 2.42 95% CI), and cerebrovascular disease (hazard ratio 1.45, 1.29 to 2.42 95% CI)

1.1.11 Stress

Stress contributes to CVD at several stages, with mechanisms acting as both acute triggers and chronic catalysts (55). Chronic stress from work and life increased CVD occurrence by 40 – 50% in prospective observational studies (55). Exposure to long term stress increased the risk of acute myocardial events, with this increase persistent after controlling for more conventual risk factors (56).

Evidence of work-related stress presents a dose response relationship over a long term period of up to 14 years (57). Higher levels of work stress increased risk of developing metabolic syndrome by up to 2.3 times higher in comparisons between sressed and non-stressed employees (57). Mechanistically, several potential causes for this increase have beene explored, with longer term stress associated with increased rise in morning cortisol levels and decreased heart rate variability, suggesting a direct effect of stress on the

autonomic nervous system and endocrine function (57). Additionally, stressed individuals are at higher risk of poor health behaviours, with one Finish study finding that those under work related stress are 50% more likely to smoke more than 20 cigarettes per day than those with lower stress (58).

1.1.12 Diet

Diet is a known modifier of CVD and is linked to other risk factors such as blood pressure or cholesterol (59, 60). Advice to reduce fat consumption, reduce intake of saturated fatty acids, cholesterol and salt and to increase fruits, vegetables, and unsaturated fats are effective at reducing serum cholesterol, LDL levels and blood pressure (12, 61). While other methods (such as pharmacotherapy) may be more effective at lowering individual risk factors, adoption of healthy diet is a preferential treatment strategy in prevention of CVD as it can prevent and delay the onset of disease and reduce the burden on health care services (27, 38).

1.1.13 Sodium intake

There is established evidence on the effect of sodium on BP. A moderate reduction in salt intake (salt being the main dietary source of sodium) causes a significant and clinically important reduction in blood pressures. Reductions equivalent to 4.4g/day has been shown to reduce systolic BP by 4.18mmHg and diastolic BP by 2.06mmHg (62). These reductions occur independent of gender and ethnic group, and in both hypertensive and normotensive individuals. However, the reductions are greater in hypertensive individuals.

Public health recommendations for most countries recommend a salt intake of less than 5-6g/day (62). The standard western diet intake is 9-12g/day. The current Australian guidelines recommend limiting intake of added salt to food, reading food labels and selecting low sodium choices when available (63).

1.1.14 Saturated fats

Saturated fat intake has previously been held as a key risk factor for CVD. However recently evidence has been presented that this may not be the case. A 2010 meta-analysis including twenty-one nutritional studies concluded no significant evidence for linking dietary saturated fat with an increased risk of coronary heart disease individually, or with CVD as whole (64). This new stance has been supported by a 2014 meta-analysis presenting null evidence of a statistical association between total saturated fat intake and coronary risk (65).

Despite this progression in understanding, most dietary guidelines recommend that saturated fatty acids make up ≤10% of an energy intake, with the aim to replace saturated fats for unsaturated fats. Australia's guidelines (63) reflect this, urging Australians to reduce saturated fat intake and replace them with foods that are high in unsaturated fats. This recommendation is a reflection of evidence from epidemiological studies that point to a 2-3% reduction in CVD when 1% of energy intake from saturated fatty acids is replaced with unsaturated acids (66). While these are general guidelines for the Australian public, the recommendations are consistent with CVD prevention. For individuals at greater risk, specialist dietary intervention is recommended (12).

1.1.15 Unsaturated fatty acids

Unsaturated fatty acids have a duel fold positive effect of lowering LDL and increasing high density lipids (67). Monounsaturated fatty acids promote healthy blood lipids by lowering LDL levels and increasing the concentration of HDL in the blood stream. They have favourable effects on blood pressure, insulin sensitivity and glycaemic control (67, 68). Omega-3 polyunsaturated fats may have cardio-protective benefits. An inverse relationship between

dietary fish consumption and CHD mortality rates was identified in a meta-analysis (69) of prospective cohort studies. Eating fish once a week may reduce CHD by 15%.

Populations that consume diets rich in monounsaturated fatty acids, such as the Mediterranean diet, have lower prevalence of chronic illness than western diet consuming individuals (70).

Trans fats - an important subclass of unsaturated fats have consistently been shown to adversely affect lipid metabolism through several mechanisms. Increased activity of cholesteryl-ester transfer protein results in higher levels of LDL, vLDL, triglycerides, and lipoprotein (a). Additionally, reduction in LDL size and HDL concentration have been reported (71).

1.1.16 Food groups

Fruit and vegetable intake has a robust inverse relationship with CVD and cancer mortality (72), with those eating seven or more daily portions having the lowest risk. Individuals who have less than three combined fruit and vegetable servings per day are at the most risk (73).

This inverse relationship has been previously reported in meta-analysis of cerebrovascular disease risk (73) and in CHD (59). Dauchet and colleagues (2006) report that this protective benefit of fruits and vegetables may be due to the inherent nutrients (such as potassium, folate and fibre) in the fruits and vegetables. These nutrients act independently on risk factors for CVD such improving lipid profiles, reducing blood pressure and increasing insulin sensitivity (59). Furthermore, a dose response relationship is suggested, with each additional portion of fruit reducing CHD risk by 4% and each additional vegetable serving reducing risk

by 7%. The literature (12, 63, 73) gives strong support to the current Australian recommendations of consuming 3-5 serves of vegetables daily, and two servings of fruit.

1.2 Multicomponent Interventions to reduce CVD risk.

While interventions targeting single risk factors have had success in controlling and treating risk, combining the treatment of multiple risk factors into a single program has also been evaluated.

Several reviews (74, 75) focus on the effect of multicomponent lifestyle interventions on CVD risk. The largest of these, a systematic Cochrane review of 55 studies (74) enveloping 163 471 participants found that counselling and education programs are effective in high risk populations, such as diabetics and hypertensive individuals, while the evidence suggests a limited benefit in general populations. The authors concluded that although multi-component interventions do result in small reductions in individual risk factors including smoking, blood pressure, and cholesterol, these benefits had little impact on coronary heart disease mortality and morbidity. This is most likely due to changes not being maintained in the long term (74). Further to this, the authors suggest that different approaches to behaviour change and lifestyle modification are needed and should be empirically tested before being promoted.

1.2.1 Workplace programs

The workplace provides a large audience for prevention strategies with 11, 576 600 individuals employed in a full time capacity and 3 499 200 in part time work in Australia as of July 2014 (76). Workplaces are not often known as a health friendly setting and are often a sedentary environment, and often a place where energy-dense food and beverages are common (77), a link between working long hours, shift work and job stress and greater employee BMI has been reported (77).

Illness is a strong driver for workplace cost associated with absenteeism, presenteeism (working while sick), disability, injuries and health care claims (77, 78). For example, obesity has a strong positive correlation with absenteeism and body fat distribution is linked with high annual sick leave (78). Both observational and direct intervention research has shown that a change in health risk factors directly relates to absenteeism and presenteeism (79, 80). A reduction of one disease risk factor decreases absenteeism by 2% and presenteeism by 9% (80).

Chronic diseases have a negative influence on productivity. Poor health can have a greater impact on performance than on absenteeism. Australian research (80) has highlighted that mental health and psychological distress (including drug and alcohol abuse) has the greatest impact on absenteeism and presenteeism, with presenteeism showing the largest negative effect. The impact of other illnesses on absenteeism and presenteeism is also magnified when combined with psychological distress (81). Both absenteeism and presenteeism place an economic burden on industry. It is estimated that the total cost of absenteeism and presenteeism due to chronic health conditions is 10.7% of labour costs (82). For workers, an unhealthy lifestyle not only leads to increased risk of CVD and the related health issues, but will also have disadvantages related to work (83). The benefit of workplace health programs extends past the obvious direct risk reduction.

Due to the burden of CVD in worldwide, and particularly amongst working populations, comprehensive workplace CVD prevention programs should target CVD risk factors (79). Additionally, elements such as the management and reduction of stress, early detection and screening programs, training in cardiopulmonary resuscitation with automated external defibrillators, and changes to the work environment to encourage healthy behaviours and

promotion of safety are recommend by the American Heart Association's policy statement (79) for worksite wellness programs for CVD prevention.

1.2.2 Effectiveness of workplace programs

Several review papers exist demonstrating that workplace programs can have a significant impact on the health of employees (77, 83, 84).

A 2010 review (83) of lifestyle-focused workplace interventions on CVD analysed 31 randomised control trials that tested a variety of interventions such as counselling, group education and exercise. Strong evidence was identified for a positive effect on body fat which itself is a strong predictor of CVD risk. No evidence for a positive effect on body weight, lipids, blood glucose and blood pressure was reported. The authors noted that the lack of demonstrated evidence for these outcome measures was the result of inconsistencies between study results, related to study populations, measurement methods and intervention type.

The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity has also been the subject of review (77). Outcomes related to weight, such as body mass, body mass index and body fat percentage were assessed when reviewing 47 papers. Modest reductions in body weight were found with a pooled data result of 1.27kg weight loss and a decrease in BMI of 0.5 among studies with a 6-12 month follow up.

The authors noted that the effectiveness of lifestyle intervention can hinge on the study population. Studies aimed at high risk populations typically yield more positive results, have a greater health impact and can be more cost effective (83). Aiming lifestyle interventions at

low risk populations may yield little benefit. This concept is supported by previous reviews of multi-component CVD programs (74).

Due to the vast and varied nature of workplaces, programs can take on many different and diverse forms (85-87). Multiple factors will influence the type of intervention that can be used in a workplace, including the number of employees, available finances, physical location and availably of health professionals (79). Reduction of barriers to participation should be a key factor in designing an appropriate workplace intervention, as the most well designed and thought out intervention will be ineffective if employees do not participate (79).

1.2.3 Internet delivered programs

The internet has provided an efficient method of increasing the number of people in disease prevention programs (84). The introduction of the internet into health care practice has increased the opportunities for interventions to reach both the general population, but also individuals with chronic disease (88). In recent years there has been an increase in the public seeking health information through the internet with 61% of Americans reporting using the internet for health information in 2009 (89). Health professionals must adapt to this new method of information distribution or risk becoming irrelevant (88).

A meta-analysis (88) of behaviour change outcomes comparing web-based and non web-based health interventions support the use of the internet as intervention delivery method. Web-based interventions improved behaviour change in physical activity, increased nutritional knowledge, improved knowledge of asthma treatment, increased involvement in health care services, slowed general health decline, improved body shape perception and improved 18-month weight loss maintenance (88). One significant advantage that internet delivered programs allow is increased self-management of chronic disease. Self-management

has already been highlighted as an effective way to improve results and increase treatment adherence in chronic illness (90). A further review (90) into patient empowerment using web-based interventions found that in comparison to usual care, web-based interventions showed positive effects on empowerment, self-efficacy and control.

1.2.4 Internet delivered programs for the workplace

A recent systematic review (84) of 18 RCTs and 11 follow-up studies was conducted to establish the effectiveness, challenges and opportunities of internet-based worksite wellness programs. Significant differences in intervention and heterogeneity in the method of delivery were noted. Sixteen of the eighteen RCT's were largely internet based, with two being multi-component studies. The majority of the follow up studies followed this path, with eight of the ten interventions (described in eleven studies) being largely internet based. Results identified by the authors point toward multi-component trials being more effective, with all the multi-modal trials demonstrating significant associations between their interventions and outcomes (84, 91-94).

2 Internet delivered workplace programs to improve physical activity: A systematic review.

2.1 Abstract

Note to examiners:

A poster presentation of this systematic review will be given at ESSA Research to Practice conference in March 2018.

Introduction

Insufficient physical activity (PA) remains a worldwide problem despite strong evidence existing for both a primary and secondary prevention effect on many non-communicable diseases. The internet is now a popular way to deliver behavioural change programs to improve adherence to PA guidelines. The workplace provides a large audience for interventions, with 65.2 % of adult Australians in some form of employment. This provides researchers a unique cohort to study. In this systematic review we examined the effectiveness of internet delivered healthy lifestyle programs that target PA in the workplace.

Method

A systematic electronic search was conducted in February 2017 using multiple databases for all published randomised control trials of internet delivered workplace programs that had physical activity as an outcome measure.

Results

Thirty-two eligible randomised trials were included in this review, spanning a total of 14,826 participants, with 58.7% of the participants female. Twelve studies originated from the United States, thirteen from Europe, two each from Australia and Canada, and single studies from

Japan and Taiwan. One study was conducted over multiple countries. Significant heterogeneity existed amongst the trials in intervention design and outcome measure. Thirty-one of the studies were classified as unclear risk or high risk of bias using the Cochrane Risk of Bias constructs. Twelve of the thirty-two studies reported significant improvements in PA.

Conclusion

There is currently weak evidence to suggest that internet-based PA programs in the workplace are effective. Future research should focus on tailored interventions that utilise supported behavioural theories, include a degree of self-monitoring, and develop autonomous supportive environments. More high-quality trials with objective measures of PA are needed.

2.2 Introduction

Insufficient physical activity (PA) is a worldwide problem and is reported as the fourth leading cause of death globally (95). Strong evidence exists regarding the benefits of PA on reducing the incidence of many non-communicable diseases (96). Solid evidence exists for regular PA providing both a primary and secondary prevention effect for cardiovascular disease, diabetes, cancer, hypertension, obesity, depression and osteoporosis (97). Even modest health benefits can occur with as little as 15 minutes of moderate exercise per day with a curvilinear dose response relationship between increased duration and intensity, and decreases in all-cause mortality (98). As such, many governmental health departments have set minimum targets of 150 minutes of moderate intensity activity per week for the adult population (40, 42). While the benefits of regular physical activity are well known, there is a burgeoning disconnect between developed guidelines and population activity levels.

Despite the establishment of recommended guidelines, much of the world's population remains insufficiently physically active. Recent analysis found that 31.1% of the global population was not meeting physical activity levels equivalent to 600 metabolic minutes per week (99). When focusing on westernised countries, the level of adults not meeting minimum activity levels rises to 45.5% in Australia (100) and 49.8% in the United States (101).

To combat the negative health consequences of a insfficiently physically active lifestyle, researchers have designed comprehensive behavioural change programs to target physical activity levels and reduce associated risk factors. One such successful program was the Diabetes Prevention Program (DPP) (102), targeting individuals at risk of diabetes. The intensive program was effective, with 74% of participants achieving the targeted goal of 150 minutes of moderate intensity exercise per week by the 24-week study period, and the

intervention group maintaining significantly higher levels of physical activity than the placebo or metformin group even four years after the intervention.

With the relatively new and quickly evolving use of the internet, researchers have adapted and developed these effective healthy lifestyle programs so that can be delivered using internet modalities with the aim of finding new ways to promote and increase physical activity in the populace. Online adaptions of the DPP have been shown to be effective in achieving clinically significant reductions in weight (103). These online adaptions typically utilise a range of modalities including email, online tracking, and automatically generated reports. In other populations, internet and eHealth programs have been previously recommended in systematic reviews as effective tools to improve physical activity levels in comparison to a wait-list control (104). Interventions typically include approaches such as the use of email to distribute educational information on physical activity, websites designed to enhance user interaction with education information, and online tracking of physical activity status. Multi-component interventions that target more than one health behaviour are also common (105-107). More recently, researchers have begun to investigate the efficacy of smart phone apps to achieve the same outcome (108), although this evidence base is still emerging.

The workplace provides a large audience for prevention strategies, with the recent American time use survey reporting that the 'average' person employed, aged 25-54, who has children, spent an average of 8.9 hours per day working or on work related activities (109). This large block of worktime can serve as a hindrance for maintaining a healthy lifestyle, as it is often sedentary(110). However, for researchers and employers alike it offers a unique audience for health promotion material. Illness is a strong driver for workplace costs associated with absenteeism, presenteeism, disability, injuries and health care claims (77, 78). Both

observational and direct interventions have shown that changes in health risk factors directly relate to absenteeism and presenteeism (79, 80) with the elimination of one disease risk factor being associated with a decrease in absenteeism by 2% and presenteeism by 9% (80). A meta-analysis (111) of thirty-four workplace health programs targeting physical activity and nutrition concluded that there is a small but positive effect on physical activity outcomes (d=0.14, p <0.01). With a well-established link between physical activity and health, researchers aiming to improve the health of workers have begun to implement internet-based programs for improving physical activity. More recent reviews conclude that internet based lifestyle interventions can have significant effect on waist circumference change (112) and weight loss (113).

Despite results being inconclusive, previous reviews have suggested that potential exists for internet delivered physical activity programs to generate positive change (114-117). The power of using the internet to deliver these interventions relates to the ability to deliver content in a low-cost manner, over any distance, to large numbers people at the time and place of their choosing. The primary costs for these programs are incurred at the planning and development stage; with delivery typically utilising existing online infrastructure that already makes up part of the modern lifestyle.

Previous reviews in this topic have concluded that the effectiveness of physical activity programs in the workplace is unclear (115, 116). The fast-moving nature of internet research and eHealth delivery necessitates an updated review of the body of evidence. This systematic review aims to investigate the evidence for the efficacy of internet delivered healthy lifestyle programs that target physical activity in a workplace environment. Secondary to this, this

review intends to update the body of literature presented in previous reviews, which were published in 2013 and 2014 respectively (115, 116), using a broader search strategy.

2.3 Methods

2.3.1 Search strategy

An electronic search was performed in February 2017 by searching the following databases: MEDLINE Complete, Academic Search Complete, CINAHL Complete, Psychology and Behavioral Sciences Collection, SPORTDiscus with Full Text, AMED, PsycINFO, Journals@Ovid, PsycARTICLES Full Text, Embase, and the Cochrane library.

Search terms for workplace, behaviour, physical activity, and internet were used in order to identify all published studies investigating internet delivered workplace programs targeting physical activity. A full list of search terms is available in Appendix 1. After exclusion of ineligible studies, bibliographies of remaining articles were also manually searched for relevant results. A manual search of JMIR was also completed. Figure 2.1 displays the results of the search process.

2.3.2 Inclusion Criteria

Studies were selected for inclusion if they met the following criteria: 1) Randomised Controlled Trials;) that were limited to an adult (≥18 years) workplace population; 3) with at least one intervention arm utilising the internet or other online modalities; 4) that implemented a lifestyle intervention targeting physical activity (but not excluding those that targeted additional health factors); 5) and reported physical activity as an outcome measure.

2.3.3 Quality Assessment

The Cochrane Risk of Bias Tool was used to assess the risk of bias in the selected studies. The risk of bias tool was created to give an alternative to quality scales, which can present misleading numerical results, and to assess the risk of bias with a focus on method and internal validity (118). Articles are categorised as having a high or low risk of bias, or in the case of insufficient information, an unclear risk of bias. Bias assessment was done by the primary author (TW).

2.3.4 Data extraction

Data such as first author, date of publication, location of study, participant numbers, intervention duration, frequency and type was extracted and tabulated in table 1. Physical activity was reported as a mean score with a change score being calculated from pre and post scores. Standard mean differences with hedges-g was calculated in line with Cochrane recommendations when adequate in text information was available.

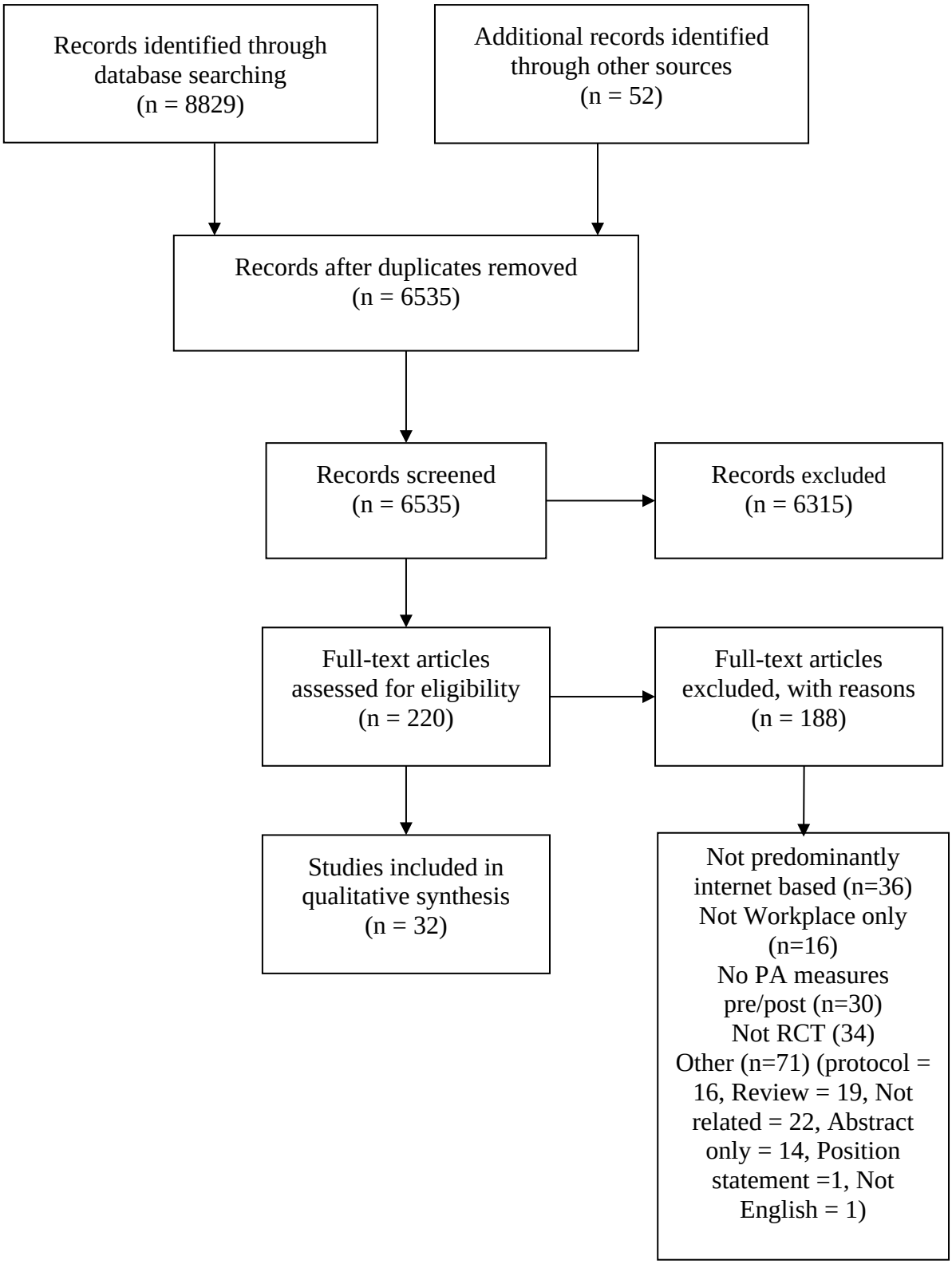

Figure 2.1: PRIMSA flow diagram.

2.4 Results

2.4.1 Characteristics of included studies

Thirty-two studies were included in this review, including two follow-up studies, spanning a total of 14,826 participants, with an n ranging from 30 to 2,121. Females were the most predominant gender (58.7%) in the assessed population. One study measured an exclusively female population (119), while two studies (120, 121) recruited males only. Of the selected trials, twelve were administered to office workers, seven to health care or hospital workers (107, 119, 122-128), and six to university staff (129-134). One focused on shift workers (121), while one (105) ran a multicentre trial across twenty-eight undescribed worksites. Detailed information about each included study is included in table 2.2.

Twenty-five of the studies had a mean BMI of ≥25kg/m^2, three had BMI mean scores of less than 25kg/m^2 (131, 135, 136), while three studies did not report BMI (119, 128, 132). Four studies targeted individuals with one or more metabolic or cardiovascular disease risk factors(107, 119, 120, 137).

Eleven studies originated from the United States (123, 125-127, 129, 130, 138, 139), six from the Netherlands (124, 140-142), and three from Scandinavia (122, 135, 143), with two studies each from Canada, Belgium, and Australia. One study was delivered across multiple countries (106), with the remainder comprising single studies from Taiwan (119), Japan (120) and Germany (137).

2.4.2 Quality

Distinct heterogeneity exists between the trial methods, with many studies reporting insufficient data to be adequately appraised in all Cochrane Risk of Bias constructs. One study was assessed as having low risk of bias (105). Six studies have an unclear risk of bias (122, 126,

131-133, 135), and the remaining twenty-five studies assessed as having a high risk of bias (106, 107, 119-121, 123-125, 128-130, 134, 136-141, 143-149). Thirteen studies used an intention-to-treat analysis to control for attrition rates (105-107, 121, 125, 131, 135, 136, 141, 143, 145, 148, 149). Fourteen reported power analysis (120-122, 124, 126, 129, 130, 137, 141, 143, 145, 146, 148, 149), with five meeting requirements (121, 124, 129, 145, 146). The Cochrane risk of bias results are presented in Table 2.1.

Table 2.1: Cochrane risk of bias for included studies.

	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other
Aittasalo (122)	+	?	?	?	?	+	+
Almeida (105)	+	+	+	+	+	+	+
Anderson (135)	+	+	?	+	+	+	?
Bennett (106)	?	?	?	-	+	+	?
Carr (129)	+	+	-	+	-	+	+
Chen (119)	?	?	?	-	+	+	+
Compernolle (144)	+	?	-	+	-	+	+
Cook (2007) (138)	?	?	?	+	+	+	-
Cook (2015) (145)	+	+	-	-	+	-	-
Deitz (107)	?	?	-	-	+	+	+
Dekkers (140)	+	+	-	?	?	+	+
Hager (132)	?	?	?	?	+	+	?
Hughes (130)	+	?	-	-	?	-	+
Irvine (139)	?	?	-	-	+	+	+
Marshall (131)	+	?	?	+	+	+	+
Maruyama (120)	+	+	-	?	-	+	?
Morgan (121)	+	+	+	?	+	-	+
Napolitano (123)	?	?	?	?	-	+	+
Plotnikoff (2005) (146)	?	?	?	?	-	+	+
Plotnikoff (2010) (150)	?	?	?	?	-	+	+
Poirier (128)	+	+	-	+	+	+	+
Pressler (137)	?	+	+	?	-	+	-
Puig-Ribera (133)	?	?	+	?	+	+	+
Reijonsaari (143)	+	+	-	-	+	+	+
Robroek (151)	+	+	+	+	-	+	+
Slootmaker (141)	+	+	?	?	+	-	+
Spittaels (136)	?	?	?	?	+	+	-
Sternfeld (125)	+	?	-	+	+	-	+
Suggs (134)	+	?	?	?	-	+	+
Tate (126)	?	?	?	?	+	+	+
Van Wier (2009) (148)	+	+	-	?	+	+	+
Van Wier (2011) (149)	+	+	-	?	+	+	+

NB. (+) low risk, (?) unclear risk, (-) high risk

2.4.3 Methodology

The most common intervention design was to use a website that can be accessed on demand by the participant. Twenty seven of the thirty two trials utilised a website (105-107, 119-121, 123-126, 128-131, 133, 134, 136-141, 143-145, 148, 149), with sixteen also using email (105, 107, 121, 123-126, 128, 129, 131, 133, 136, 140, 143, 148, 149). The other four interventions were delivered exclusively through email (122, 125, 135, 146). Frequency of contact among the email delivered interventions ranged from weekly to monthly. Eighteen of the interventions also included additional components to the online delivery, the most common being the addition of a pedometer or activity monitor (n=11) (120-122, 128, 129, 133, 141, 143, 144, 148, 149). Two studies provided monetary incentive to participants to complete the study (105, 107).

Twenty-one (105, 107, 120-123, 129-132, 134, 136, 138-140, 144-149) studies utilised a specific behaviour theory in their intervention, the most common being social cognitive theory (n=9), followed by the transtheoretical model (n=7), and the theory of planned behaviour) (n=4). One study utilised the Health Action Process Approach (122).

A variety of control conditions was used in the trials, with the most common being non-contact control groups (n=9). Five trials utilised wait-list control groups (107, 121, 123, 129, 145), two provided the same material presented in the intervention in an alternative print form instead of via online (131, 138). Six received usual care, either by a brochure, or by continuation of the standard workplace health program (124). One study contacted the control group with a weekly email reminder to continue normal physical activity (135), while three compared tailored advice to non-tailored advice (126, 136, 137). Study characteristics are presented in Table 2.

2.4.4 Efficacy

Nine studies utilised objective measures of physical activity. Five directly with pedometer measured steps or physical activity monitors (120, 128, 129, 133, 143, 144), and four through changes in $V0_2$ or lactate threshold testing (135, 137, 140, 141). The remaining studies relied on self-report questionnaires such as the International Physical Activity Questionnaire (IPAQ) or the Godin leisure-time exercise questionnaire. Extracted results are presented in Table 2.3.

Twelve (37.5%) of the thirty-two studies included in the review indicated statistically significant improvements in physical activity following the intervention when compared to a non-treatment control, wait-list control or usual care group (119, 121, 123, 125, 128, 133-135, 139, 144-146). One study had a significant decrease in sedentary time when compared to a wait-list control, with no increase in physical activity (129). Standardized mean differences with hedges-g were calculated in line with Cochrane recommendations (152). Twenty studies reported sufficient information in text for calculation to be possible. Overall, reported effect sizes were small, with seventeen studies calculated to have effects of less than 0.4. Irvine and Morgan reported large effect sizes (g=0.91, g=0.77). Seven of the nine studies (128, 129, 133, 137, 140, 143, 144) that utilised objective PA measures presented enough information for hedges-g calculation. Effect size remained low with six studies showing effects of less than 0.4. One study (129) found a decrease in sedentary time but with no corresponding increase in PA, with moderate effect (g=0.79).

2.5 Discussion

2.5.1 Aim/Purpose

This systematic review collated findings from randomized controlled trials investigating the effectiveness of internet based physical activity interventions in workplaces. We found weak evidence for the efficacy of internet delivered programs to increase PA in the workplace.

2.5.2 Effective interventions

While overall, the effect of internet based physical activity interventions were low, it is pertinent to examine the characteristics of those studies that elicited a significant effect:

Dietz and colleagues tested the effectiveness of an on-demand website and reminder emails targeting a variety of behavioural risk factors for CVD. Participants with at least one CVD risk factor were allocated to a six-week intervention consisting of a five-module website or a wait-list control. Key to the intervention was tailored advice derived from web-based risk assessments. Intervention information was structured around the social cognitive theory. The authors reported a significant increase in total ($p=0.016$) and strenuous exercise levels ($p=0.004$), as measured by the Godin leisure-time exercise questionnaire.

Irvine (139) indicated a significant ($p <0.001$) improvement in self-reported minutes of physical activity per day in comparison to a non-treatment control through the testing of a comprehensive website designed to improve levels of PA. The website offered education and support through text and multimedia. Minutes of activity per day was calculated from a single item questionnaire from the Current Exercise Status Scale (CESS).

Plotnikoff (146) ran a twelve week email intervention delivering partnered physical activity and nutrition messages via a weekly email. Significant differences ($p < 0.01$) were observed in energy expenditure between the intervention and the non-contact control group at the end of the study period using a modified version of the Godin Leisure Time Exercise Questionnaire. Importantly, the authors highlight that the control group reduced physical activity over the course of the study by 11%, most likely due to the effect of the Alberta winter months during which the study took place. Additionally, there was also a significant main effect for time in workplace activity status, based on a four-point rating of a single question on activity in the workplace on most days.

Similar significant results in male shifter workers who participated in a 14-week study by Morgan et al (121). Based on social cognitive theory, the study involved four components of a single 75-minute face-to-face information session, a freely accessible public website with additional individualised feedback, and a weight loss handbook with pedometer. The intervention group significantly improved their physical activity levels as measured by a modified Godin leisure scale ($p=0.03$, Cohen's $d = 0.77$).

Several other studies found significant results in objective pedometer measurements(128, 133, 144). Compernolle (144) and colleagues trialled computer-tailored step advice in conjunction with a pedometer and accompanying booklet. Statistical differences were found between the intervention and non-intervention control for improvements in steps per day ($P=<0.05$). Both groups were assessed with a blinded pedometer that was only readable by the researchers. Similarly, Poirier et al (128) investigated a walking program with adaptive daily step goals and a pedometer on daily step count. The six-week intervention was effective

at increasing daily steps in comparison to a no treatment control (P=<0.001). This effect was evident in both sedentary and non-sedentary participants.

A longer intervention period was investigated by Puig-Ribera (133), who conducted a 19-week trial of a walk at work intervention in which they investigated the effect of a on demand website that enabled participants to log daily step counts, interact socially with other participants, and receive fortnightly goal and education information. Statistically significant effects were seen in both daily step count (P=0.0013) and in sedentary time (P=0.046) when compared to a control group encouraged to maintain normal behaviour. Anderson and colleagues (135) also reinforced the importance of social environment by encouraging workers via email to form small groups to do ten minutes of stair walking. Compared to a group reminded to continue their normal exercise habits, significant improvements were seen in VO_2 max.

Sternfield (125) reported significant improvements in minutes of moderate activity (p=0.0002), vigorous activity (p=0.03) and, minutes per week of walking (p=0.003) relative to the control group. Larger improvements were seen in participants who were inactive at baseline. The authors utilised a comprehensive sixteen-week tailored email and website intervention focusing on physical activity, fruits, vegetables, fats, and sugars.

Cook et al (145) conducted a recent study in older workers with a tailored on demand website that provided an interactive environment coving a multitude of health aspects around aging. The three-month intervention was effective at increasing mild exercise levels as measured by the Godin-leisure time exercise questionnaire.

Several other studies provided promising but inconclusive results. Chen et al (119) compared a no treatment control to an online health management platform. Participants could check personal health test data, and log dietary and exercise records for review by experts who then offered recommendations for improvement. The authors reported a significant difference between groups at 1.5 months in exercise behaviour from a modified health behaviour score questionnaire, but no significant differences at the end of the three-month intervention. Napolitano and colleges (123) investigated the efficacy of a three month intervention website with additional email tip sheets on physical activity levels and stage of change. There was a significant difference between intervention and control for time spent in walking activity ($p < 0.05$) at both the one month and three month assessments. A significant difference existed between intervention and the wait-list control group at one-month ($p < 0.05$) for moderate intensity minutes of physical activity, although this difference was no longer significant at the three-month assessment. Both moderate minutes and walking minutes were calculated from the thirty-point Behavioural Risk Factor Surveillance System (BRFSS).Two further studies provided promising results (129, 134). Carr et all (2013) investigated the effectiveness of an internet delivered theory based program coupled with a portable pedal machine and pedometer on physical activity levels and sedentary time. While no significant difference was found in physical activity in comparison to the wait-list control group, a significant reduction in daily sedentary time ($p<0.01$) (Cohens $d = 0.79$) was noted. Suggs, Blake, Bardus and Loyd (2013) found an improvement in workplace time physical activity in comparing an email intervention with an email and SMS text message intervention. A significant between group differences was found with the email group being effective at increasing work time physical activity. No other differences were found.

None of the other twenty studies found significant effect on physical activity outcomes.

2.5.3 Physical activity effectiveness

In contrast to the evidence presented for the low success rates of internet delivered workplace trials, Greaves et al (153) presenting a comprehensive review of reviews, found that generally physical activity interventions (not necessarily online and in the workplace) can provide significant and clinically meaningful results (equivalent to 30-60 minutes of walking per week). Further, the authors reviewed and coded intervention components that increased the effectiveness of physical activity and dietary interventions. In systematically identifying and grading the evidence for intervention components the authors are able to provide recommendation on what components may increase interventions effectiveness. Greaves and colleagues report high level evidence for interventions that target both diet and PA; the use of established behaviour change techniques such as goal setting; interventions that encourage social support; interventions deliver in a wide range of settings; delivered by a range of health professionals; and with a strong focus on maintenance. Care must be taken in applying these recommendations directly to an internet delivered context as online interventions focus much more on how the content is delivered (for example the mode of delivery); whereas offline interventions put significant work into how the information is received. Notwithstanding, much can be learned from these methods.

Transferring the effectiveness of offline interventions into those delivered in an online context remains a challenge.

2.5.4 Offline Components

Many online interventions are coupled with offline components such as face-to-face meetings or pedometers. Differentiating between the effects of the online component and the effect

of the additional modalities is not possible with the trials presented. While the addition of offline components may increase the efficacy of the intervention, it may present boundaries to the implementation of the intervention. Solely online interventions present the benefit of low cost and ease of delivery to remote and isolated areas – the addition of a pedometer for example may increase the cost of an intervention, and require extra resources for delivery. Researchers will need to weigh up the cost benefit of such additions.

Difficulty occurs when separating the effects of the addition of offline components to an internet delivered intervention, as most studies are not designed to detect the effect the additional components may bring. It is possible that a mixed delivery study will be receiving a significant proportion of the achievable benefit from the offline components.

Several studies had face-to-face contact as part of the intervention, ranging from a preliminary one hour meeting (122) to monthly face-to-face meetings with dieticians or physical trainers (120). Thorndike offered a face-to-face visit with a nutritionist and/or trainer every three months.

Carr et al (129) aimed to reduce the daily sedentary time of sedentary, overweight office employees in the USA. The multicomponent intervention used a portable desk pedal machine coupled with online motivation and tracking to encourage ‘active sitting’. Participants in the intervention significantly reduced sedentary time by an average of 58 minutes per day, as measured objectively by an ankle worn physical activity monitor.

Several other interventions used offline components in addition to online services. Morgan et al (121) reported significant improvements in metabolic minutes per week of physical activity with a comprehensive intervention involving a website coupled with a pedometer,

individualized dietary feedback, printed handbook and single face-to-face information session. This intervention was also successful at showing significant changes in weight, waist circumference, BMI and resting heart rate.

Aittasalo (122) combined pedometers with emails promoting walking among office employees. While only small and non-significant changes were recorded in physical activity outcomes, the authors note that more intensive face-to-face interventions may be needed to elicit a significant result. Reijonsaari (143) also used an activity monitor, coupled with a website to upload and view physical activity data. The authors reported no significant improvements in physical activity measures. Comparison to other trials is troublesome, as the majority of the participants (70%) achieved ACSM guidelines for physical activity at the baseline measures. However, a sub-group analysis of sedentary employees did not show improvement of physical activity.

Slootmaker (141) utilized a relative sedentary population for a physical activity monitor and website intervention, recruiting 302 Dutch adults from various workplaces with the least active 50% invited to continue participation in the RCT. While relatively inactive when compared to the whole group, 69% of the intervention group and 65% of the control group achieved PA recommendations at baseline. These active participant groups increase the likelihood of ceiling effect, where achievable benefits from the website and monitor intervention may have already been absorbed by the participant's baseline activity levels. Additionally, the studied population was relatively young (23 to 39 years old). A Cochrane systematic review(154) of workplace pedometer interventions concluded that due to low quality of available studies, and high risk of bias, there is was insufficient evidence to assess whether workplace pedometer interventions are beneficial.

2.5.5 Behavioural theory

Behavioural interventions typically build upon a specific psychological theory. Twenty-one of the thirty-two studies included utilised a specific behavioural theory in their intervention design. Four (125, 126, 135, 142) further studies included components of psychological theory, but did not credit a particular theory. Webb (155) reports that internet health behaviour change interventions (not limited to PA) that utilised psychological theories had larger effect sizes that those that did not. Effect sizes were greatest in interventions that use theory of planned behaviour (d+= 0.36, 95% CI 0.15 to 0.56) followed by transtheoretical change model (d+= 0.20, 95% CI 0.08 to 0.33) and, social cognitive theory (d+= 0.15, 95% CI 0.04 to 0.25). Further to this, Greaves et al (153) noted that there is medium quality associative evidence that a basis of psychological theory, and accompanying components, leads to greater outcomes in dietary and physical activity interventions.

Foundation use of behaviour theory is critical as it changes both the intervention information, but also the way that the information is presented. Napolitano (123) for example, based their intervention on social cognitive theory (SCT) principles, with a small quiz at each website login designed to assess the participant's stage of change. The participant was then guided to the appropriate area of the website for their stage but was also able to freely explore the other areas. Use of theory such as SCT prevents 'one size fits all' block information for all participants. While this may increase the intervention effectiveness, it also increases the work required to design and create an intervention.

Greaves et al (153) provides high value evidence that offline interventions should use be built upon a well-established and defined behaviour change techniques. Techniques and theory often overlap, as components such as goal setting, self-monitoring and problem solving are

common to many of the behaviour theories. A systematic review and meta-regression by Mitchie Et al (156) assessed the effectiveness of behavioural change components of 69 PA interventions. The authors conclude that there is support for the use of self-monitoring, intention forming, and specific goal setting. Further use, and specific adaption of behavioural theories, with a larger focus on self-monitoring behaviours, may improve the efficacy of internet delivered workplace programs.

2.5.6 Study quality

A significant proportion (twenty-two, 64%) of the trials included in this review utilised self-report measures for physical activity outcomes. While self-report measures have downsides in possible over-reporting of physical activity data due to social desirability bias, and difficulty in recalling past physical activity, they are often cheaper and easier to administer to large groups, especially via the internet. Recall style measures also do not typically alter the behaviour being measured, whereas activity monitors may cause changes in normal activity levels. This Hawthorne effect may account for some of the increases in physical activity, as an observable effect has been seen with repeated measures (157). Many of the studies used single item measures of physical activity. In order to gain greater accuracy of the effect of internet delivered PA interventions in the workplace, multiple item physical activity measures should be utilised, in addition to objective measures.

Ten studies (120, 124, 128, 129, 133, 135, 137, 140, 141, 144) reported the use of objective measures in assessing primary outcomes. Four trials used direct measures of physical fitness, measuring v02 max either by maximal cycle ergometer testing (135), Chester step test (107, 141) or improvement in lactate anaerobic threshold (137). Six studies measured activity using a pedometer or physical activity monitor (120, 128, 129, 133, 143, 144). The remaining studies

relying on self-report questionnaires such as the International Physical Activity Questionnaire (IPAQ) or the Godin leisure-time exercise questionnaire.

2.5.7 Intervention participation

Thorndike (127) tracked usage of the interventions, finding that 69% of the intervention group logged onto the website at least once, with 63% visiting ≥5 times. Despite offering face-to-face contacts with a trainer or nutritionist, only 55% of participants chose to meet. Aittasalo (122) likewise reported that 60% of the intervention participants utilise the provided pedometers regularly and that 80% read the emailed messages. Van Wier (142) reported that only 18% of participants in the intervention group completed all sessions. Dekkers (140) reported similar low adherence with 17% of participants completing all available modules of the intervention. These low adherence and participation rates may constrain studies and prevent the identification of effective methods. Achieving greater participation in intervention should be an aim of further research.

Greaves et al (153) recommends using social support methods in physical activity interventions to improve the effectiveness of the interventions. Poirier investigated the effects of social contacts in a non-workplace internet intervention and found higher levels of engagement in individuals with more social contacts in the program. These participants opened more emails, visited the website more often and completed more progress challenges than non-social participants. Translating this into workplace programs may be done through creating social links in work teams amongst colleagues. Morgan et al (121) was successful in this, using existing work teams of 15 men who were cluster randomised together in the study. While this cannot guarantee that individuals will discuss and encourage each other in achieving health behaviours, it provides an environment where this is possible. Future

research should encourage social links and support, possibly by the use of team environments or with discussion forums that embolden participants to learn and share experiences with each other. Furthermore, researchers should be sure that participant engagement with the intervention is measured, and strategies to improve participation included maximising effectiveness.

Attrition rate in the selected studies was also high, ranging from 2% to 52% . Thirteen of the trials used an intention to treat analysis design to offset the relatively high attrition rates. Despite this, only five (121, 124, 129, 145, 146) papers noted in text that they achieved statistical power, with nine (120, 122, 126, 130, 137, 141, 143, 148, 149) stating they did not achieve sufficient power, and eighteen (105-107, 119, 123, 125, 128, 131-136, 138-140, 144, 147) making no statement on power calculation.

2.5.8 Strength and limitations

A key limitation is the heterogeneity of the included studies, with large ranges of population, intervention design, control group and outcome measures reported. This heterogeneity should be unsurprising, as many interventions are directly tailored for the workplace in which they are delivered. This heterogeneity does inhibit the use of quantitative meta-analysis assessment of the trials.

2.6 Conclusion

Despite the perceived benefits of the internet in delivering lifestyle interventions to a workplace population, there is currently weak evidence to support their efficacy. Specifically tailored interventions that rely on well supported behavioural theories, including a degree of self-monitoring and developing social support may be more effective in improving PA. Future research in this area should focus on developing high quality study design with

randomised control processes and objective PA measures. Investigators may want to design interventions that are novel in psychological theory delivery, possibly with the addition of newer behavioural change theory applications, such as autonomous supportive environments.

This systematic review can be used to inform researchers on the current evidence base for internet delivered health programs in the workplace environment, and aid in the development of successful behaviour change programs that aim to improve physical activity levels. This can be of benefit to employers and health practitioners alike.

Table 2.2 Details of included studies

Study	Design/Participants	Intervention	Internet	PA Outcome Measure	Intervention Effect	Analysis
Attiasalo (2012) (122) Finland	**Participants:** 241 insufficiently active (<150 moderate minutes, or < 75 vigorous minutes per week **Attrition Rate**:27% intervention, 19% control **Recruitment:** 10 occupational health care units	**Focus:** Walking **Groups:** a) Pedometer with logbook and monthly emails, b) data collection only **Offline components**: Pedometer, 1hr information session, walking leaflets and printed log books **Other behaviours targeted:** None **Duration:** 6 months **Follow-up:** 12 months	**Format:** Emails **Frequency**: Monthly **Theory**: HAPA	**Primary:** Walking and sitting time in various categories. **Instrument:** Adapted IPAQ	**6 months:** No between group differences in walking or sitting time **12 months:** No between group differences in walking or sitting time	**Power:** Not met **ITT**: No **Randomisation:** Stratified randomisation with random allocation sequences for balanced groups. **Statistical tool:** Logistic regression and linear model.
Almeida (2015) (105) United States	**Participants:** 1790 employees with BMI ≥ 25kg/m^2 **Attrition Rate:** 90% for INCENT, 86% for LMW **Recruitment:** 28 worksites	**Focus:** Weight loss **Groups:** a) daily emails to promote healthy behaviours with monetary incentive and comprehensive website b) minimal intervention comparison of condensed materials from a) with 4 1hr presentations on health behaviours and 4 newsletters on different exercise programs	**Format:** Tailored emails and comprehensive website **Frequency:** Daily emails, **Interactivity:** Website included video, discussion forums and access to electronic fitness advisor **Theory:** SCT	**Primary:** Minutes in vigorous and moderate PA categories **Instrument:** Combination of Rapid assessment PA scale and BRFSS, and reported number of days/time spent in strength training variables	**6 months:** No between group differences for increases in moderate or vigorous PA. However both groups increased moderate and vigorous PA	**Power:** No mention **ITT**: Yes **Randomisation:** Two arm cluster randomisation **Statistical tool:** Mixed linear regression model

		Offline components: Monetary incentive **Other behaviours targeted:** PA and Dietary behaviours **Duration:** 6 Months				
Anderson (2013) (77) Denmark	**Participants:** 160 with mean BMI of 23 **Participation Rate**: 82.7% **Attrition Rate:** 10.4% intervention, 9.2% control **Recruitment:** Large administration company	**Focus:** Aerobic Fitness **Groups:** a) Weekly email reminders to form small groups and walk the stairs for ten minutes. b) weekly emails to continue current PA levels. **Offline components:** One day of HR monitoring during stair climbing **Other behaviours targeted:** none **Duration:** 10 weeks	**Format**: Email **Frequency**: Weekly **Interactivity**: None **Theory:** No specific theory	**Primary:** $V0^2max$ mL/min/kg **Instrument:** Max cycle ergometer test **Others:** low, medium and high intensity leisure time PA **Instrument:** Modified Saltin and Grimby	**10 weeks:** Significant group x time interaction for aerobic fitness (P <0.001) with increases of 1.45mL/min/kg (95% CI 0.64-2.27) No other changes in PA or other measures	**Power:** No mention **ITT**: Yes **Randomisation:** Computer generated with 2:1 ratio to intervention **Statistical tool:** 2x2 mixed factorial design (time and group)
Bennett (2011) (106) United States, Africa & Asia	**Participants**: 145 **Attrition Rate:** 35% intervention, 15% control **Recruitment:** 8 different organisations	**Focus:** Indicators of Cardiovascular disease **Groups:** a) Website available on demand with webinars and lessons b) no contact control **Offline components**: Telephone support	**Format:** Two component website for health and leadership **Frequency:** Always available **Interactivity:** Animated and narrated lessons with self-assessments, simulations, short videos and extra reading.	**Primary:** Leisure time PA **Instrument:** Godin leisure time scale	**6 months:** No significant difference for PA outcomes	**Power:** No mention **ITT**: Yes **Randomisation:** No mention of method **Statistical tool:** Mixed methods for repeated measures

		Other behaviours targeted: Diet, PA, stress, mood management **Duration:** 6 months	**Theory:** No mention			
Carr (2013) (129) United States	**Participants:** 40 employees with BMI ≥ 25kg/m^2 reporting less than 60 mins of moderate to intense PA per week and who report 75% of their work time is sitting **Participation Rate**: 71% **Attrition Rate:** 23% **Recruitment:** University workers	**Focus:** Daily sedentary time **Groups:** a) Access to portable pedal machine while at work, motivational website, and pedometer. b) Wait-list control asked to maintain normal behaviours **Offline components:** Portable pedal machine with software, pedometer **Other behaviours: targeted:** Cardiometabolic risk factors, intervention compliance **Duration:** 12 weeks **Follow-up**: 12 weeks	**Format:** Motivational website with tips and reminders. Pedometer tracking through website prompted by emails. **Frequency:** On demand website, daily emails **Interactivity:** logging of steps and virtual competition in small groups, newsfeed of profile photos and updates from participants **Theory**: SCT	**Primary:** Minutes of daily sedentary time, Minutes of light, moderate, and vigorous PA **Instrument:** StepWatch physical activity monitor	**12 weeks:** Significant between group difference for daily sedentary time (P <0.01).	**Power**: Met **ITT**: No **Randomisation:** 1:1 computer randomisation **Statistical tool:** ANCOVA, adjusted for baseline value
Chen (2013) (119) Taiwan	**Participants:** 66 full time employees with one or more components of metabolic syndrome **Attrition Rate**: 4.55%	**Focus:** Metabolic risk **Groups:** a) Intervention group using a health management platform, b) data collection only	**Format:** Website **Frequency:** On demand **Interactivity:** Check personal test data, upload diet and exercise	**Primary:** Health behaviour scale **Instrument:** Adapted health behaviour scale	**1.5 months:** Significant group x time effect for PA behaviour (P=<0.05) **3 months:** No lasting effect.	**Power:** No mention **ITT**: No **Randomisation:** No mention of method

	Recruitment: Teaching hospital employees	**Offline components**: none **Other behaviours targeted:** Diet **Duration:** 1.5 months **Follow-up**: 3 months	diary. Receive tailored diet and exercise recommendations. **Theory:** No mention.	**Validated:** Internally validated, Cronbach's α 0.807		**Statistical tool**: Mixed model
Compernolle (2015) (144) Belgium	**Participants**: 274 **Attrition Rate:** 31% Intervention, 22% control **Recruitment:** 8 white collar workplaces	**Focus:** PA (steps) **Groups:** a) booklet, pedometer and access to website for 3 months. b) no intervention. **Offline components:** Pedometer, booklet on increasing PA, average daily step count reported by researchers. **Other behaviours targeted**: None **Duration**: 3 months **Follow-up**: 3 months	**Format:** Website **Frequency:** On demand **Interactivity:** web based questionnaires, computer tailored advice including goals to achieve more steps. **Theory:** TPB, TTM	**Primary**: Steps **Instrument:** Blinded pedometer **Secondary:** PA and sitting time **Instrument:** IPAQ (short)	**1 month:** Significant improvement in steps/day (P=<0.01), Walking (P=<0.05) in comparison to control **3 months:** Significant improvement in steps/day (P=<0.05)	**Power:** No mention **ITT**: No **Randomisation:** Computer generated **Statistical tool**: ANCOVA
Cook (2007) (138) United States	**Participants:** 419 **Attrition Rate:** 15% intervention, 13% control **Recruitment:** Large human resources provider	**Focus:** Multi-component (Diet, PA & stress) **Groups:** a) website based, b) 5 commercial print booklets **Duration**: 3 months **Follow-up:** 3 months	**Format:** Website **Frequency:** On demand **Interactivity:** Graphics, audio, and video. **Theory:** SCT, TTM	**Primary:** Godin Leisure score **Instrument:** Godin Leisure-time exercise questionnaire **Secondary**: Godin Sweat score	**3 Months:** No differences between groups for PA	**Power:** No mention **ITT**: No **Randomisation:** No mention of method **Statistical tool**: ANCOVA

				Instrument: Godin Leisure-time exercise questionnaire		
Cook (2015) (145) United States	**Participants:** 278 employees aged ≥50 years **Recruitment:** Large global IT company	**Focus:** Multi-component (Diet, PA, stress, aging beliefs, and smoking) **Groups:** a) web based health program, tailored for 50+ b) Wait-list control **Duration:** 3 months **Follow-up**: 3 months	**Format**: Website **Frequency**: On demand **Interactivity:** Tailored assessments. Text, video, graphics and narration. **Theory:** SCT	**Primary:** Godin Leisure score **Instrument:** Godin Leisure-time exercise questionnaire **Secondary**: Godin Sweat score **Instrument:** Godin Leisure-time exercise questionnaire	**3 months:** Significant improvement for mild exercise (P=0.01), no changes for other PA measures.	**Power:** Met **ITT:** Yes **Randomisation:** Block randomisation **Statistical tool:** Multiple linear regression models
Deitz (2014) (107) United States	**Participants:** 210 with at least one known CVD risk factor **Participation Rate:** Average website viewing time was 100 minutes over 6 weeks **Attrition Rate:** 11% **Recruitment:** Hospitals	**Focus:** Reduce cardiac risk **Groups:** a) on demand, 5 module website, b) wait-list control **Offline components**: Monetary incentives **Other behaviours targeted:** Diet, PA, Efficacy, tobacco, and stress **Duration:** 6 Weeks **Follow-up:** 6 Weeks	**Format:** Website **Frequency**: On demand **Interactivity:** Tailored risk assessments and suggestions, video, narration, and graphics. **Theory:** SCT **Format:** Email **Frequency:** Every two weeks **Interactivity:** Reminder to login to website	**Primary:** Godin Leisure score **Instrument:** Godin Leisure-time exercise questionnaire **Validated**: Yes **Secondary**: Godin Sweat score **Instrument:** Godin Leisure-time exercise questionnaire **Validated:** Yes	**6 weeks:** Significant improvement in total exercise (P=0.016), and strenuous exercise (P=0.004)	**Power:** No mention **ITT:** Yes **Statistical tool**: ANCOVA
Dekkers (2011) (140)	**Participants:** 276 with BMI ≥25kg/m^2 random	**Focus:** Cardiovascular risk factors	**Format:** Website	**Primary:** $V0^2$max mL/min/kg	**6 months:** no significant differences	**Power:** Not calculated for PA

Netherlands	sub sample of ALIVE@work **Attrition Rate:** 22% internet, 27% phone, 18% control **Recruitment:** 7 Large companies	**Groups:** a) Internet website b) phone counselling, c) no intervention control **Offline components:** All groups received standard self-help materials on PA and diet. **Duration:** 6 months **Follow-up**: 24 months	**Frequency:** On demand **Interactivity:** 10 modules with several assignments each **Theory:** CBT **Format:** Email **Frequency:** on completion of module **Interactivity:** Tailored support based off assignments	**Instrument:** Chester step test (submax)	**24 months:** no significant differences	**ITT:** No **Randomisation:** Computer Block randomisation, delivered via opaque sealed envelope **Statistical tool:** Linear regression on 141 participants
Hager (2002) (132) United States	**Participants:** 525 **Recruitment:** Large private university	**Focus:** Exercise behaviour, readiness to change **Groups:** a) stage based intervention with tailored to stage emails b) action message group with general emails c) control with nutrition emails. **Offline components**: None **Other behaviours targeted**: None **Duration:** 6 weeks **Follow-up**: 6 weeks	**Format**: Email **Frequency:** weekly **Interactivity:** Group dependent – Tailored or general **Theory:** TM	**Primary:** Seven day exercise recall (kcal/day) **Instrument:** Blair et al 1991 **Secondary**: Occupational time PA **Instrument:** Health insurance plan of New York questionnaire (25-point) **Secondary**: Leisure time PA **Instrument:** Health insurance plan of New York questionnaire (25-point)	**6 weeks:** No significant differences between variables or groups.	**Power:** No mention **ITT**: No **Randomisation:** No mention of method **Statistical tool**: ANOVA
Hughes (2011) (130)	**Participants:** 423 aged ≥40 years	**Focus:** Health behaviours	**Format:** Website	**Primary:** vigorous and moderate PA per week.	**6 months:** No significant differences	**Power:** Mentioned, not met

United States	**Attrition Rate:** 19% Realage, 15% COACH, 12% control **Recruitment**: University	**Groups:** a) COACH group received in person counselling and phone or email contact b) REALAGE group had access to website to develop improvement areas c) CONTROL received printed health promotion materials. **Other behaviours targeted:** Diet, PA, stress, and smoking. **Duration**: 12 months **Follow-up:** 6 months and 12 months.	Frequency: On demand **Interactivity:** Online test that generates risk score and indicated areas that need improvement, create plans and behaviour goals. **Theory**: SOC	**Instrument:** 7-item Behavioural risk factor surveillance system scale	**12 months:** No significant differences	**ITT**: No **Randomisation:** Computer based, stratified by education and race/ethnicity. **Statistical tool:** Mixed-effects regression model. 1-tailed test for significance.
Irvine (2011) (139) United States	**Participants:** 211, with ≤90 minutes of weekly PA **Attrition Rate**: 7% **Recruitment:** Large manufacturing plant **Setting:** Internet at work **Design:** RCT	**Focus:** PA **Groups:** a) Tailored website, b) non-intervention control **Other behaviours targeted:** Attitudes and knowledge to PA, stress, depression. **Duration**: 28 days **Follow-up**: 28 days	**Format:** Website **Frequency:** On demand at work **Interactivity:** Education & support via text, video & flash. Using MI principles. Tailored to users preferred exercise type, current activity level and personal barriers **Theory:** SCT, TRA **Format:** Emails **Frequency:** Weekly	**Primary:** CESS **Instrument:** Current exercise status scale (single item) **Secondary:** Minutes per day of activity **Instrument:** Single item, rated on 7 point scale.	**28 days:** Significant difference in Minutes of exercise per day (P=<0.001, η^2=0.22), Significant improvement in CESS (P=<0.001, η^2=0.26)	**Power:** No mention **ITT**: No **Randomisation:** No mention of method **Statistical tool**: MANCOVA, ANCOVA

			Interactivity: Reminder email to visit website.			
Marshall (2003) (131) Australia	**Participants**: 655 **Attrition Rate:** 23% web, 20% print **Recruitment:** Academic staff at university	**Focus:** Increase PA **Groups:** a) website b) print of same materials **Offline components**: None **Duration:** 8 weeks **Follow-up:** 8 weeks	**Format:** Website **Frequency**: On demand **Interactivity:** stage based quizzes, personalised sections on goal setting, activity planning, PA readiness. **Theory:** TTM **Format:** Emails **Frequency:** Every two weeks **Interactivity:** Personalised, stage based **Theory:** TTM	**Primary:** met.minutes per week **Instrument:** IPAQ	**8 weeks:** No significant differences in PA between groups.	**Power:** No mention **ITT**: Yes **Randomisation:** computer based, stratified by stage of change. **Statistical tool:** ANCOVA controlled for differences in baseline PA
Maruyama (2010) (120) Japan	**Participants:** 101 males aged 30-59 with one of more metabolic risk factors **Attrition Rate:** 7% intervention, 20% control **Recruitment:** Health insurance company	**Focus:** Metabolic risk factors **Groups:** a) website with counselling, b) no treatment control **Offline components:** Monthly individual contact with dietician (20mins) and physical trainer (10mins). Pedometer. **Duration:** 4 months	**Format:** Website **Frequency**: On demand **Interactivity:** record diet and Pa activity, upload pedometer logs. Counsellors and family members could comment on reports. **Theory**: SOC	**Primary**: Step **Instrument:** Pedometer HJ-7101T Omron Health Care co., Ltd. Japan	**4 months:** no significant difference between groups.	**Power:** Not met **ITT**: No **Randomisation**: Computer Statistical tool: ANOVA

		Follow-up: 4 months				
Morgan (2011) (121) Australia	**Participants:** 110 male shift workers BMI ≥25-40kg/m^2 **Attrition Rate:** 17% Intervention, 20% control **Recruitment:** Aluminium plant shift workers	**Focus:** Weight loss **Groups:** a) website access (publicly available), submitted eating and exercise diaries with up to 7 individualised feedback emails. b) wait-list **Offline components:** Weight loss handbook and pedometer, 75 minute face-to-face health education session. **Other behaviours targeted**: diet **Duration:** 14 weeks **Follow-up:** 14 weeks	**Format:** Publicly available website **Frequency:** On demand, but asked to log diet and PA daily for a month, fortnightly for the next month and once a week for the third month. **Interactivity:** Logging of diet and exercise activity. **Theory:** SCT **Format**: Email **Frequency:** Up to 7 across 3 months **Interactivity:** Individualised feedback based on a weeks' worth of dairy entries. Participants also able to ask questions to researchers. **Theory**: SCT	**Primary:** Met.min.wk **Instrument:** Godin Leisure-time exercise questionnaire	**14 weeks:** Significant change for total met minutes (P=0.03, d=0.77), and current PA level (P=<0.001, d=0.75)	**Power**: Met **ITT**: Yes **Randomisation:** Computer based, randomised by work crew. Blinded randomiser. **Statistical tool:** Natural log transformation for met.min.wk, mixed models for analysis.
Napolitano (2003) (123) United States	**Participants:** 65 inactive (<120mins of moderate PA per week, or <60 minutes of vigorous PA per week) **Attrition Rate:** 20%	**Focus**: PA **Groups:** a) website with information on PA and weekly tip sheets b) wait-list control **Duration:** 3 months	**Format**: website **Frequency**: On demand **Interactivity:** Quiz on each website entry to assess stage of change. SOC information	**Primary:** Minutes of activity per day **Instrument:** BRFSS **Validated:** Yes	**1 month:** Intervention group had significantly more walking minutes (P=<0.001) and moderate minutes (P=<0.05) **3 months:** Intervention group improved walking	**Power:** No mention **ITT**: No **Randomisation:** No mention of method

	Recruitment: Hospital workers	**Follow-up:** 1 month and 3 months	presented but all areas available. **Theory**: SCT **Format**: Emails **Frequency**: Weekly **Interactivity:** tip sheet on goal setting, self-monitoring etc., with link back to website. **Theory:** SCT		minutes (P=<0.05). no lasting effect for moderate minutes.	**Statistical tool:** Log transformed PA data, ANCOVA
Plotnikoff (2005) (146) Canada	**Participants**: 2121 Attrition Rate: 18.4% **Recruitment:** Large workplaces	**Focus:** PA and diet behaviour, knowledge and attitude **Groups:** a) weekly combined PA and diet emails for 12 weeks. b) nothing **Other behaviours targeted**: Diet **Duration**: 12 weeks **Follow-up**: 12 weeks	**Format**: Email **Frequency**: Weekly **Interactivity:** Combined PA and diet information, **Theory:** SCT, TTM, TPB & Protection motivation theory	**Primary:** met.min.wk **Instrument:** Modified Godin	**12 weeks:** Significant increase for PA from intervention group (P=<0.01), Sig decrease from control group (P=<0.01).	**Power**: Met **ITT**: No **Randomisation:** 3:1 ratio towards intervention **Statistical tool:** ANOVA, Outliers trimmed
Plotnikoff (2010) (147) Canada Follow up to Plotnikoff (2005)	**Participants:** 1590 **Recruitment:** Large workplaces	**Focus:** PA and diet behaviour, knowledge and attitude **Groups:** a) weekly combined PA and diet emails for 12 weeks. b) received email content in	**Format**: Email **Frequency**: Weekly **Interactivity:** Combined PA and diet information, **Theory:** SCT, TTM, TPB & Protection motivation theory	**Primary:** met.min.wk **Instrument:** Modified Godin	**6 months:** No significant differences in PA between groups.	**Power:** No mention **ITT**: No **Randomisation:** As per original **Statistical tool:** ANOVA

		bulk at the end of the 12 weeks **Offline components:** None **Other behaviours targeted**: Diet **Duration**: 12 weeks **Follow-up:** 6 months				
Poirier (2016) (128) United States	**Participants**: 265 **Participation Rate:** 77.7% utilised program at least once **Attrition Rate**: 18% **Recruitment:** Health care company	**Focus:** Walking **Groups:** a) walkadoo internet program that delivers step goals via emails or texts, paired with an activity tracker b) no treatment **Offline components:** Activity tracker, optional text messages **Duration:** 6 weeks **Follow-up:** 6 weeks	**Format:** Website **Frequency:** On demand **Interactivity:** reports form activity tracker, virtual awards, social community, automated goal setting **Theory:** No mention **Format:** Email **Frequency:** Daily **Interactivity:** Adaptive daily step goals tailored from recent activity level. **Theory:** No mention	**Primary:** Steps per day **Instrument:** Pebble+ wireless accelerometer	**6 weeks:** Improvement in steps per day in intervention group. Significant in comparison to control (P=<0.001)	**Power:** No mention **ITT**: No **Randomisation:** 1:1 ratio, computer based **Statistical tool:** Two-tailed independent T-test
Pressler (2010) (137) Germany	**Participants:** 140 sedentary (self-report ≤1x week), mean BMI 29.0 kg/m^2 with ≥2 metabolic risk factors. 11% female	**Focus:** Physical activity outcomes **Groups:** a) structured exercise program b) unstructured exercise program	**Format:** Website **Frequency:** On demand **Interactivity:** Intervention group received structured	**Primary:** Weight adjusted performance at lactate anaerobic threshold **Instrument:** P_{AT}/kg **Validated:** Yes	**12 weeks:** Sig improvements in both groups for P_{AT}/kg. No between group differences.	**Power:** Not met **ITT**: No **Randomisation:** 3:2 ratio towards intervention

	Attrition Rate: 40% Intervention, 52% control **Recruitment:** Automobile company	**Offline components:** Reduced price membership at local fitness centre **Duration**: 12 weeks **Follow-up**: 12 weeks	exercise plan via calendar function, with choice of activity and tailored intensities. Weekly goal progressed towards 1500 Met.min.wk. Control only had calendar function with no planned workouts or goal setting. **Theory:** No mention	**Secondary:** Daily step average **Instrument:** Pedometer plus	No differences for daily steps.	**Statistical tool:** Independent samples t-test
Puig-Ribera (2015) (133) Spain	**Participants**: 264 **Recruitment:** Six Spanish university campuses	**Focus:** Sitting time, PA **Groups:** a) W@WS group, automated website to reduce sitting and increase incidental PA b) maintained normal behaviour **Offline components:** Pedometer with paper diary. **Duration**: 19 weeks **Follow-up:** 8 weeks, 19 weeks, 2 months	**Format:** Website **Frequency**: On demand **Interactivity:** logging of daily step counts, social environment, goal setting every two weeks, educational information, suggesting strategies to overcome barriers. **Theory:** No mention **Format**: Email **Frequency:** weekly (weeks 9-12, fortnightly (weeks 13-15) **Interactivity:** encouraging increases in daily steps and to reduce sitting time **Theory:** No mention	**Primary:** Daily step count **Instrument:** Pedometer (yamax-200) **Secondary:** Daily sitting time **Instrument:** Paper log diary	**21 weeks:** Significant group x phase interaction found for daily step count (P=0.0013), and occupational sitting time (P=0.046)	**Power:** No mention **ITT:** No **Randomisation:** Randomised by worksite, participants blinded to other groups **Statistical tool:** Linear mixed model
Reijonsaari (2012) (143)	**Participants:** 521, 70% reaching 600 Met.min.wk	**Focus**: PA	**Format**: Website	**Primary:** met.min.wk	**12 months:** No significant difference in PA	**Power:** Not met

Finland	**Participation Rate:** 14%of days logged in first 6 months, 9% in second 6 months. **Attrition Rate:** 34% intervention, 32% control for PA measures **Recruitment:** insurance workers	**Groups:** a) Monitored steps, set goals and viewed website with counselling via web or text message. b) Information leaflet on PA and results on testing. **Offline components:** Pedometer. Normal occupational care continued in both groups. **Other behaviours targeted:** Work productivity, sickness absence **Duration:** 12 months **Follow-up**: 12 months	**Frequency**: On demand **Interactivity:** Logging of PA levels, Display of PA score and previous activity. Goal displayed and could be updated. **Format**: Email **Frequency:** Reminder email when no use of website for 2 weeks	**Instrument:** IPAQ		**ITT:** Yes **Randomisation:** Block in groups of ten, computer –generated. **Statistical tool**: ANCOVA
Robroek (2012) (151) The Netherlands	**Participants:** 924 **Attrition Rate:** 42% for intervention, 37% control **Recruitment:** Health care organisation, commercial services & government executive.	**Focus:** Cost effectiveness, PA & Nutrition **Groups:** a) Website with monthly emails b) standard workplace health programs **Offline components:** Information leaflet on **Other behaviours targeted**: General health **Duration**: 2 years **Follow-up:** 2 years	**Format:** Website **Frequency**: On demand **Interactivity:** Extensive computer tailored information on self-reported PA and nutrition, monitoring of diet, PA and weight, assessment of fat intake with feedback and option to ask questions to health professionals. **Theory:** No mention, but tailored	**Primary:** Percentage of participants who reached PA of ≥30 minutes of moderate to vigorous exercise per day, or ≥20 minutes of vigorous PA per day. **Instrument**: IPAQ **Validated:** Yes	**1 Year:** No significant effect **2 Years:** No significant effect	**Power:** Yes **ITT:** no **Randomisation:** Cluster randomised by worksite **Statistical tool:** Multi-level logistic regression

			Format: Email **Frequency:** Monthly for first 12 months **Interactivity:** Focus on PA and nutrition, encouraging participants to fill out self-monitoring and submit questions. **Theory:** No mention.			
Slootmaker (2009) (141) The Netherlands	**Participants:** 102**,** inactive 50% of a larger invited sample. **Participation Rate:** Average of 10 logins during 3 month period. **Attrition Rate:** 6% intervention, 2% control **Recruitment:** Office workers	**Focus**: PA **Groups:** a) Web based tailored PA advice with uploading of activity score from activity monitor b) Print brochure with general PA recommendations **Offline components:** Physical activity monitor **Duration**: 3 months **Follow-up**: 8 months	**Format:** Website **Frequency**: On demand **Interactivity:** Uploading of PA score from activity monitor, development of 3-month goal, tailored advice and motivation. **Theory:** No mention	**Primary:** met.min.wk **Instrument:** AQuAA (activity questionnaire for adolescents and adults) **Secondary:** Predicted v02 max **Instrument:** Chester step test	**3 months:** No significant difference in PA levels or V02 **8 months:** No significant difference in PA levels or V02	**Power:** Not met **ITT**: Yes **Randomisation:** Sealed envelopes **Statistical tool:** Independent samples T-test
Spitaels (2007) (136) Belgium	**Participants**: 526 **Attrition Rate**: 28.90% **Recruitment:** Office workers	**Focus**: PA **Groups:** a) Tailored advice website and reinforcement emails b) Tailored advice website c) non-tailored standard PA advice website **Duration:** 6 months	**Format:** Website **Frequency**: On demand **Interactivity:** Tailored advice based on PA and psychosocial determinants questionnaire, targeted to stage of change.	**Primary:** Min.wk **Instrument**: IPAQ	**6 month:** All groups reported significant increase in PA	**Power:** No mention **ITT**: Yes **Randomisation:** no mention of method **Statistical tool**: ANOVA

		Follow-up: 6 months	**Theory**: TPB **Format**: Email **Frequency:** 5 emails over 8 weeks **Interactivity:** Tailored link to website information, based on SOC information. **Theory:** SOC			
Sternfeld (2009)(125) United States	**Participants:** 787, 78% had a BMI of ≥25 kg/m^2 **Attrition Rate:** 34% intervention, 28% control **Recruitment:** Health care workers	**Focus:** Diet & PA **Groups:** a) ALIVE tailored email messages b) received only feedback from testing **Duration**: 16 weeks **Follow-up:** 32 weeks	**Format:** Email **Frequency:** Weekly for 2 months, fortnightly for 2 months. Reminder messages sent between each of the intervention emails. **Interactivity:** Three path email intervention with choice of path for participants of PA, Fats/sugars, or Fruit/vegetable information. Tailored to lifestyle and includes small step goals. **Theory:** No mention **Format**: Website **Frequency:** On demand, linked from email.	**Primary:** Various intensities (min.wk) and total activity (met.min.wk) **Instrument:** IPAQ	**16 weeks:** Significant positive results in total activity (MET.min.wk) (P=0.004), moderate PA (P=0.0002), vigorous PA (P=0.03), walking (P=0.003) and sedentary behaviour (P=0.05) **32 weeks:** Continuing positive result in total activity (MET.min.wk) (P=0.04), moderate PA (P=0.002) and walking (P=0.0002)	**Power:** No mention **ITT**: Yes **Randomisation:** No mention of method **Statistical tool:** Mixed effect multiple linear models

			Interactivity: Modules of information based on achieving the goals. Participants not restricted and can view all modules. Also includes discussion board, progress tracking, barrier review and links to additional information. **Theory:** No mention.			
Suggs (2013) (134)	**Participants**: 331 **Recruitment:** university and college staff	**Focus:** PA **Groups:** a) Email only b) email + SMS **Duration**: 12 weeks **Follow-up**: 16 weeks	**Format**: Email **Frequency:** weekly **Interactivity:** Specific theory construct to motivate an increase in PA **Theory:** TPB **Format:** SMS **Frequency:** Twice weekly **Interactivity:** Reinforcing email message	**Primary:** MET.h/week **Instrument:** IPAQ	**12 weeks & 16 weeks:** No improvement in PA. Sig decrease in PA for Email + SMS (P=<0.05)	**Power:** No mention **ITT:** No **Randomisation**: Computer **Statistical tool:** Latent growth model
Tate (2001) (126)	**Participants:** 91 with BMI 25-36 **Attrition Rate:** 26.4% Website + therapy + email, 23% website only. **Recruitment:** Hospital employees	**Focus:** Weight loss **Groups:** a) Website & email with behavioural therapy & tracking b) Website only **Offline components:** 1 hr **face-to-face** info session	**Format**: Website **Frequency:** On demand **Interactivity:** General information related to weight loss, directory of related links on PA, diet,	**Primary:** Weekly kcal expenditure **Instrument:** Self report format of Paffenbarger activity questionnaire.	**3 & 6 months:** Significant time effect (P=<0.03). No group x time effect.	**Power:** Not met **ITT**: No **Randomisation:** No mention of method **Statistical tool**: ANOVA

		with nutritional information. **Other behaviors targeted**: PA & diet **Duration:** 6 months **Follow-up:** 3 month and 6 month.	self-monitoring etc. Diet and exercise tracking. **Theory:** No mention **Format:** Email **Frequency**: Weekly **Interactivity:** Behavioral lesson on weight loss, self-regulation and individualised feedback from therapist. **Theory:** No mention			
Van Wier (2009) (148) The Netherlands 2 year follow up from Van Wier (2011) (149) The Netherlands	**Participants:** 1386 with BMI ≥25 kg/m^2 **Attrition Rate:** 43% phone, 46% internet, 52% control **Recruitment:** Service industry employees	**Focus:** Weight management **Groups:** a) Phone counselling with printed material b) website with online material and email counselling c) Printed material with no counselling **Offline components:** Pedometer **Other behaviours targeted**: Diet & PA **Duration**: 6 months **Follow-up:** 6 months (2009, 2 years (2011)	**Format**: Website **Frequency:** On demand **Interactivity:** Individualised web page from data entered in modules. Homework with each module **Theory:** Behaviour therapy **Format:** Email **Frequency:** On completion of each module (scheduled every 2 weeks) **Interactivity:** Counsellor comments on homework specific to module.	**Primary:** MET.min.wk **Instrument**: SQUASH	**6 months:** No significant difference between control and internet group for PA. Phone group significantly improved (P=<0.001) **2 years:** No significant difference between groups for PA.	**Power:** Not met **ITT:** Yes **Randomisation:** concealed allocation with permuted blocks to ensure equal distribution in each company. **Statistical tool:** Multiple linear and logistic regression.

Table 2.3 Results of included studies.

Author	Date	Outcome	Group	Baseline $\bar{x}$	Post $\bar{x}$	Change Score	p value	SMD w Hedges
Attasalo	2012	Total Walking (weekly minutes)	Intervention	370	457	87	ns	0.312
			Control	400	431	31		
Almeida	2015	Total minutes of vigorous PA	Intervention	17.88	26.06	8.18	ns	0.037
			Control	19.1	24.85	5.75		
		Total minutes of Moderate PA	Intervention	45.05	67.6	22.55	ns	0.038
			Control	45.75	63.79	18.04		
Anderson	2013	mL/min/kg	Email	Not reported		2.32	<.001	Insufficient data
			Control			.86		
		Low intensity leisure time PA hrs.wk	Email			-0.15	0.98	Insufficient data
			Control			-0.15		
		Moderate Intensity leisure time PA hrs.wk	Email			0	0.89	Insufficient data
			Control			0.03		
		Vigorous Intensity leisure time PA hrs.wk	Email			0.1	0.31	Insufficient data
			Control			-0.04		
Bennett	2011	Leisure time (Godin)	Intervention	40.67	51.85	11.18	0.07	0.310*
			Control	41.47	43.78	2.31		
Chen	2013	Adapted Health behavior scale (exercise)	Intervention	11.7	14.4	2.7	0.03	Insufficient data
			Control	11	11.1	0.1		
Carr	2013	Minutes of daily sedentary time	Intervention	584.9	526.1	-58.8	0.01	-0.794
			Control	544.2	599.7	55.5		
		Minutes of light PA per day	Intervention	263.9	270.3	6.4	0.64	0.113
			Control	265.7	262.2	-3.5		
		Minutes of moderate PA per day	Intervention	14.5	23.3	8.8	0.13	0.220
			Control	18.6	17.4	-1.2		
		Minutes of vigorous PA per day	Intervention	2.7	4.9	2.2	0.33	0.393
			Control	1.2	1.5	0.3		
Compernolle	2015	Pedometer based steps per day	Intervention	8759.98	9235.48	475.5	.004	0.281
			Control	8627.69	8101.77	-525.92		
		Self-report sitting time	Intervention	512.11	511.20	-0.91	.95	0.261
			Control	460.91	464.73	3.82		
		Self-report walking	Intervention	14.49	37.05	22.56	.14	-0.059
			Control	26.17	42.37	16.2		

		Self-report moderate PA	Intervention	23.30	25.59	2.29	.08	0.342
			Control	24.94	15.43	-9.51		
		Self-report Vigorous PA	Intervention	10.64	9.13	-1.51	.52	0.163
			Control	9.76	6.78	-2.98		
		Self-report Total PA	Intervention	49.00	73.68	24.68	.16	0.209
			Control	56.11	55.47	-0.64		
Cook	2007	Godin Leisure time score	Intervention	46.55	57.35	10.8	ns	0.121
			Control	42.81	46.53	3.72		
		Godin Sweat score	Intervention	2.08	1.91	-0.17	ns	-0.044
			Control	2.17	1.94	-0.23		
Cook	2015	Godin Strenuous exercise	Intervention	Not Reported			.61	Insufficient data
			Control					
		Godin Moderate exercise	Intervention				.06	Insufficient data
			Control					
		Godin Mild exercise	Intervention				.01	Insufficient data
			Control					
		Godin Sweat	Intervention				.33	Insufficient data
			Control					
		Godin Overall	Intervention				.08	Insufficient data
			Control					
Deitz	2014	Total Exercise	Intervention	45.36	48.15	2.79	0.016	Insufficient data
			Control	42.45	38.3	-4.15		
		Mild Exercise	Intervention	4.23	4.57	0.34	0.377	Insufficient data
			Control	4.86	5.27	0.41		
		Moderate Exercise	Intervention	3.15	3.24	0.09	0.262	Insufficient data
			Control	3.29	3.84	0.55		
		Strenuous Exercise	Intervention	1.85	1.96	0.11	0.004	Insufficient data
			Control	1.26	1.1	-0.16		
Dekkers	2011	V02max.ml.kg.min	Internet	36.3	39.1	2.8	ns	0.018
			Phone	37.6	38.7	1.1	ns	
			Control	38.9	39.2	0.3	ns	
Hager	2002	Seven day exercise recall kcal/day	Action	2756.11	2860.50	104.39	.28	0.262
			Staged	2824.14	2831.86	7.72		
			Control	2991.06	3027.46	36.4		
		Occupational activity	Action	8.46	9.17	0.71	.16	0.284

			Staged	7.88	8.13	0.25		
			Control	8.56	9.11	0.55		
		Leisure time activity	Action	6.48	7.04	0.56	.97	0.093
			Staged	6.80	7.23	0.43		
			Control	7.13	7.5	0.37		
Hughes	2011	Moderate minutes of PA per week	Realage	Not Reported			.928	Insufficient data
			Control					
		Vigorous minutes of PA per week	Realage				.472	Insufficient data
			Control					
Irvine	2011	CESS (Current exercise status scale)	Intervention	2.05	3.27	1.22	<0.001	0.912
			Control	2.18	2.42	0.24		
		Minutes PA/ day (7 point scale)	Intervention	2.67	4.78	2.11	<0.001	0.878
			Control	2.96	3.21	0.25		
Marshall	2003	Total weekly PA	Print	2413	2518	105	0.52	0.040
			Web	2425	2433	8		
Maruyama	2010	Weekly walking steps	Intervention	9834	10279	445	0.16	Insufficient data
			Control	8974	8770	-204		
Morgan	2011	Total Met minutes	Intervention	Not Reported		0.4	0.03	0.765
			Control			0.1		
		Current PA Level	Intervention			0.4	<0.001	0.743
			Control			-0.2		
		Workday PA	Intervention			0.8	0.18	0.377
			Control			0.4		
Napolitano	2003	Moderate minutes of PA per day	Intervention	68.79	112	43.21	<0.05	0.357
			Control	80.86	82	1.14		
		Walking minutes per day	Intervention	57.24	99.75	42.51	<0.001	0.392
			Control	87.57	68.39	-19.18		
Plotnikoff	2005	Weekly MET.min	Intervention	664.05	683.68	19.63	<0.01	0.132
			Control	668.56	592.66	-75.9		
Plotnikoff	2010	Weekly MET.min	Intervention	719.9	771.0	51.1	ns	0.029
			Control	619.2	749.1	129.9		
Poirier	2016	Steps per day	Intervention	5102	5411	309	<0.001	0.319
			Control	5412	4751	-661		
Pressler	2010	Steps per day	Intervention	7181	8757	1576	ns	0.391
			Control	6947	6836	-111		

Puig-Ribera	2015	Steps per day	Intervention	8862	9786	924	0.0013	0.102
			Control	9920	9427	-493		
Reijonsaari	2012	MET.min/week	Intervention	2083	2047	-36	ns	-0.170
			Control	2258	2338	80		
Robroek	2012	% reaching sufficient moderate to vigorous PA	Intervention	67	73	6	ns	Insufficient data
			Control	68	73	5		
		% reaching sufficient vigorous PA	Intervention	31	27	-4	ns	Insufficient data
			Control	28	35	7		
Slootmaker	2009	$V0_2$max mL/kg/min	Intervention	41.7	Not reported		ns	Insufficient data
			Control	41.2				
		Median Light MET.min.wk	Intervention	630	636	6	ns	Insufficient data
			Control	720	678	-42		
		Median Moderate MET.min.wk	Intervention	90	75	-15	ns	Insufficient data
			Control	120	90	-30		
		Median Vigorous MET.min.wk	Intervention	17	80	-90	ns	Insufficient data
			Control	120	113	-7		
		Median Moderate to Vigorous MET.min.wk	Intervention	320	197	-123	ns	Insufficient data
			Control	240	281	41		
Spitaels	2007	Total PA min.wk	Email	696	776	80	ns	0.129
			Tailored	640	682	42		
			Standard	622	708	86		
		Moderate to Vigorous PA min.wk	Email	438	479	41	ns	0.136
			Tailored	362	397	35		
			Standard	376	428	52		
		Vigorous PA min.wk	Email	155	134	-21	ns	0.194
			Tailored	134	111	-23		
			Standard	122	128	6		
Sternfeld	2009	Median Total PA MET.min.wk	Intervention	1915	Not reported		0.04	Insufficient data
			Control	1575				
		Median Moderate PA MET.min.wk	Intervention	195			0.002	Insufficient data
			Control	161				
		Median Vigorous PA MET.min.wk	Intervention	53			0.26	Insufficient data
			Control	45				
		Median Walking min.wk	Intervention	75			0.0002	Insufficient data
			Control	75				

Suggs	2006	Total PA Met.Hrs.wk	Email	53.4	48.4	-5	ns	-0.022
			Email+ SMS	59.5	48.8	-10.7		
		Workplace PA Met.Hrs.wk	Email	5.4	6.3	0.9	<0.05	0.163
			Email+ SMS	8	5	-3		
		Leisure time PA Met.Hrs.wk	Email	17.9	19.8	1.9	ns	0.121
			Email+ SMS	16.1	17.5	1.4		
Tate	2001	Kcal/week expenditure from PA	Education	1031	1125	94	ns	-0.143
			Behavior	1360	1289	-71		
Van Wier	2009	Median Total PA MET.min.wk	Phone	5895	6875	980	Phone <0.005, Internet ns	Insufficient data
			Internet	6060	7080	1020		
			Control	6114	5940	-174		
Van Wier	2011	Median Total PA MET.min.wk	Phone	5912	7470	1558	ns	Insufficient data
			Internet	6060	7613	1553		
			Control	6184	7200	1016		

3 Extended Methodology

3.1 Aim

The Aim of REVUP was to assess the effectiveness of an online delivered, workplace health program on improving cardiovascular risk factors. REVUP was the first study to deliver a DPP style intervention entirely via online means to an Australian workplace. The successful delivery of the program has the potential to reduce costs, increase efficiency, sustainability and accessibility of workplace health programs, particularly for organisations with remote and dispersed locations. These potential benefits may help to inform workplace health choices for businesses in the future, particularly in remote areas, or businesses with dispersed employees.

3.2 Study design

The REVUP study was a single-blind, 24-week, randomized controlled trial, Utilising computer randomisation, blind outcome assessors and multiple objective outcome measures. The study was run from the University of Sydney, Lidcome campus. Trial data was stored in locked filing cabinets on campus. The trial ran from August 2014 to July 2016, ceasing due to expenditure of funds, and submission deadlines.

3.3 Inclusion and exclusion criteria

Targeted participants were aged between 18 and 80 years and engaged in employment or with the Uniting Church of Australia (UCA). Participants were required to be willing and able to travel for multiple testing sessions at the University of Sydney, Lidcombe campus. Subjects were required to be able to walk unaided and have no unstable medical conditions such as

hyperglycaemia, uncontrolled arrhythmias, or any condition that significantly impairs physical activity.

The UCA were approached to be involved with the study as one of Australia's largest employers, with staff working many different capacities and job roles, they present a unique opportunity to trial and expand a workplace health program. UCA also has multiple worksites in a variety of locations, including regional, remote and city-based centres.

3.4 Participants

Sample size estimation was calculated based on a projected change in physical activity (minutes per week) in the intervention group for a total effect size of 0.88. This is based on previously published research with an education based online intervention that is similar in method to REVUP (139). Two-tailed, a-priori power calculations with an alpha of 0.05 and beta set at 0.20 calculated an actual power of 0.68 for a total sample of 32 (16 in in each group) using G-Power software (158).

Based on this target, recruitment was aimed at involving 40 participants, to allow for attrition.

Recruitment was open from August 2014 to July 2016. Organisation wide emails were sent by staff at The Uniting Church offering general information about the study and an email address and contact number for more information.

3.4.1 Telephone screening.

Telephone screening was used to assess interested individuals for eligibility. Screening took approximately 20 minutes, involving a detailed explanation of the study aims, design and implementation, as well as a series of questions on health conditions, injuries, medicine usage and questions on ability to participate in the study. A copy of the screen is available in

[appendix 2]. After screening, forms were reviewed by the researchers, and all potential subjects were informed of their eligibility. An information package was sent to the eligible subjects including information related to the testing venue, and a brief outline of the assessments procedure. In order to obtain medical clearance for each participant, a standard letter was mailed to their nominated practitioner with a participant signed note indicating the doctor may release any relevant medical information to the researchers.

A total of 36 individuals expressed interest in the study with 30 individuals completing the telephone screen, with 29 being found eligible. 19 completed the baseline testing, with 19 randomised. Initial screening was done by NS and TW.

3.4.2 Randomisation and blinding.

Participants were randomized into an intervention or a control group following completion of baseline assessments. Randomization was performed by a researcher (JF) who was not involved in testing of participants or delivery of the intervention, using computer-generated randomly permuted blocks of ten, stratified by age (18-39; 40+). Stratification was done as it was believed a significant portion of the participants would be older than 40. Participants were informed of their group allocation by phone call and email from the researcher (TW).

REVUP was a single blinded study, with randomisation done by a blinded researcher after the participant had completed their first assessment section. The primary researcher (TW) conducted the initial assessment and delivered the intervention components. A third, independent and blinded to allocation researcher completed the follow-up assessments.

3.4.3 Informed Consent.

Subjects were given a participant information statement and an informed consent form (appendix 3) at their first visit at the University of Sydney, Lidcombe campus. They were guided through all aspects of the information statement in person with a researcher, and their questions answered to their satisfaction. Those subjects who agreed to participate in the study were asked to sign the consent form per guidelines of the Sydney South West Area Health Service and the University of Sydney Human Research Ethics Committees.

3.5 Baseline assessment.

Initial testing was split over two days, to allow for repeated measures to be made, and for adequate data collection from the ActiGraph monitors. Figure 3.1 displays the testing order. The first assessment consisted of fasted blood draw for measures of C-reactive protein (CRP), cholesterol (low and high density lipoproteins), serum glucose, and serum insulin levels. Fasting was required for 10-12 hours prior to the test, which was confirmed by the researcher. While fasted, bioelectrical impedance, body mass, resting heart rate and supine blood pressure was also measured. Following these measures breakfast was available for the participants, after which the rest of the testing was completed. Physical measures of gait speed, handgrip strength, static balance, five repetition sit to stand, stair climb power, one repetition max on leg press and chest press and six-minute walk tests were competed. ActiGraph physical activity monitors and logbooks were then given to each participant.

The second assessment was completed at least eight days later, and included collection of the ActiGraphs and logs, and retesting of the six-minute walk test, and one repetition max tests. Questionnaires on demographics, nutrition, self-reported exercise, depression, anxiety and stress were also collected.

Each test is outlined in detail in section 3.10 below.

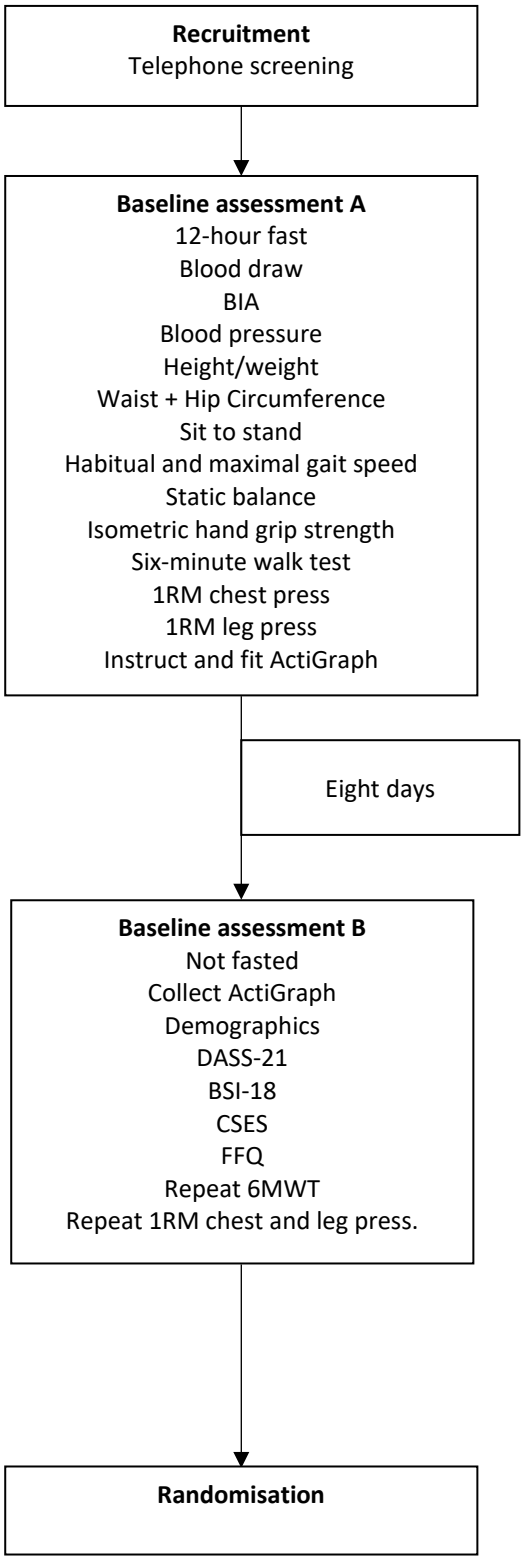

Figure 3.1: Testing flowchart

3.6 Intervention

The participants randomised to the intervention group received links to online educational material each week via email. Topics covered included strategies for increasing physical activity, education on dietary choices to increase fibre and reduce fat, how to keep track of activities, and how to overcome barriers to exercise (See Table 1). Educational sessions were planned to take approximately 20 minutes each week to review, and included a newsletter with information, an activity to complete each week relating to the content of the newsletter, and a short ten-minute video relating the week's topic. Participants were provided with weekly follow-up via email where the researcher reviewed the previous week's activity, offered support and encouragement, and offered advice on how to overcome any barriers or set-backs. This researcher was also able to answer any other questions that the participant had.

Detailed information on the development of the intervention components is available in section 3.7 below.

3.6.1 Control group

The participants randomised to the control groupreceived standard written advice on nutrition and exercise. Nutrition advice was presented in a brochure titled "Healthy eating for adults – Eat for health and wellbeing" (159). This described the Australian Dietary guidelines in a simple and easy to follow brochure, with tips on choosing nutritious foods and drinks, making discretionary choices and appropriate serving size. Additionally, it contained links to the eat for health website (www.eatforhealth.gov.au) (160) for individuals to seek more information.

Similarly, exercise information was delivered via a Department of Health brochure titled “Is your family missing out on the benefits of being active every day?” (161). This brochure presented the Australian physical activity guidelines for each age group, as well as additional information on limiting sedentary behaviour, reducing screen time, and strength training. Links to websites containing further information is also presented.

These resources were chosen as the control information as they are already readily available to the general Australian public. Additionally, they present the same nutritional and PA guidelines that REVUP expands upon.

After the 12-week assessment, participants received the intervention as outlined above for a further 12 weeks.

3.7 Development of the REVUP Intervention

The REVUP intervention consisted of twelve weeks of bi-weekly emails delivered on the Monday and Thursday of each week. The first email of the week consisted of a short message outlining the topic, an attached PDF document with a 3-5 page 'newsletter' and a hyperlink to a video presentation. The follow-up email, delivered on the Thursday of each week contained a short message asking the participants how they fared with the newsletter activity, and a reminder to feel free to ask questions to the researcher. Each email was short, introducing the topic and reminding the participant to contact the researcher if they needed support. Each component of the intervention will be outlined below.

3.7.1 Newsletter

REVUP involved twelve weekly newsletters covering a range of topics. Topic titles are listed in table 3.1. Newsletters ranged in size from 800 words to 3500 words, presented in full colour with accompanying images and graphics, and sent as a PDF file. Each week was presented an individual topic, and included activities that strived to help the participant to practically apply the information presented. This included questions on overcoming barriers, initiating change, preparing for setbacks and understanding and identifying benefits of making healthy lifestyle decisions.

Print health interventions are a tried and tested delivery modality for health programs (162), and can include brochures, booklets or newsletters. Print modalities present numerus advantages such as physical media in which the client can take with them, relative ease of production with modern word processing, and ease of adaptability in style. There are however, some possible barriers of literacy, language, and cost (particularly if delivered in

large quantities). Additionally, updating information is not possible without a reprint. This may be a significant factor in a fast-changing health landscape. Findings from previous research (163) indicate that personalised or targeted print approaches are more effective as non-personalised approaches. As such, week's one, nine and twelve involved individualised, tailored feedback on exercise habits – presenting current exercise levels compared to the recommended 150-300 minutes per week of moderate intensity physical activity. Complete newsletters are available in appendix 4.

3.7.2 Video content.

The video component of REVUP was created by JF, MB, and TW. Each video presented on the weekly topic and was developed as a narrated PowerPoint presentation, converted to video and uploaded to YouTube. The YouTube links were set to unlisted – meaning they could only be accessed via the direct URL, and were not listed on search engines. Video titles and ULR's are available in table 3.3 below. YouTube was chosen as the delivery platform as it accessible on most devices, has multiple options for video quality, enabling low bandwidth usage, and is free of charge for both uploading and viewing. Streaming the videos from YouTube also overcomes the problem of large size emails that would have been required if the videos were included as attached files, and reduces wait time for the viewer, as they can watch the video as it loads, rather than waiting for a whole discrete file to be downloaded.

Current research into the effectiveness of video interventions on health behaviour change is inconclusive. A comparative analysis of 30 studies (164) found that while multimedia is a promising alternative to print information, they often perform equally. Some specific examples show promise however, with Hill et al (2009) comparing video to a written workbook in educating falls preventions strategies to older hospital patients and concluding

that the video message was more likely to achieve the successful uptake of the falls prevention message (165).

Table 3.1: REVUP Newsletter and video topics.

Week	Newsletter Topic	Video Topic
1	Getting active	Getting active
2	Goal setting	Goal setting
3	Healthy eating – fruits & veges	Fruits and vegetables
4	The glycemic index	The glycemic index
5	Healthy Eating – protein & fat	Healthy cues
6	Overcoming barriers	Problem solving
7	Alcohol and Smoking	Alcohol and Smoking
8	Mental Health	Long term self-management
9	Strengthening your exercise plan	Strengthening your exercise plan
10	Meal planning	Meal planning & eating tips
11	Set -backs and positive thought	Standing up for your health
12	Just the beginning	The slippery slope of lifestyle change

Table 3.2 Video titles and URL's

Week	Title	Hyperlink
1	Getting active	https://youtu.be/rbvCOiKlDOU
2	Goal setting	https://youtu.be/Qzby7YHP39k
3	Fruits and vegetables	https://youtu.be/gaJ_uYoAoTw
4	The glycemic index	https://youtu.be/MPDU6SF7Q1c
5	Healthy cues	https://youtu.be/haHP0Dz0GYE
6	Problem solving	https://youtu.be/wBgw-I5uAnk
7	Alcohol and Smoking	https://youtu.be/9GxhTPJ2peY
8	Long term self-management	https://youtu.be/bRecQ-EZ36o
9	Strengthening your exercise plan	https://youtu.be/-u-ubvXGeUc
10	Meal planning & eating tips	https://youtu.be/pd20w-8Kn7M
11	Standing up for your health	https://youtu.be/gmBRU8YQ3yQ
12	The slippery slope of lifestyle change	https://youtu.be/w6AIcHuEX4M

3.8 Development of the REVUP content.

3.8.1 Background

The REVUP program was not developed in isolation, but built upon successful work of previous researchers, in various domains. One of the most widely recognised successful healthy lifestyle interventions is the Diabetes Prevention Program (DPP). The REVUP trial follows similar principles to the DPP but delivered to a relatively healthy population.

3.8.2 The Diabetes Prevention Program

The DPP was a large, multi-site trial of an intensive lifestyle intervention targeting the prevention of type two diabetes in individuals with impaired glucose tolerance at high risk of developing diabetes (166). The study was a three-arm design, with the lifestyle balance program proving to be effective, achieving a 58% reduction in the incidence of diabetes in comparison to the placebo arm. Standard pharmacological treatment of metformin attained a 31% decrease in comparison to placebo (167).

The 'lifestyle balance program' was developed as a goal based intervention, with key goals of a 7% reduction of bodyweight in the initial six months of the program and maintaining thereafter, and an increase of physical activity to 150 minutes per week of moderate physical activity (or maintenance if that was already achieved). These goals were clearly outlined to the participant and supported by frequent contact with specially trained case managers, who delivered the core-curriculum individually to each participant, and the maintenance information in both individual and group environments. The core-curriculum involved 16 sessions delivered in the first 24 weeks of the program, aiming to educate on nutrition, physical activity, and behavioural self-management. The first eight weeks had a focus on energy intake and expenditure, self-monitoring of diet and exercise. The following eight

weeks concentrated on motivational, psychological and social aspects in sustaining behavioural change. The core-curriculum was delivered in addition to a participant notebook that included worksheets for each of the sessions. Several other resources were given to participants, including a logbook for tracking diet and physical activity, a DPP specific fat counter booklet that indicated the fat and calorie intake of >1500 foods. The final key component to the DPP was a 'toolbox' stepped strategy approach to overcoming barriers that was individualised per participant need. It enabled the application of particular strategies to enhance adherence and contained items such as cookbooks or personal training sessions (166).

3.8.3 Psychological theory

Behavioural change is multifaceted in problem and difficult in application. Across recent time, behavioural change theories have attempted to explain the dynamics that occur in an individual's attempt to change a given behaviour. REVUP, being in nature a behavioural change intervention, is built around key concepts of behavioural change theorem. These include improving self-efficacy for change through education, intention forming, goal setting and reviewing, providing feedback on performance, and focusing on the positives for change.

Many psychological models try to explain human interactions around adopting new behaviours. Inherent to all these models is the same subject – people. As such there is significant overlap amongst the behavioural determinates that the models describe, usually under different names. For example, Social cognitive Theory (SCT) and the Theory of Planned Behaviour both place importance of self-efficacy, outcome expectation and goal setting (168, 169).

3.8.3.1 *Health Belief Model*

The Health Belief Model (HBM) (170) is one of the most widely recognised conceptual models of how individuals approach making decisions about their health behaviours. Four key moderators of behaviour are represented in the model. Firstly, individuals were motivated to adopt healthy strategies for change if they feel susceptible to the negative health outcomes of not changing. Secondly, the greater the severity of the negative outcomes the more likely they are to adopt change, thirdly, the predicted benefits of adopting a healthier behaviour must be strong enough to prevent the negative consequences and lastly, strong barriers may exist that override adopting healthy behaviours, even when the perceived benefit or severity is high. The theory also recognises that there may be 'calls to action'; internal or external cues that can spur an individual to change such as friend adopting a healthy behaviour.

In practical application, however, these four moderators of change may have less effect than previously anticipated. Carpenter (171) conducted a meta-analysis of 18 studies that directly utilised and measured the HBM variables. The reviewed papers addressed various health behaviours including tuberculosis testing, smoking cessation, drug taking, condom use, preventative health screening, and general health program attendance. The strength of the relationship between the HBM variable and the likelihood of adopting the target behaviour was analysed, with susceptibility and severity having no significant relationship with change in behaviour (susceptibility r=0.05, severity r=0.15), and benefits and barriers having only small effect (benefits r=0.27, barriers r=0.30).

Researchers and practitioners therefore, should focus on instructing the benefits of changing behaviour, as opposed to the detriments of continuing in the current unhealthy behaviour. A practical example of this could be with tobacco smoking – educating the individual on the

benefits of cessation such as increased taste, improved sense of smell, and improved oxygen exchange (172). In contrast, a detriment focused approach would be concerned with presenting the increased risk of cancer, lung disorders, and cardiovascular disease that are apparent in smokers.

REVUP therefore focuses on reinforcing the benefits of making positive changes in addressed behaviours.

3.8.3.2 *Social cognitive theory*

Bandura's Social Cognitive theory (SCT) specifies a series of determinants that influence behaviour (169, 173). These can be categorised into knowledge of health risk and benefits, perceived self-efficacy of control over an individual's own health habits, the outcome expectation of the benefits and costs of changing a health habit, the health goals that individual set for themselves (or have set for them), perceived facilitators who can aid in achievement of change, and finally any social or structural impediments that may hinder effective change. Bandura (2004) comments that self-efficacy is the chief determinate as it impacts behaviour both directly in itself, but also by influencing the other determinates (173). Individuals with stronger self-efficacy set higher goals, commit to them more fully, expect more positive outcome and view impediments as challenges to improve.

SCT constructs are utilised extensively in the REVUP study, with application of outcome expectations (benefits of exercise and healthy diet), behavioural capability (small step progression of PA), self-efficacy (barrier identification, self-reflection, and feedback), goal setting, and perceived facilitators to enhance experience (accredited exercise physiologist to answer questions via email).

3.8.3.3 *Transtheroretical model*

The Transtheroretical model (TTM) (174) is primarily a model of motivation stages, and the progression of an individual through these stages. The model proposes that there are five stages of behaviour change. Precontemplation is where the individual does not intend to start a new healthy behaviour and may indeed be unaware of the need to change. Contemplation is he stage at which individual intend to start a healthy behaviour in the near future, and are aware of the pros of changing their behaviour. However, in this stage, the cons may still balance the pros, causing ambivalence to change. Progressing from contemplation to preparation, individuals begin to notify others about their intention to change, and begin to make specific plans to action the health behaviour. Once an individual begins to activity work on the health behaviour, they are categorised into the action phase, and upon maintaining the action for six months they have reached the maintenance phase of the model. The TTM also allows for an individual to regress through the stages, termed relapse. This can occur at any point, and an individual may regress back multiple stages.

While REVUP does not draw upon the stages of change of the TTM, it does utilise other aspects of the model termed processes of change (174). These processes are the activities that an individual can utilise to help them step through the stages. Due to the participants in REVUP volunteering for a healthy lifestyle program, it was hypothesised that most the subjects would be in the preparation or action phase of TTM, and as such the processes of change included should reflect those phases (175). Self-liberation is the belief that one can change and make a commitment to change. This is reflected REVUP through global and specific goal setting. Another process of change is counter conditioning – swapping bad habits for good habits. This is applied in dietary habits, physical activity, and building resistance to

setbacks. Similarly, there is a focus on helping relationships, both through suggesting the inclusion of family and friends in health behaviours, but also in developing rapport with the study instructor. REVUP also seeks to enhance decisional balance. Decisional balance is a component of TTM that is described as the individuals relative weighting of pros and cons. Targeted questions in the newsletters on the individual's personal pros and cons of making a change are designed to raise this internal choice.

3.8.4 Application of psychological theories to REVUP

The table below (TABLE) examines the content areas of REVUP and the specific psychological theories that they draw from. Many aspects are generic to multiple theories.

Table 3.3: Application of psychological theory examples.

Psychological theory	Application to REVUP content
Health belief model	Focus on the benefits of health behaviour change, as opposed to the detriments. Development of internal 'calls to action' through intrinsic goal setting, in addition to external exercise goals from the REVUP program.
Social cognitive theory	Outcome expectations: Benefits of healthy behaviour change every week (exercise, diet, smoking cessation, and alcohol consumption) Behavioural capability: Small step progression of PA, achievable goals.

	Self-Efficacy: Barrier identification, self-reflection, feedback. Goal setting: Intrinsically set goals and generic REVUP exercise program goals. Perceived facilitators: Accredited exercise physiologist to answer questions via email.
Transtheoretical change model	Self-Liberation: It was perceived that most REVUP participants would be in the preparation or action phases of TTM. Self- liberation is similar to self-efficacy in that it is the internal belief of being able to achieve change and stick with it. Self-liberation is fostered through small step goal setting and feedback. Counter-conditioning: Swapping bad habits fro good habits. This was used extensively in REVUP in addressing dietary habits, physical activity, and building resistance to setbacks. Decisional balance: Relative weighting of pros and cons was addressed in the targeted newsletter activities, asking the participants to actively weigh up the pros and cons of behavioural change.

3.8.5 Exercise advice

Exercise information was developed by an accredited exercise physiologist in line with the Australian Government recommendations for physical activity and sedentary behaviour. Participants are encouraged to accumulate 300 minutes of moderate intensity or 150 minutes of vigorous intensity PA per week, or a combination of both. These targets were interpreted in line with progressive overload guidelines, so that for a insfficiently active participant, the target would be achieved by the end of the twelve-week program. Initial advice focused on a volume increase of moderate intensity PA– either as a factor of increased duration, or increased intensity (or a combination of both). Advice delivered recommended that some form of PA should be done on most days, in combination with concerted efforts to improve incidental PA.

150 – 300 minutes per week of moderate intensity exercise has been shown to elicit health benefits in a wide range of populations. It is the standard recommendations of PA in most of the western world, including Australia, United States, Canada and Britain, amongst others (42, 176, 177).These guidelines a have stemmed from a breadth of literature across many years that have highlighted a dose response relationship to (178) the volume of physical activity and the health response (179). Substantial evidence exists that physical activity prevents and treats individual risk factors of CVD, especially those related to atherosclerotic risk such as high blood pressure (36), insulin resistance (37), dyslipidaemia (38), and obesity (29). Inversely, strong evidence exists linking a lack of physical activity with an increased risk of many non-communicable diseases including, all-cause mortality, coronary heart disease, hypertension, cerebrovascular disease, metabolic syndrome, type 2 diabetes, some cancers and depression (33-35).

3.8.6 Nutrition advice

Nutritional advice also followed the Australian Government guidelines from the National Health and Medical Research Council (NHMRC) (63), in combination with a focus of eating low glycaemic index (GI) carbohydrates. Participants were advised to aim for consumption of two serves of fruit, and five serves of vegetables each day, to reduce processed food intake, aim for low GI choices of carbohydrates, and to eat lean protein sources. Reflective of the guidelines, REVUP suggested that participants limit intake of saturated fat, added sugar, and added salt.

The addition of low glycaemic style dietary advice was made as low GI diets have been shown to be effective in reducing weight and cardiovascular risk, in a variety of populations (180-182). Low GI and low GL diets have been shown to be independently associated with reductions in t2dm (GI RR = 1.4, 95% CI: 1.23, 1.59; GL RR = 1.27, 95% CI 1.12, 1.45) and heart disease (GI RR 1.29 95% CI 1.00, 1.56) (183). This is supported by a meta-analysis showing a significant reduction in HBA1c from low GI diets in comparison to high GI diets (184) in diabetic individuals. Three distinct weeks were presented on nutrition in REVUP to reduce the bulk load of information, and to enable incremental steps in dietary change. Dietary logs were available to the participants if they chose to use them.

3.8.7 Alcohol and smoking cessation.

REVUP included information on the recommended dietary intake of alcohol. Australian guidelines from the NHMRC (185) are presented, following the general guidelines of limiting intake to no more than two standards drinks on any day, and drinking no more than four standard drinks in a single occasion. Health detriments of excessive intake are also presented,

with information on how to identify indicators of problematic intake, and strategies to reduce and control alcohol intake.

Alcohol intake in Australia has been identified as a significant impactor of health (186). Consumption of alcohol contributes to 2.3% of Australia's total disability adjusted life years (DALYS), including 18.1% of injury related DALYS and 9.7% of mental disorder DALYS.

Tobacco smoking is a strong and independent risk factor for CVD (1, 4, 43, 44). The risk associated with smoking has dose-response relationship, however, even light and intermittent smoking has harmful effects (45). Independently, tobacco is attributed to 13.4% of Australia's cancers (187). REVUP mirrors current Australian standards of smoking cessation (188). Demographic health information on tobacco smoking is presented, with the focus on the benefits of quitting. This included both long and short-term benefits. Resources for more information were presented with advice to contact general practitioners, the Quitline and associated Quitnow webpage (189), and associated mobile phone applications.

3.8.8 Mental health information

Two main areas of mental health were addressed in week eight of REVUP, with a focus on depression and anxiety. Anxiety disorders are the most common mental health concern in Australia, with affective disorders such as depression being the second most prevalent (190). Information presented included prevalence amongst the Australian population, common signs and symptoms, and resources on finding further information and help such as the beyondblue website. Additionally, a DASS-21 was provided with the newsletter, for the participants to fill out and self-monitor. This questionnaire was not collected by the researchers. The purpose of the information in this week of content was not to try and assist in controlling and improving mental health directly – that is beyond the scope of this

intervention, but to raise awareness of the common presentations of depression and anxiety and offer some avenues for gaining assistance.

3.9 Intervention topics

3.9.1 Week 0 – Welcome to the REVUP study.

This newsletter is sent to participants upon randomisation into intervention. It contained some brief information on the study, and a how to exercise safety guide.

3.9.2 Week 1 – Getting active.

The first week of REVUP introduces the 150 to 300 minutes per week of moderate physical activity goals, and how to plan and begin physical activity. A graphical representation of the participants self-reported level of physical activity (based on the Godin measure performed in the baseline assessment) vs the 300 minutes per week goal was also included. Eight questions based on preparing the participant for activity were included, with questions such as “Are there activities that I did in the past that I can take up again?” The video podcast guided participants through the PA guidelines, and stepped them through beginning physical activity task.

3.9.3 Week 2 – Goal setting.

Week two focuses on the importance of effective goal setting, including using specific, measurable, achievable, rewarding, and time oriented goals, process goals, and results focused goals. The activity focused on developing short term goals to build towards the 150 or 300 minutes per week goal. The video podcast offered some more examples and tips on setting physical activity goals.

3.9.4 Week 3 – Healthy eating, fruits and vegetables

The first of four diet related topics, focusing on adequate intake of fruit and vegetables, aiming towards the two servings of fruit and five servings of vegetables per day goal. Various benefits of adequate fruit and vegetable intake presented. An intake checklist was provided. Video focused on the benefits of adequate intake of fruits and vegetables and setting a fruit and vegetable intake goal.

3.9.5 Week 4 – The glycaemic index.

The second of the nutrition related weeks introduces the glycaemic index, carbohydrate serving size, and the traffic light glycaemic index list. The activity is about replacing high GI foods with lower GI alternatives, and tracking the serves of fruits, vegetables, and low GI carbohydrates. The video message reinforces the glycaemic index, and provides a walkthrough of the activity.

3.9.6 Week 5 – Healthy eating: protein and fats.

Week five presents information on servings sizes of lean meats and dairy based foods. It delivers advice on swapping saturated fat heavy foods with unsaturated alternatives. The activity applies this by tracking lean meat serves, and reducing saturated fat intake with questions relating to swapping ‘bad’ fat foods for ‘healthier’ fat options. A serves checklist is provided. The video message is about stimulus control, embracing healthy cues, avoiding unhealthy triggers, and swapping unhealthy habits for healthier alternatives.

3.9.7 Week 6 – Overcoming barriers.

Week six provides information on overcoming barriers to physical activity, and presents some simple solutions to common barriers, turning inactive activities into active ones, reducing sedentary time and increasing incidental exercise. The video focuses on problem solving,

identifying behaviour chains that lead to unhealthy activities and applying problem solving to break unhealthy behaviour chains.

3.9.8 Week 7 – Alcohol and smoking

Both the video and newsletter present information about alcohol intake, detriments of excessive intake and the link between alcohol intake and risk factors for disease. NHMRC guidelines (185) for alcohol intake and some strategies to reduce intake are offered, with links to further help if required. Information on the health detriments of smoking, and the short and long-term benefits of quitting are presented. Links to government resources on quitting smoking are provided.

3.9.9 Week 8 – Mental health.

Week eight of the REVUP program provides information on depression and anxiety, including prevalence, signs, and symptoms. A DASS-21 was provided for the participants to self-administer and score with links to depression and anxiety resources listed. Video concentrated on developing self-management skills, with advice on how to self-monitor health behaviours and adjust goals as needed.

3.9.10 Week 9 – Strengthening your exercise program.

This week revisits the initial 300 minutes per week goal for PA and provides further positive benefits from being active. It also includes an individualised, updated graph of the participants current physical activity levels in relation to the 300 minutes per week goal. A revision of the fruit and vegetable intake targets is also presented. The video informs on ways to further enhance physical activity levels, with advice on resistance training, and information on the benefits of vigorous exercise.

3.9.11 Week 10 – Meal planning.

Both the newsletter and video outline five steps to healthy eating, smart shopping, planning food preparation, and reading nutritional food labels. Some information on adapting recipes to improve the nutritional content is also listed. The activity focuses on identifying the participant's perceived benefits of healthy eating. A small meal planning calendar template was attached.

3.9.12 Week 11 – Set-backs and positive thought.

Week 11 video content emphasises reducing sitting and sedentary time with an attached sitting time chart for participants to analyse their siting time behaviours. The newsletter identifies common set-backs and self-defeating thoughts and provides examples on how to overcome and combat self-defeating thoughts with positive thinking and mindfulness.

3.9.13 Week 12 – Just the beginning

The final newsletter congratulates the participant on reaching the final week, and revisits the original physical activity goal with a personalised goal chart. Participants are asked to reflect on any progress made since the beginning of the study. The final video is on recovering from slips in healthy behaviour, identifying triggers and preventing further set-backs.

3.10 Outcome measures.

All outcomes were blindly assessed at baseline, as assessment were conducted prior to randomization. Follow-up assessments at 3 months were conducted by a blinded outcome assessor. A participant flow chart is presented at figure 3.1

3.10.1 Physical activity.

The ActiGraph GT3x (ActiGraph, LCC, Pensacola, FL) was used to measure PA (minutes of light, moderate, vigorous and very vigorous PA, mean minutes of moderate to vigorous PA), step count, sedentary time and energy expenditure. It measures acceleration in vertical, antero-posterior and medio-lateral planes. Activity counts are calculated using a combined vector magnitude of all three axes, calculated in small chunks (epochs) of time post filtering. ActiGraphs were set to record in a resolution of 10 second epochs.

Each ActiGraph was worn on the non-dominant side hip during awake hours, in line with the anterior superior iliac spine for eight consecutive days. Participants were requested to keep a log of wear time (such as removing for swimming, showering and bed) to enable accurate analysis.

Validation of wear time was done using the automatic algorithm formula developed by Choi 2011 (191) utilising zero-count thresholds for non-wear time within a 90 minute window. This was then be manually checked against the wear time logs recorded by the participant. Energy expenditure was also be calculated using cut-point method (192). Cut point values are displayed in table 3.3.

Table 3.4: ActiGraph PA Cut-point values.

Activity intensity	Cut-point values
Light	0 to 2689
Moderate	2690 to 6166
Vigorous	6167 to 9642
Very vigorous	9643 and above

3.10.2 Godin-Shephard Leisure-Time Activity Questionnaire

Additional to objective measures of physical activity, self-reported physical activity were recorded through the Godin-Shephard Leisure-Time Activity Questionnaire (GSLTPAQ) (193). This is a widely utilised subjective measure of leisure time physical activity (LTPA) that considers exercise done in free time in a typical seven-day period. The questionnaire consists of four questions, the first three asking for the frequency of bouts greater than 15 minutes in three categories (mild, moderate, and strenuous). The fourth question asks for the number of times the participant engaged in LTPA long enough to work up a sweat. Participants then answer subjectively selecting from one of three categories: often, sometimes or never/rarely (193).

LTPA is distinctly measured apart from total PA as it is more likely to be volitional and performed at a higher intensity (194, 195). Higher intensity PA may provide greater health and fitness benefits.

Interpretation of the information gathered from the Godin-Shephard LTPA questionnaire can be done in multiple ways (194);

Firstly, multiplication of the number of bouts exceeding 15 minutes in each category by the appropriate multiplier of metabolic equivalents (3,5 & 9 for mild, moderate, and strenuous), giving a total score in arbitrary units (termed the leisure score index). Alternativity, multiplication of the reported minutes in each category by the frequency, giving self-reported minutes of LTPA per week for mild, moderate and vigorous LTPA. This was the recording method chosen for REVUP. Finally, threshold cut-offs using either of the above methods to categorise participants as either physically active or inactive.

The leisure score index has been validated across various populations and amongst multiple metrics, including for fitness indexes such as V02max, body fat percentage and BMI in apparently healthy adult populations (193, 194). Advantages exist in recording both the frequency and duration of LTPA bouts as it enables the researcher to report both minutes of LTPA (for easy contrast to current recommended PA guidelines expressed as total minutes per week) and for the calculation of the leisure score index.

3.10.3 Blood pressure.

Three measures of resting supine brachial blood pressure were taken using a manual sphygmomanometer (Welch Allyn Model DS66) using the left arm. The participant was requested to rest supine for 5 minutes before measurement. The participants arm was elevated slightly on a small pillow so the cuff is approximately at the level of the atrium (196). The researcher then palpated the brachial artery in the antecubital fossa and line up the mid mark of the cuff with the artery, leaving approximately 2-3cms between the bottom of the cuff and the antecubital fossa. The stethoscope diaphragm is placed upon the brachial artery and the cuff inflated to 180mmHg and then deflated at a slow rate of 2-3mmHg per second

until the readings are recorded. Three measures will be taken with at least 1 minute between each measure (196).

3.10.4 Waist circumference

Waist and hip measurements were taken with a Lufkin W606PW flexible steel anthropometric measuring tape following procedures set out by the International Society for the Advancement of Kinanthropometry (ISAK) (197).

Waist circumference is taken at the narrowest point inferior to the 10th rib and superior to the iliac crest, with the subjects standing relaxed, feet together and arms relaxed (197). The measure is taken at the end of normal expiration. If no obvious narrowing of the waist is visible, the measure will be taken half-way between the 10th rib and the iliac crest. Three measures will be recorded.

3.10.5 Hip circumference

Hip measurements will be taken at the greatest posterior protuberance of the gluteal muscles (197). The subject will be standing, feet together, with arms crossed across the chest, and the gluteal muscles relaxed. Three measures will be recorded.

3.10.6 Body mass

Body weight will be recorded in kilograms to the nearest 100 grams on an A&D weighing HW-F200K scale. (A&D Australia PTY LTD, Adelaide) Weight is recorded three times, with the participant stepping off the scale completely each time. Participants will be weighed in minimal attire and asked to wear the same attire for subsequent testing dates.

3.10.7 Stature

Height will be measured using a wall mounted stadiometer (Holtain Limited, UK). The stretch stature method (197) will be utilised with the participant positioned barefoot on the stadiometer plate, with the heels, buttocks and upper back touching the rule, and the head placed in the Frankfort plane. Height is measured on inspiration with a slight lift applied by the researcher. This will be repeated twice, with a third measure if required.

3.10.8 Body Mass Index

Body Mass Index (BMI) is calculated by dividing the subject's body mass in kilograms by the square of the height measured in meters. BMI is currently used in the definition of overweight and obesity by the World Health Organisation (WHO) (198).

3.10.9 Combination metrics

Waist to height ratio (WHtR) will be calculated by dividing the participant's waist circumference by their height. WHtR is a better predictor of early health risk than BMI and waist circumference alone (199). Waist to height ratio is a proxy measure of central adipose tissue, backed with strong predictive evidence of cardiometabolic risk factors across a number of different populations (200, 201). WHtR can be stratified into cardiometabolic risk categories that may be more predictive of health risks than using more traditional groupings of BMI and waist circumference (199). These are <0.5 'no increased risk', >0.5 - <0.6 'increased risk' and >0.6 as 'very high risk' (199).

3.10.10 Bioelectrical impedance

Bioelectrical impedance analysis (BIA) is a non-invasive method of determining fat-free mass (FFM) and fat mass (FM) and will be measured using a BIA-101S machine (RLJ Prizm, S/N: B10875E). BIA utilises small alternating currents conducted through the body to provide

measures of electrical impedance. This impedance is based on the water content of the tissue, which is only situated in FFM (202, 203). These results can in turn be used to calculate body fat percentage which is a valid measure of CVD risk (204), and has been shown to be more sensitive than BMI in risk estimation.

FFM is calculated using the formula (205); $FFM = -4.104 + \left(0.518 \times \frac{H^2}{R}\right) + (0.231 \times W) + (0.130 \times Reactance) + (4.4229 \times sex; men = 1, women = 0)$

Where H is Height in cm, R is resistance in watts, and W is weight in kg.

FM is calculated with the formula (206); $FM = -4.211 + \left(0.267 \times \frac{H^2}{R}\right) + (0.095 \times W) + (1.909 \times sex; men = 1, women = 0) \pm (0.012 \times age) + (0.058 \times reactance)$

Where H is Height in cm, R is resistance in watts, and W is weight in kg.

3.10.11 Blood sampling

Measurements of glucose, insulin, Liver Function Tests (LFT), cholesterol (Total, High Density Lipoprotein (HDL), Low density Lipoprotein (LDL)), and high sensitivity C-reactive protein (CRP) will be gathered by venous blood draw after a 12 hour fast. Fasting is confirmed by the researcher before drawing. A total of 28.5ml of blood will be collected in two red top plain tubes and one yellow top serum-separating tube that will be centrifuged for 10 minutes at 2200-2500 RPM. Analysis will be performed by Douglas Hanly Moir pathology.

3.10.12 Demographics Information and Health History Questionnaire

This self-administered questionnaire attains general information for subject identification such as gender, ethnicity, residence, marital status and education.

3.10.13 Core Self-Evaluation

The core self-evaluations scale (CSES) is a questionnaire that provides a measure of a high order personality trait that is indicated by four specific personality traits; generalized self-efficacy, self-esteem, locus of control, and neuroticism (emotional stability) (207, 208). Responses for each of the 12 questions are recorded on a scale that ranges from 1 (disagree strongly) to 5 (agree strongly). The CSES has been validated in a variety of situations including task performance, motivation, and both job and life satisfaction (208). CSES has previously also been linked with resistance training adoption in older adults (209). Sample items from this scale are “Sometimes I feel depressed,” “I am capable of coping with most of my problems,” and “I determine what will happen in my life.”

3.10.14 Brief Symptom Inventory-18 (BSI-18) (210, 211)

The Brief Symptom Inventory 18 (BSI-18) is an 18-question instrument that assesses psychological distress (212). The BSI-18 was born out of the longer symptom checklist 90 questionnaire after a need for a clinically relevant and quicker measure was identified. BSI-18 takes three common clinical psychological constructs of somatisation, anxiety, depression, and an overall measurement of distress termed the global severity index. The eighteen questions are split evenly over the three constructs with the participants asked to report on how much that problem has distressed them during the past 7-days, inclusive of the day of the test. Each item is ranked on a scale of 0 (not at all) to 4 (extremely). Scores from each section are measured by summation of the relevant questions ranging from 0-72 for global severity index, and 0-24 for the other three constructs.

3.10.15Depression, Anxiety and Stress Scale (DASS-21)

The DASS-21 is a 21 item, self-report questionnaire designed to measure both the presence and severity of a range of symptoms common to both Depression and Anxiety. It provides both individual measures of depression, anxiety, and stress, as well as a total scale score. The DASS-21 is shorter form of the 42-item depression anxiety stress scale (213), and has been shown to be internally consistent with a Cronbach's alpha α of .93 (95% CI .93-.94) for the total scale (214). The DASS-21 questions relate to the presence and severity of a symptom from the past 7-day period. Items are scored from a 0 (did not apply to me at all over the last week) to 3 (applied to me very much or most of the time over the past week), with a higher score indicating higher levels of distress. Crawford, Cayley, Lovibond, Wilson & Hartley, 2011 present normative data from an Australian general population sample for analysis of results (215).

3.10.16Dietary Questionnaire for Epidemiological Studies (DQES)

The DQES version 2 is Food Frequency Questionnaire (FFQ) intended to measure the dietary intake of participants. The DQES is 125 item self-administered questionnaire that reports the frequency of consumption and portion size of food items over a defined period. Advantageously, it has shown to be valid for an Australian adult (216), as well as for type 1 and type 2 diabetics (217). It has been validated in short term studies (218) (four weeks) and previously been used in similar interventions to REVUP (219).

3.10.17 6-minute walk test (6MWT)

The 6MWT is a submaximal measure of functional walking capacity, measured in the distance covered (meters) in a period of 6 minutes. Participants self-select the intensity of the test, with the aim of covering as much distance as possible in the 6 minutes, without running or

jogging (220). The test will be conducted indoors, in an air-conditioned and carpeted area at all testing timepoints. Participants will be instructed that they can slow down or stop if necessary, but to resume walking as soon as possible. The test protocol will be administered with standardised feedback at each minute as per The 2002 American Thoracic Society guidelines (220). Distance will be measured by the researcher following the participant with a trundle wheel. Upon cessation of the test, the researcher will record any reported symptoms. If the test is terminated early, the time and the distance will be noted, as well as the reason for the early termination.

3.10.18Stair climb test

The stair climb test is a simple test of power (221). Participants are asked to climb a set of stairs as rapidly as possible. The duration of the attempt will be recorded by the researcher with a hand-held stopwatch. The time starts on the researchers go, and stops when both feet reach the top step (222). Power is calculated by using the formula $P = \frac{(MxD)x\ 9.8}{t}$ where P is power in watts, M is body mass in kg, D is the vertical distance travelled and t is the time taken in seconds. Two trials will be recorded.

3.10.19Static balance test.

The static balance test is a progressive test of six stages, each progressively more difficult. Each stage must be held for 15 seconds before progression. The balance stands are done in the following order: Wide stance, narrow stance, semi-tandem, tandem stance, one leg eyes open, one leg eyes closed. The test will be performed next to a wall or chair, in normal exercise footwear. The observer will stop the test when the 15 seconds has passed, or the subject loses balance, or the feet move position. Some arm and trunk movement is allowable.

3.10.20 Five repetition sit to stand test (FRSTS)

The five repetition sit to stand (FRSTS) is a measure of lower limb strength and power. Participants are required to stand up and sit down five times as fast as they can, without the use of the arms. Participants should start seated, with arms folded across the chest. The time is measured from the first seated position, until the participant achieves the fully upright position on the fifth repetition (223). The FRSTS has good to high test-retest reliability (224).

3.10.21Gait speed

The gait speed test is a measure of the habitual and maximal walking speed of the participant. Both maximal and habitual gait velocity are good indicators of functional status, and the decline of that status from both disease state and age (225). Gait speed is measured with an ultra-timer device (Ultra-timer: Raymar, Oxfordshire, UK), with the participant asked to walk in a straight line at their normal speed for two trials and their maximal speed for two trials. The researcher starts the timer when the subjects has reached terminal walking speed. Gait velocity is calculated as an average of the two respective measures.

3.10.22Isometric dynamometer handgrip strength testing.

Maximal hand grip strength will be measured on both dominant and non-dominant hands using a Jamar handgrip dynamometer (Sammons Preston, Bolingbrook, IL). Participants will be seated with the shoulder adducted and elbow flexed to 90̊. Three maximal contractions will be conducted on each side, with one minute rest between trials. The maximal score was recorded as the highest of the three trials. While isometric hand grip strength is a direct measure of the maximal hand strength, it is also related to activities of daily living (226) and is a predictor of general upper body strength (227).

3.10.23One repetition max testing

Keiser K400 pneumatic resistance machines (Keiser Corporation, Fresno, CA) will be used to measure one repetition max for the chest press and leg press exercises. The one repetition maximum (1RM) is the maximum weight that can be lifted for one repetition only, through the full range of motion. Before testing, subjects will be familiarised with the technique for each machine, and instructed on correct breathing technique and the avoidance of the Valsalva manoeuvre. Initial range of motion is measured unweighted, with the participant completing five to ten repetitions to familiarise the movement (228). Subjects will attempt progressively heavier weights, reporting a Borg rating of perceived exertion (229) after each repetition. Once the Borg rating is greater than 15 out of a maximum of 20, one minute rest is given between each trial. Once a participant is unable to reach full range of motion on two attempts at least 60 second apart, it is considered a failure.

3.11 Statistical analysis

Data were collated, entered and analysed in SPSS 24 (SPSS, INC., Chicago, IL, USA) by TW. Analysis of results was done through multiple methods.

Multivariate normality was assessed using the Shapiro-Wilk test, which is the appropriate test for sample sizes below 50 (230). Data that was deemed non-normally distributed was treated with log-transformation.

Normally distributed results were analysed with repeated measures analysis of variance (ANOVA) and probability values reported. Data that was resistant to log transformation was assessed with a with a non-parametric style ANOVA method, utilising work from Quade 1967 (231). This involved converting the data to change scores, ranking the data, and then running

on ANOVA with group on the unstandardised residuals of a linear regression between the ranked change scores and baseline measures. Probability values were reported.

To ascertain possible directional trends in the data despite the non-significance of mean difference testing, an effect size was calculated. Partial eta squared was utilised as a measure of variance effect, being wildly used in similar applications where repeated measures ANOVA are used as the significance discriminator (232). Magnitude of effect was set at 0.01 for small, 0.06 for moderate and 0.14 for large.

Due to the relatively high rate of participant attrition, an intention to treat analysis was not utilised to preserve sample power. This should be taken into account when reviewing and interpreting the results of the present study. Previous systematic reviews in the field have called for researchers to use intention to treat analysis to better demonstrate the treatment effect of an intervention (77). The decision not to utilise intention to treat was made post-hoc.

4 Results

4.1 Baseline data

Following recruitment emails, 36 individuals requested, and were given more information on the study. Of the 36, 30 were successfully, telephone screened, with 29 eligible and one found not eligible for enrolment. 21 individuals were baseline tested and randomised, 13 into the intervention group, and 8 into control. Nine individuals chose not to progress for various reasons, with the most common being not able to commit to the time required for the testing (n=6).

Of the 21 participants randomised and entered into the trial, 15 presented for follow-up testing, with 9 from the intervention and 6 from control. Participant flow is presented in figure 4.1.

Baseline descriptive data is presented in table 4.1 and 4.2. Of the total sample, 14 males and 7 females were recruited. The mean BMI was 29.21 (σ 4.95), placing the average participant in the overweight category, with small differences between male participants ($\bar{x}$ 29.21, σ 5.13) and females ($\bar{x}$ 29.9, σ 4.87). The mean age was 50 years (σ 14.52), and the mean hours worked was 42.9 (σ 10.6). The recruited cohort was highly educated, with all participants holding bachelor's degree.

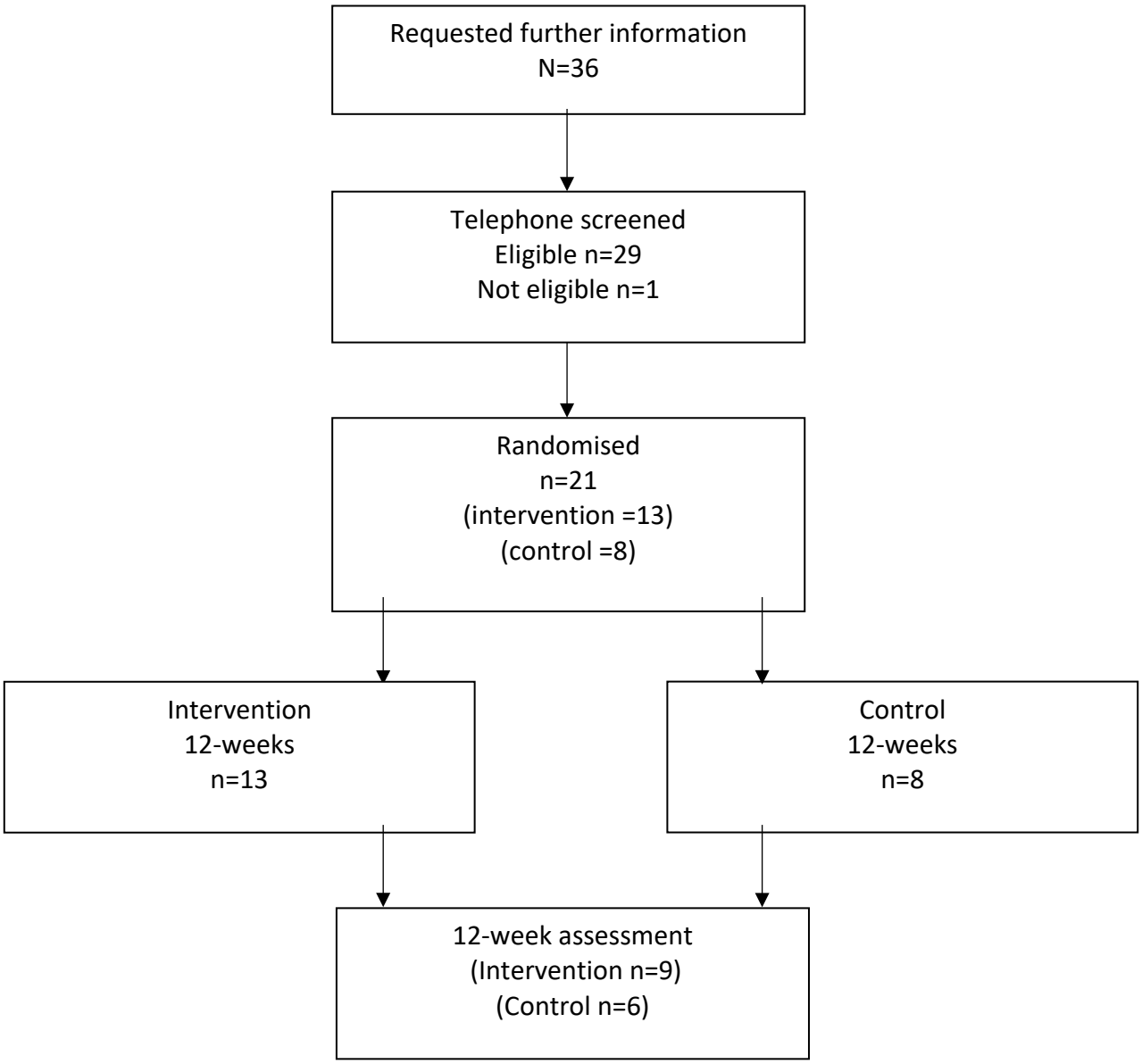

Figure 4.1: Participant flow through REVUP.

Table 4.1: Baseline descriptive data

	Control (n=8)		Intervention (n=13)		Total (n=21)	
	Mean	SD	Mean	SD	Mean	SD
Age	52.13	9.34	49.23	17.23	50.33	14.52
Gender	4 males, 4 females		10 males, 3 females		14 males, 7 females	
Weight	85.34	15.34	94.39	16.33	90.94	16.21
Height	174.44	12.76	177.95	7.76	176.61	9.80
BMI	28.16	5.03	29.86	5	29.21	4.95
Hours worked per week	41.75	12.99	43	9.34	42.9	10.6

Table 4.2: Participant demographics

	Control (n=8)		Intervention (n=13)		Total (n=21)	
	Count	%	Count	%	Count	%
Education						
Bachelor	4	50%	6	46%	10	47.6%
Higher Degree	4	50%	7	54%	11	52.4%
Marital status						
Single	1	12.5%	2	15.4%	3	14.3%
Married	5	62.5%	10	76.9%	15	17.4%
Defacto	0	0%	1	7.7%	1	4.8%
Divorced	1	12.5%	0	0	1	4.8%
Widowed	1	12.5%	0	0	1	4.8%

4.2 Primary outcomes

Objectively measured physical activity data is presented in table 4.3, including group means, standard deviations, mixed ANOVA p values, and partial eta squared variance size. Overall, no significant difference was detected in between groups for any of the PA outcomes. Mean improvements were observed in moderate-to-vigorous PA (MVPA), but with large standard deviations. Additional mean improvements were observed in step count measures.

Table 4.3: ActiGraph physical activity means, standard deviations and ANOVA results

	Control				Intervention					
	Pre (n=7*)		Post (n=6)		Pre (n=13)		Post (n=9)			Partial Eta Squared
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p	h^2
Light[1]	6674	476	6138	1019	6391	440	6502	482	.548	.037
Moderate[1]	289	109	368	131	244	142	162	61	.949	.000
Vigorous[1]	2	2	12	15	5	7	21	30	.473	.053
Very vigorous[1]	0	0	134	320	1	1	7	19	.384	.076
MVPA[1]	292	110	380	140	250	145	420	199	.824	.005
Steps[2]	49984	16469	56775	11616	43903	14588	57447	16132	.723	.013
EE (Kcal)[3]	836	1029	1084	1197	371	97	492	201	.219	.147

*One participant did not consent to wearing the ActiGraph
[1] minutes per week
[2] Steps per week
[3] Energy expenditure calculated from physical activity only.

4.3 Secondary outcomes

4.3.1 Resting measures

Analysis with repeated measures ANOVA show no statistically significant difference in resting measures (table 4.4). Some moderate effects are seen in BMI (h^2 =0.061), waist to height ratio (h^2 =0.085), and large effect seen for systolic blood pressure (h^2 =0.281). Care should be taken in the interpretation of these effects due to lack of significant result and small sample size.

Table 4.4: Resting measures means, standard deviations and ANOVA results

	Control				Intervention					
	Pre (n=8)		Post (n=6)		Pre (n=13)		Post (n=9)			Partial Eta Squared
	Mean	SD	Mean	SD	Mean	h^2	Mean	SD	p	h^2
Mass (kg)	85.34	15.34	87.59	15.6	94.39	16.33	88.4	14.76	.843	.003
BMI	28.16	5.03	30.68	6.13	29.86	5.00	25.96	4.07	.396	.061
Hip circumference (cm)	108.23	11.69	111.59	11.09	110.30	8.72	108.79	7.98	.688	.014
Waist circumference (cm)	93.26	11.06	97.43	13.62	99.19	14.07	95.38	9.79	.510	.037
WtHR	0.56	0.06	0.57	0.06	0.56	0.07	0.54	0.04	.311	.085
Systolic BP (mmHg)	119.75	9.02	108.5	14.1	121.91	10.20	123.87	10.47	.061	.262
Diastolic BP (mmHg)	73.04	7.62	80.56	27.85	72.36	8.20	75.13	9.32	.634	.020

4.3.2 Blood markers

No significant differences were detected in any blood measure (table 4.5), with only a non-significant large effect seen for serum glucose levels (h^2 =0.145).

Table 4.5: Blood marker means, standard deviations and ANOVA results

	Control				Intervention					
	Pre (n=8)		Post (n=6)		Pre (n=13)		Post (n=9)			Partial Eta Squared
	Mean	SD	Mean	SD	Mean	h^2	Mean	SD	p	h^2
CRP	1.18	0.72	1.48	0.69	2.73	1.77	3.47	3.89	.830	.004
Total cholesterol	4.89	0.82	4.58	1.00	5.23	1.03	5.34	1.02	.620	.019
Triglycerides	0.91	0.33	0.88	0.33	1.66	1.19	1.31	0.96	.819	.004
HDL	1.46	0.30	1.47	0.14	1.40	0.55	1.99	1.57	.504	.035
LDL	3.01	0.62	3.12	0.75	3.07	0.67	3.44	0.69	.637	.018
Serum Insulin	5.75	4.03	6.00	4.00	5.73	2.80	5.78	3.15	.836	.003
Serum Glucose	5.26	0.55	5.32	0.55	5.50	0.79	5.01	0.49	.162	.145

4.3.3 Physical function

No significant difference between physical function measure was identified (table 4.6). Effect size remained negligible for most measures, to the exception of maximal gait speed that retuned a partial eta squared value 0.108 for large effect.

4.3.4 Table 4.6: Physical function means, standard deviations and ANOVA results

	Control				Intervention					
	Pre (n=8)		Post (n=6)		Pre (n=13)		Post (n=9)			Partial Eta Squared
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p	h^2
Balance score	80.46	6.44	85.06	5.75	83.23	5.34	82.65	5.07	.715	.012
Sit to stand	8.44	1.62	8.69	1.40	8.98	1.89	8.51	0.89	.976	.000
Habitual gait speed	0.71	0.08	0.68	0.05	0.69	0.07	0.66	0.11	.544	.031
Maximal gait speed	0.49	0.05	0.46	0.07	0.44	0.07	0.41	0.09	.250	.108
Dominant grip	41.04	11.39	39.28	8.23	41.33	10.92	40.04	13.34	.973	.000
Non-Dominant grip	36.30	10.87	36.47	8.72	38.29	12.64	38.29	13.05	.625	.021
6MWT	707.27	73.25	744.58	89.36	711.46	61.41	760.32	97.84	.593	.025
Chest 1rm	209	75	188	58	234	59	207	53	.407	.058
Leg 1rm	1820	471	1927	503	2115	664	2133	771	.477	.043

Psychological outcomes

Table 4.7 presents statistically significant differences in total DASS-21 total score, DASS depression index, and DASS stress index. Partial eta squared effect indicated large effect for DASS-21 total, large effect for DASS depression index, moderate but non-significant effect for DASS anxiety, and large effect for DASS Stress.

Table 4.7: Psychological questionnaire means, standard deviations and ANOVA results

	Control				Intervention					
	Pre (n=8)		Post (n=6)		Pre (n=13)		Post (n=9)			Partial Eta Squared
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p	h^2
DASS-21 Total	9.88	5.52	10.50	6.72	8.46	4.70	4.66	2.78	.040	.287
DASS Depression	2.38	2.33	3.17	3.13	1.15	1.21	1.22	1.72	.036	.296
DASS Anxiety	1.63	1.30	2.33	1.86	1.31	1.75	1.33	1.12	.218	.114
DASS Stress	5.88	3.68	5.00	2.90	4.46	2.15	3.56	2.13	.044	.277
BSI-18	4.25	2.12	6.67	5.85	4.08	2.96	3.89	4.08	.460	.043
CSE	42.00	3.78	31.50	20.24	43.50	5.64	28.83	22.09	.706	.011

4.3.5 Self-reported physical activity.

Godin leisure time physical activity outcomes showed no statistically significant differences across groups and time (table 4.8). Moderate exercise minutes per week showed a large effect, with mild exercise presenting a moderated effect.

Table 4.8: Self-reported physical activity means, standard deviations and ANOVA results

	Control				Intervention					
	Pre (n=8)		Post (n=6)		Pre (n=13)		Post (n=9)			Partial Eta Squared
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p	h^2
Strenuous exercise*	0	0	10.00	24.49	43.46	47.19	78.89	84.18	.415	.052
Moderate exercise*	119.38	208.78	42.50	21.39	87.31	102.03	120.00	100.37	.131	.167
Mild exercise*	69.38	72.63	108.33	161.42	133.46	151.87	93.89	75.65	.279	.089
Resistance training*	2.50	7.07	3.33	8.16	53.85	116.16	35.56	58.97	.653	.016
Sweat score	2.38	0.74	2.67	0.52	1.75	0.87	2.67	0.52	.553	.028

*minutes per week

4.3.7 Dietary outcomes.

Table 4.9 presents results from the food frequency questionnaire, showing no statistically significant differences. Several large effects are seen in carbohydrate and fruit intake, with moderate effect seen in energy intake, fat intake, saturated fat intake, protein intake, and sugar intake.

Table 4.9: Dietary intake means, standard deviations and ANOVA results

	Control				Intervention					
	Pre (n=8)		Post (n=6)		Pre (n=13)		Post (n=9)			Partial Eta Squared
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p	h^2
Energy (kj)[1]	7580.85	2952.23	8172.35	3897.47	8153.99	2644.70	8098.42	1813.11	.356	.122
Fat (g)	69.52	43.88	91.98	52.89	68.43	42.46	81.38	21.86	.205	.097
Saturated Fat (g)	26.95	16.77	36.39	20.95	28.21	18.01	31.88	11.09	.164	.131
Protein (g)	92.29	37.80	102.02	59.04	97.63	25.67	102.77	14.67	.513	.064
Carbohydrate (g)	183.38	67.37	181.00	60.43	203.36	72.70	199.65	51.15	.272	.169
Sugar (g)	73.42	31.26	65.15	22.65	95.28	43.32	101.79	24.46	.493	.066
Fruits*	3.25	0.71	4.00	1.26	3.69	1.25	3.90	0.74	.227	.145
Vegetables*	3.63	1.19	3.33	1.21	4.54	1.20	5.20	1.14	.125	.031

[1] Energy intake per day in kilojoules
*Serves per day

5 Discussion

5.1 Summary

The primary aim of REVUP was to evaluate the efficacy of an online delivered workplace health program on improving cardiovascular risk factors, using a single blinded, randomised controlled trial design. The results suggest that in this sample, the REVUP program was not statistically effective at improving cardiovascular risk factors.

Alterative effect size analysis of the results indicates that majority of outcome measures change in a positive direction suggesting that while REVUP may not have the statistical power to show significance, there is a trend towards an effective program. Caution should be taken when interpreting these results however as the sample size is small, and the standard deviations too large to satisfy statistical rigor, with many of the 95% confidence intervals spanning across zero.

5.2 Baseline characteristics

The recruited population consisted of 14 males and seven females, with a mean age of 50 (SD 14.52). The participants were on average highly educated, with all of them having a university bachelor's degree or higher degree, and working 42.9 hours per week. Education level is known predictor of exercise adoption, with more educated individuals more likely to participate in exercise than those with lower education levels (233). Most of the participants (76.9%) were married and were, on overage, overweight [BMI 29.21 kg/m^2 (SD 4.95)].

5.3 Primary outcome

Self-report physical activity data suggests that at baseline, 47% of the participants were achieving a minimum of 150 minutes of moderate to intense physical activity per day. This is representative of only leisure time physical activity (as per the Godin leisure time questionnaire.), however it suggests that significant portion of the sample was already physically active before the intervention. This was confirmed with objective ActiGraph data showing that 68% of the total sample was achieving at least 150 minutes of moderate to vigorous physical activity (MVPA) per week. This is comparable to previous research, with 65% of the sample population in Spittaels, De Bourdeauduij, Brug, and Vandelanotte (2007) meeting minimum requirements for PA at baseline (136).

This poses an interesting conundrum to the results of REVUP. REVUP was targeted towards the goal of achieving first a 150 minutes per week accumulative total of moderate to vigorous exercise, and then progressing towards a 300 minute per week total. By study end, every participant had achieved that goal as reported by the ActiGraph data. This threshold may be misleading however, as once accounting for participant attrition, only one individual in the intervention group moved from insufficiently active to sufficiently active, with the rest either already achieving the threshold limit or dropping out. Three of the four participants in the intervention group who were categorised as insufficiently active through ActiGraph data dropped out of the study. This effect is similar to reported literature, with Martin and Sinden (2001) reporting that older adults are more likely to adhere to RCT exercise trials if they have a history of physical activity (234).

Despite this, there was a trend toward increasing physical activity amount, with small effects seen. The mean increase of MVPA in the intervention group was 170 minutes per week, which is a practical and clinically significant difference – with a recent review identifying a minimum of 90 minutes per week the threshold for health benefits (98). The control group also improved the amount of MVPA completed, with a mean increase of 88 minutes per week. This concurrent increase most likely accounts for the lack of statistical significance from inferential measures. Regardless, any increase in physical activity may reduce the risk of CVD, with the pattern of association between exercise and disease risk showing a clear dose response relationship (39, 235).

Changes in activity level from the control group may be caused by a sub-conscious (or conscious) effort to increase the amount of PA that they were completing, as a possible Hawthorne effect from the research attention, as is reported to be a risk with both blinded and unblinded pedometers (236). This Hawthorne effect however, would presumably affect both the control and intervention groups in the same way. It is also possible that the control group participants were previously contemplating an increase in health behaviour, with the intent to make a change in PA habits a possible driver for joining the study. Cross-contamination between groups is also a possibility, however the risk of this seems low, with the individuals recruited working independently of each other, and specifically being asked not to share intervention information.

5.4 Weight & BMI

Body mass and BMI are intrinsically related. Neither showed statistically significant improvements, however the partial eta squared effects pointing towards a reduction of BMI in the intervention group. BMI is a well-known indicator of cardiovascular disease risk (237),

with an increasing BMI related to an increase in conditions such as diabetes and hypertension (2). However, more recent meta-analyses and large scale studies have identified that there are more accurate risk profiling measurements that are quick and easy to administer such as waist to hip ratio, and waist to height ratio (238).

5.5 Waist-to-height ratio

Waist-to-height ratio (WtHR) is a simple but effective measure of early health risk, that may be more sensitive to classifying health risk than utilising BMI alone (199, 201). Individuals are classified as being at 'early health risk' if they have a WtHR ≥ 0.5. At baseline, 66% of REVUP participants were classified in this risk category. Regardless of intervention or control, there was no change in individual participants moving across the risk categories, however there is a moderate effect displayed (h^2=0.85) for reduction in the intervention group.

5.6 Psychological questionnaires.

Using percentile norms for an Australia population developed by Crawford and colleagues (239), 28.5% of the participants at baseline were ranked in to the 85th or higher percentile for depression, anxiety and stress score. Statistically significant reductions were seen in Ttoal DASS score, DASS depression, and DASS stess. This trend is also reflected in the core self-evaluation outcomes, with the a noticeable (but not statistically significant difference) for the intervention group. Both measures reflected effect sizes that show a directional change towards a reduction in psychological distress, despite only one week of the REVUP program being specifically directed towards targeting psychological distress. This shows promise that e-health delivery could be a potential vehicle for psychological distress treatment. Previous literature (240) has identified that a combination physical activity and internet delivered cognitive behavioural therapy intervention is more effective than usual care at reducing

depressive symptoms, in addition to providing a non-stigmatising treatment alternative. While not the primary aim or within the scope of REVUP, this avenue holds promise for clinically meaningful changes.

5.7 Blood markers

Blood marker testing of participants was inconclusive, with no measure reaching statistical significance, and effect sizes conflicting.. Three reasons for this are likely, the first being that 12-week intervention period is most likely not long enough to harness a meaningful change in the blood related outcome measures, the second is that REVUP was underpowered to assess these measures with any accuracy. Thirdly, it is also likely that there is a ceiling effect, with the majority of participants already physically active, the treatment benefits from the exercise may have already been realised.

5.8 Physical function

Effect sizes remained low for physical function measures to the exception of balance and sit-to-stand. This lack of difference and effect size is unsurprising, with the twelve-week program being too short a duration to garner effective change in these outcomes. Additionally, these measures are most likely suffering for the previously discussed ceiling effect, where the impact of an already sufficiently active intervention and control group is reducing the available amount of change in these measures. Furthermore, there was a reduction in the self-reported amount of resistance training being completed by the intervention group. This may have impacted the strength based physical function outcome such as one repetition max testing, grips strength testing, and to a lesser degree, five repetition sit to stand time.

5.9 Attrition

Of the 21 recruited participants, 15 were tested at the 12 week timepoint. Attrition was higher in the intervention group, with four individuals dropping out, and two dropping out of the control group. The most common reason for drop out was lost contact (four participants), with REVUP employing a three-contact strategy, whereby after three unsuccessful attempts to book in for assessment, the participant was deemed to be lost. One participant withdrew due to spouse health issues, and one moved parish area to outside NSW. Attrition rates fit within the scope of similar published literature, with ranges of 2-52% (see Chapter 2.5.7).

5.10 Limitations

REVUP has several limitations that should be discussed. Firstly, despite a long recruitment period and repeated attempts at enrolment, only a small sample size was recruited. This impacts both the statistical rigor of the results, and the ability to generalise results to the wider community. A-priori power calculations stipulated a sample size of 32 would be required to enable effective analysis of physical activity data.

Secondly, program engagement outcomes were not measured, and as such it is not possible to discern whether a lack of change in outcome measures is due to an ineffective program, or a lack of use of the program. The final realisation of this however is similar, in that a program that is not utilised by participants is not an effective one.

Measures of program success other than health outcomes would have enabled a deeper analysis of the success and failures of the study. These measures could include participants enjoyment and satisfaction around the program, and the way that it was delivered. This would enable further refinement of the material for future iterations or future research directions.

No adverse events or harms were reported by the participants

5.11 Strengths

REVUP utilised a single blinded randomised control trial method, with the addition of objective measures of physical activity. This decreases the risk of possible bias, both from research practice, but also from the use of self-report measures. Additionally, some measures that have inherent deviation in results (such as one-repetition max testing, and the 6MWT) were tested twice at each time point, to reduce the impact of non-physical elements such as motivation. Further strengths of the trial include the support from the employer, who encouraged and enabled employees to partake in the trial during workplace hours. This reduced the barriers for engaging with REVUP for participants. Furthermore, the Uniting Church of Australia provided funding for the project, enabling use of further outcome measures.

REVUP was delivered entirely over existing infrastructure, providing a proof-of-concept that e-health interventions can be delivered with very little delivery cost. The use of existing email infrastructure, as well as the use of YouTube, made the intervention easily accessible for the participants.

Finally, REVUP was conducted in an Australian population, who are currently under represented in the physical activity e-health literature.

REVUP was built upon a sound literature base representing the diabetes prevention plan, and individual psychological theories, particularly social cognitive theory, health belief model, and transtheoretical model of change. Table 3.3 (Chapter 3, section 3.8.4) details some of the specific applications of psychological theory principles to REVUP content.

5.12 Not all constructs form the theories were used in the development of REVUP, but rather those that are well supported in meta-analytical literature (171), such as focusing on benefits rather than detriments, goal setting, strengthening self-efficacy and self-liberation, and providing feedback. How can we improve the success of programs such as REVUP?

5.12.1 Measurement of adherence

Program adherence is an indicator and predictor of program success. A meta-analysis of e-therapy studies found that increased adherence is positively associated with improved health outcomes (241). This association is representative of the relationship to session attendance and outcomes in physical rehabilitation. This association of adherence, particularly when measured by website logins (the most predominantly reported measure of adherence in e-therapy literature) is most likely due to the number of logins representing the participants willingness to use the program.

While measuring and reporting adherence is advantageous to researchers, care should be taken in choosing the optimal measure. A combination of objective measures and subjective measures is recommended (241). Objective measures that focus on program interaction such as module completion and activity results may offer a more accurate reflection of adherence than measures of program exposure such as the website logins or video views.

REVUP did not effectivity measure adherence. Post hoc analysis of YouTube video views are inconclusive, as there is no effective method to discern the views from researchers checking video status and the participants intentional viewing of the video. Additionally, while REVUP did involve an activity to complete each week, this was not collected or checked.

5.12.2 Feasibility measures

Additionally, to adherence and of program engagement, measures of participant satisfaction and enjoyment should be taken. This can focus on the wider program, the content delivered, and the method of delivery. Such measures can be administered via questionnaire, or through focus group interviews. This will enable future iterations of the program to be refined to better suit the target participants and hopefully enhance program satisfaction and retention.

5.12.3 Social support tools

Anecdotally, participants the REVUP trial reported feeling isolated during the program. This is both a function of the research design - participants were not put through as batches - and to help prevent cross contamination between the groups were asked not to discuss the contents of the program with peers. Additionally, the cohort work relativity independently of each other, and as such already experience a degree of occupational isolation. Despite the researcher being free and able to answer questions via email, the uptake of this avenue for support was very low. This isolated feeling may have contributed to the low adherence in the REVUP study. With social support being a key component of social cognitive theory (242), it is prudent to investigate methods to enhance social support in online interventions.

Previous researchers have looked at including social support tools in online delivered programs in an effort to enhance both participant adherence and retention to the program, as well as improving outcomes. One such study compared the use of social support tools in an online delivered adult walking intervention (243). Online social support tools were offered to one intervention arm, using sub-groups of 3-5 participants who were encouraged to engage with discussion forums and instant messaging. Analysis of the outcome measures exhibited no significant differences in PA outcomes (although both control and intervention

improved), psychosocial indicators or other health outcomes between the groups. The lack of an improved effect in the social support group may be a product of the low use of the tools. On average only 2.8 messages were drafted per participant across the 12-week intervention. The researchers acknowledge that the use of randomly allocated sub-groups may have reduced the effectiveness of the method, as participants did not know each other before the start of the study (244).

This highlights some interesting constructs, in that simply providing access to online social support tools does not guarantee they will be used. Researcher allocated sub-groups may limit effective social cohesion, and further research is warranted looking at using online social support tools in groups with pre-existing social cohesion. This could therefore be an effective tool in workplace delivered interventions, as there is a level of pre-existing social environment.

Alternatively, rather than adding social networks to health interventions, some researchers have added health interventions to existing social networks such as Facebook and Twitter(244-246). This has a large potential for effectiveness and reach, with Facebook alone having 1.37 billion active users per day in September 2017 (247). Additionally, health information can be shared amongst existing social contacts, using established and not artificially created social groups. This may enhance the retention issues that are common amongst standalone health interventions, with a 2014 systematic review (246) reporting marked differences in participant retention between standalone interventions (50%) and interventions utilising existing social networks (77-96%). Further meta-analyses (244) have identified a modest positive effect (Hedge's g: 0.24, 95% CI 0.04 - 0.43) for interventions aimed at changing health behaviour using existing social networking platforms.

Unfortunately, interventions that use existing social networks do not report high engagement (5-15%), this is possibly due to the myriad of more immediately gratifying things to do on such social network platforms. Interventions that do report higher engagement typically mirror the more traditional aspects of social media use such as entertainment and use of social circles. One such study that reported very high engagement was Foster's use of a Facebook application in addition to logging pedometers (245). It provided participants with the ability to interact with an existing friendship base as the participants were known to each other prior to the intervention. Additionally, a competitive environment was established through the use of step count leader boards. While this intervention was very successful in achieving an increase in PA, retainment, and engagement of participants, it was a small sample (n=10) and of short duration (21 days). It is unclear if the engagement would maintain over longer duration studies. Despite these limitations, future research should consider the benefits of launching an intervention on an existing social platform, amongst established peer groups.

5.12.4 Age and intervention reception

REVUP had an age range of participants from 28 to 76 years, with a mean age of 50.3 years. This presents some interesting factors for consideration, as the differing ages of participants may change their intentions towards PA (248). Research by Alley et al in 2017 in an Australian population (248), found marked differences between the intentions for PA between the age groups. Older adults (65+) preferred to be more frequently active for shorter bouts than younger adults (18-44), and both older and middle-aged (45-64) adults preferred slower paced PA than the younger adults. A large proportion (65%) of the older adults represented in the study had no intention to engage in PA, compared to only 25% of younger adults. These marked differences amongst the life stages may be key in designing effective interventions

targeting PA behaviour, with a one size fits all approach across the age groups not sufficiently targeting the needs of each individual group.

At baseline, REVUP had a split of 42% younger adults (18-44), 37% middle aged (45-64) and 21% older adults (65+). Despite this split in age categories, the information presented was the same for all participants. Additionally, the recommended PA guidelines for older adults differs slightly than that of adults 18-64. This was not reflected in REVUP, with all participants receiving the guidelines for the 18-64-year-old range.

While the guidelines for adults 18-64 call for 150 minutes per week of moderate intensity activity, or 75 minutes of vigorous PA (or an equivalent combination of both), increasing to 300 minutes per week, the 65+ guidelines focus on achieving 30 minutes per day of moderate activity, with no call to increase intensity if not desired. This could have an undesired effect of presenting PA recommendations that are undesirable, and perhaps perceived as unattainable to the older adults in the study. This seems unlikely however, with all participants aged over 65 achieving the minimum level of PA at baseline. This is most likely due to the inherent nature of volunteer programs recruiting individuals who are engaged and interested in their health.

Future research should however consider the importance of tailoring the PA information for differences in exercise intention, specifically by promoting lower intensity activity in 30 minute bouts to increase the likelihood of adherence.

5.12.5 Intervention tailoring

In an effort to enhance the efficacy of health interventions, researchers have implemented various strategies to make the material presented more relatable and specific to the individual or population they are researching.

Amongst the literature involving print and e-health delivery there is a breadth of differing methods for tailoring interventions (249). Broadly, then can be broken into four categories.

Generic communication involves no individualisation of the message in any way, and the message is being communicated is not aimed or targeted at a specific group or sub population. This includes the bulk of population level material, such as brochures and guidelines. Personalised generic communication is where the generic material is personalised, usually with just the inclusion of an individual's name. This is common in print and email modalities where the generic information is addressed to an individual.

Targeted communication involves the customisation of the information to reach a specific group or sub-group of a population. This is perhaps the most widely used method of tailoring in health education, with examples such as health information for distinct genders or sufferers of specific conditions. Tailored communication is a combination of the above strategies that presents information designed specifically for an individual. It is unique to the participant and is built from individual assessment.

Targeted and tailored interventions have their roots in the transtheoretical model of change (174), which states that individuals fall within categories of motivation depending on their willingness to change. It has been thought that targeting these different categories of change would lead to more efficacious results. More recently this has been shown to not be as

effective as theorised, with a 2014 meta-analysis (250) of theory influence on the effectiveness of health behaviour interventions showing that interventions using a single behavioural theory are only weakly more effective than those that do not (SMD 0.32 95% CI .25, .39 p=0.03). Additionally, a comprehensive meta-regression in effective theoretical techniques for both physical activity and healthy eating interventions (251) found that only the use of self-monitoring, intention forming, and specific goal setting was effective in improving outcomes. These three methods are common to many behaviour theories.

While theory use does not necessarily equate to greater outcomes, using computer tailoring systems has been shown to be effective (249). Computer based tailoring has advantages of mimicking interpersonal communication by enabling individualised feedback, motivation, and advice. Broekhuizen, Kroeze, van Poppel, Oenema, and Brug conducted a comprehensive systematic review investigating computer-tailored advice on PA and dietary behaviour (249). They concluded that computer based tailoring was effective, with 69% of tailored interventions in PA more effective than non-tailored control and 83% of studies showing an increase in fruit and vegetable intake with tailoring. While the effect sizes remain small for these studies, the evidence suggests that despite the behavioural theory behind the decision to tailor not being crucial, the tailoring itself has a positive effect on study outcomes (249). This supports previous meta-analytic reviews on tailoring in print health behaviour change interventions (163).

REVUP utilised elements of targeted and tailored information. Several weeks of the intervention were specific to the individual, with reporting's of the PA levels of participants in relation to the 300 minutes per week goal. Additionally, each email was personalised to include the individual's name. The addition of further tailored information may have been

advantageous to the program. This could include items such as an increased frequency of feedback of the participants current PA level in relation to the program goal and tailoring of the information based off the participant preferences, especially in relation to alternate modes of exercise and adjusting exercise intensity.

5.13 Autonomous supportive environments.

A method of improving behaviour change and improving adherence to change processes is to create and foster an autonomous supportive environment in the program/relationship. Researchers have suggested that to improve health outcomes, we need to include a focus on the social influences that contribute to the problem (252). This is the target of Self-determination theory (253), and it provides investigators with a structure to look at the interpersonal support, and motivation for health behaviour change. Key to this motivation to change is the extent to which the change process is experienced as autonomous or controlled.

This self-regulation is deterministic of the type of motivation that is built. Autonomous self-regulation is linked to improved persistence, greater task performance and better health outcomes (252). Autonomy support is theorised to provide an environment that facilitates intrinsic motivation creation, and the possible adaption of extrinsic reasons to change to intrinsic goals (253).

Autonomous self-regulation is thought to be fostered by acknowledging an individual's feelings and unique perspectives on the task, using neutral language, avoiding excessive pressure and control, providing choice and options, and using constructive positive feedback.

The source of this autonomy support is also important, with perceived autonomy support from health care professionals predicting actual autonomous self-regulation and greater

outcomes in a 6-month weight loss trial. Participants that reported greater autonomy supportiveness had increased weight loss duration and total weight, as well as greater participation in the program (254). Autonomous support from walk leaders positively predicted increases in PA and subject vitality in a 16 week walking program (255). Interestingly, non-human sources of autonomous support environment (ASE) from the program itself were also positivity correlated to improvements in PA and vitality. This is especially interesting to researchers in online-delivered programs, as there often significantly reduced amounts of human to human contact in comparison to traditional offline interventions.

While it is advantageous to develop an ASE in a health intervention, the majority of actual behaviour change occurs when individuals are at home or work, and not directly interacting with the program or researcher. Extending the ASE into these environments may be key to a successful behavioural intervention. A 2014 study on the sources of autonomy support found that individuals that reported higher levels of spouse or family autonomy supportiveness had improved weight loss in the long term compared to spouse/family that used a more direct approach to behaviour change (252).

Autonomous supportive environments are theorised to be beneficial as they improve intrinsic motivation, which turn builds adherences to change strategies and resilience to setbacks (256). Autonomous supportive practitioners foster this environment through several key behaviours previously mentioned of acknowledgement, choice, and rationale in both the information they present, and in the way the information is presented.

Building ASE through online delivery methods provides a greater challenge. It may be more difficult to build rapport and develop relationship through online methods, with lack of face

to face communication. Further development of methods to enhance ASE through online methods may lead to a powerful and effective environment that will improve adherence to programs through driving intrinsic motivation. The use of online methods to enable and enhance autonomy in a health context is yet to be researched.

5.14 Conclusion

The use of a single blinded, randomised control trial of internet delivered workplace health programs was not effective at providing significant differences in outcome measures. However, trends in data identified by using adjusted effect size analysis show that there is promise in the program. Development of strategies to enhance adherence and to recruit inactive individuals may boost program success.

Further trials should focus on improving attrition, engagement, and utilisation of the interventions. Investigation into the use of building and nurturing autonomous supportive environments may help to provide greater engagement and ultimately better participant outcomes.

6 References

1. Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, Verschuren M, et al. European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). European Heart Journal. 2012;33(13):1635-701.
2. World Health Organization. Global Atlas on cardiovascular disease prevention and control 2011 [Available from: http://whqlibdoc.who.int/publications/2011/9789241564373_eng.pdf?ua=1.
3. Australian Institute of Health and Welfare. Australia's health 2014. AIHW Cat no AUS 1782014.
4. Expert Dyslipidemia Panel of the International Atherosclerosis Society Panel members. An International Atherosclerosis Society Position Paper: global recommendations for the management of dyslipidemia--full report. Journal Of Clinical Lipidology. 2014;8(1):29-60.
5. White HD, Chew DP. Acute myocardial infarction. The Lancet. 2008;372(9638):570-84.
6. Greenland P, Alpert JS, Beller GA, Benjamin EJ, Budoff MJ, Fayad ZA, et al. 2010 ACCF/AHA Guideline for Assessment of Cardiovascular Risk in Asymptomatic AdultsA Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance. Journal of the American College of Cardiology. 2010;56(25):e50-e103.
7. Cholesterol Treatment Trialists C. Efficacy and safety of more intensive lowering of LDL cholesterol: a meta-analysis of data from 170 000 participants in 26 randomised trials. The Lancet. 2010;376(9753):1670-81.
8. Reiner Ž, Catapano AL, De Backer G, Graham I, Taskinen M-R, Wiklund O, et al. ESC/EAS Guidelines for the management of dyslipidaemias: The Task Force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and the European Atherosclerosis Society (EAS). European Heart Journal. 2011;32(14):1769-818.
9. Prospective Studies C, Lewington S, Whitlock G, Clarke R, Sherliker P, Emberson J, et al. Blood cholesterol and vascular mortality by age, sex, and blood pressure: a meta-analysis of individual data from 61 prospective studies with 55,000 vascular deaths. Lancet. 2007;370(9602):1829-39.
10. National Heart Foundation of Australia and the Cardiac Society of Australia and New Zealand. Reducing risk in heart disease: an expert guide to clinical practice for secondary prevention of coronary heart disease. Melbourne; 2012.
11. Anderson TJ, Gregoire J, Hegele RA, Couture P, Mancini GB, McPherson R, et al. 2012 update of the Canadian Cardiovascular Society guidelines for the diagnosis and treatment of dyslipidemia for the prevention of cardiovascular disease in the adult. The Canadian journal of cardiology. 2013;29(2):151-67.
12. National Vascular Disease Prevention Alliance. Guidelines for the management of absolute cardiovascular disease risk.; 2012.

13. Twigg SM, Kamp MC, Davis TM, Neylon EK, Flack JR. Prediabetes: a position statement from the Australian Diabetes Society and Australian Diabetes Educators Association. The Medical Journal Of Australia. 2007;186(9):461-5.
14. Nathan DM, Davidson MB, DeFronzo RA, Heine RJ, Henry RR, Pratley R, et al. Impaired Fasting Glucose and Impaired Glucose Tolerance: Implications for care. Diabetes Care. 2007;30(3):753-9.
15. Association AD. Diagnosis and Classification of Diabetes Mellitus. Diabetes Care. 2010;33(Supplement 1):S62-S9.
16. Abdul-Ghani MA, Tripathy D, DeFronzo RA. Contributions of beta-cell dysfunction and insulin resistance to the pathogenesis of impaired glucose tolerance and impaired fasting glucose. Diabetes Care. 2006;29(5):1130-9.
17. Dunstan DW, Zimmet PZ, Welborn TA, de Courten MP, Cameron AJ, Sicree RA, et al. The Rising Prevalence of Diabetes and Impaired Glucose Tolerance: The Australian Diabetes, Obesity and Lifestyle Study. Diabetes Care. 2002;25(5):829-34.
18. Tuomilehto J, Lindström J, Eriksson JG, Valle TT, Hämäläinen H, Ilanne-Parikka P, et al. Prevention of Type 2 Diabetes Mellitus by Changes in Lifestyle among Subjects with Impaired Glucose Tolerance. New England Journal of Medicine. 2001;344(18):1343-50.
19. Coutinho M, Gerstein HC, Wang Y, Yusuf S. The relationship between glucose and incident cardiovascular events. A metaregression analysis of published data from 20 studies of 95,783 individuals followed for 12.4 years. Diabetes Care. 1999;22(2):233-40.
20. Marks JB, Raskin P. Cardiovascular risk in diabetes: A brief review. Journal of Diabetes and its Complications. 2000;14(2):108-15.
21. The Emerging Risk Factors C. Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies. The Lancet. 2010;375(9733):2215-22.
22. Lawes CMM, Parag V, Bennett DA, Suh I, Lam TH, Whitlock G, et al. Blood glucose and risk of cardiovascular disease in the Asia Pacific region. Diabetes care. 2004;27(12):2836-42.
23. Australian College of General Practitioners and Diabetes Australia. General practice management of type 2 diabetes 2014-15,. Melbourne; 2014.
24. Baker MK, Simpson K, Lloyd B, Bauman AE, Singh MAF. Behavioral strategies in diabetes prevention programs: A systematic review of randomized controlled trials. Diabetes research and clinical practice. 2011;91(1):1-12.
25. Haslam DW, James WPT. Obesity. The Lancet. 2005;366(9492):1197-209.
26. Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Houston Miller N, Hubbard VS, et al. 2013 AHA/ACC Guideline on Lifestyle Management to Reduce Cardiovascular Risk: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Journal of the American College of Cardiology. 2014;63(25, Part B):2960-84.
27. Board J. Joint British Societies' consensus recommendations for the prevention of cardiovascular disease (JBS3). Heart. 2014;100(Suppl 2):ii1-ii67.
28. Landsberg L, Aronne LJ, Beilin LJ, Burke V, Igel LI, Lloyd-Jones D, et al. Obesity-related hypertension: Pathogenesis, cardiovascular risk, and treatment—A position paper of the The Obesity Society and the American Society of Hypertension. Obesity. 2013;21(1):8-24.
29. Shaw Kelly A, Gennat Hanni C, O'Rourke P, Del Mar C. Exercise for overweight or obesity. Cochrane Database of Systematic Reviews [Internet]. 2006; (4). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003817.pub3/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD003817.pub3/asset/CD003817.pdf?v=1&t=hypdbl4x&s=4438bf6de6280afcd58f70f163a6b4a75f8c5e30.
30. Lewington S, Clarke R, Qizilbash N, Peto R, Collins R, Prospective Studies C. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. Lancet. 2002;360(9349):1903-13.
31. National Heart Foundation of Australia (National Blood Pressure and Vascular Disease Advisory Commitee). Guide to management of hypertension 2008. Updated 2010. 2010.
32. Arguedas Jose A, Perez Marco I, Wright James M. Treatment blood pressure targets for hypertension. Cochrane Database of Systematic Reviews [Internet]. 2009; (3). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004349.pub2/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD004349.pub2/asset/CD004349.pdf?v=1&t=hys4fgkb&s=7e4031764e17762cbb09539ad028123193f19aa2.
33. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. The Lancet.380(9838):219-29.
34. Bassuk SS, Manson JE. Epidemiological evidence for the role of physical activity in reducing risk of type 2 diabetes and cardiovascular disease2005 2005-09-01 00:00:00. 1193-204 p.
35. Thompson PD, Buchner D, Piña IL, Balady GJ, Williams MA, Marcus BH, et al. Exercise and Physical Activity in the Prevention and Treatment of Atherosclerotic Cardiovascular Disease: A Statement From the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity). Circulation. 2003;107(24):3109-16.
36. Cornelissen VA, Smart NA. Exercise Training for Blood Pressure: A Systematic Review and Meta-analysis. Journal of the American Heart Association. 2013;2(1).
37. Orozco Leonardo J, Buchleitner Ana M, Gimenez-Perez G, Roqué i Figuls M, Richter B, Mauricio D. Exercise or exercise and diet for preventing type 2 diabetes mellitus. Cochrane Database of Systematic Reviews [Internet]. 2008; (3). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003054.pub3/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD003054.pub3/asset/CD003054.pdf?v=1&t=hypd0tc1&s=e866ea3c066066676253641189d612ea0bb8b668.
38. Franklin BA, Durstine JL, Roberts CK, Barnard RJ. Impact of diet and exercise on lipid management in the modern era. Best Practice & Research Clinical Endocrinology & Metabolism. 2014;28(3):405-21.
39. Foulds HA, Bredin SD, Charlesworth S, Ivey A, Warburton DR. Exercise volume and intensity: a dose–response relationship with health benefits. Eur J Appl Physiol. 2014;114(8):1563-71.
40. Warburton D, Charlesworth S, Ivey A, Nettlefold L, Bredin S. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. International Journal of Behavioral Nutrition and Physical Activity. 2010;7(1):39.
41. Wen CP, Wai JPM, Tsai MK, Yang YC, Cheng TYD, Lee M-C, et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. The Lancet.378(9798):1244-53.

42. Brown W, Bauman A, Bull F, Burton N. Development of Evidence-based Physical Activity Recommendations for Adults (18-64 years). Australian Government Department of Health; 2012.
43. Ambrose JA, Barua RS. The pathophysiology of cigarette smoking and cardiovascular diseaseAn update. Journal of the American College of Cardiology. 2004;43(10):1731-7.
44. Godtfredsen NS, Holst C, Prescott E, Vestbo J, Osler M. Smoking Reduction, Smoking Cessation, and Mortality: A 16-year Follow-up of 19,732 Men and Women from the Copenhagen Centre for Prospective Population Studies. American Journal of Epidemiology. 2002;156(11):994-1001.
45. Schane RE, Ling PM, Glantz SA. Health Effects of Light and Intermittent Smoking: A Review. Circulation. 2010;121(13):1518-22.
46. Anthonisen NR. The Effects of a Smoking Cessation Intervention on 14.5-Year Mortality. Annals of Internal Medicine. 2005;142(4):233.
47. Critchley JA, Capewell S. Mortality risk reduction associated with smoking cessation in patients with coronary heart disease: A systematic review. JAMA. 2003;290(1):86-97.
48. Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors2004 2004-06-24 22:04:23. 1519 p.
49. Godtfredsen NS, Prescott E. Benefits of smoking cessation with focus on cardiovascular and respiratory comorbidities. The Clinical Respiratory Journal. 2011;5(4):187-94.
50. Lindson-Hawley N, Aveyard P, Hughes John R. Reduction versus abrupt cessation in smokers who want to quit. Cochrane Database of Systematic Reviews [Internet]. 2012; (11). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD008033.pub3/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD008033.pub3/asset/CD008033.pdf?v=1&t=hyr0ffpj&s=d888281111cdc26d8441ca5d857d6ac7388d3f9f.
51. Stead Lindsay F, Perera R, Bullen C, Mant D, Hartmann-Boyce J, Cahill K, et al. Nicotine replacement therapy for smoking cessation. Cochrane Database of Systematic Reviews [Internet]. 2012; (11). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD000146.pub4/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD000146.pub4/asset/CD000146.pdf?v=1&t=hyk6csmg&s=b361c78a1da8d53767a77a68dceb0b57917d8046

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD000146.pub4/asset/CD000146.pdf?v=1&t=hyk6d58y&s=9260c30835d76c1e5d5531ec6f8dc011cd54f7a3.
52. Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghali WA. Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis. Bmj. 2011;342:d671.
53. Rehm J, Baliunas D, Borges GL, Graham K, Irving H, Kehoe T, et al. The relation between different dimensions of alcohol consumption and burden of disease: an overview. Addiction. 2010;105(5):817-43.
54. Cohen BE, Edmondson D, Kronish IM. State of the art review: depression, stress, anxiety, and cardiovascular disease. American journal of hypertension. 2015;28(11):1295-302.
55. Steptoe A, Kivimäki M. Stress and cardiovascular disease. Nature Reviews Cardiology. 2012;9(6):360.

56. Yusuf S, Hawken S, Ôunpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. The lancet. 2004;364(9438):937-52.
57. Chandola T, Brunner E, Marmot M. Chronic stress at work and the metabolic syndrome: prospective study. Bmj. 2006;332(7540):521-5.
58. Kouvonen A, Kivimäki M, Virtanen M, Pentti J, Vahtera J. Work stress, smoking status, and smoking intensity: an observational study of 46 190 employees. Journal of Epidemiology & Community Health. 2005;59(1):63-9.
59. Dauchet L, Amouyel P, Hercberg S, Dallongeville J. Fruit and vegetable consumption and risk of coronary heart disease: a meta-analysis of cohort studies. The Journal Of Nutrition. 2006;136(10):2588-93.
60. Hartley L, Igbinedion E, Holmes J, Flowers N, Thorogood M, Clarke A, et al. Increased consumption of fruit and vegetables for the primary prevention of cardiovascular diseases. Cochrane Database of Systematic Reviews [Internet]. 2013; (6). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD009874.pub2/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD009874.pub2/asset/CD009874.pdf?v=1&t=hts41th2&s=e0e3c713a3038bf216e84ba29df79bb07752dfe6.
61. Rees K, Dyakova M, Wilson N, Ward K, Thorogood M, Brunner E. Dietary advice for reducing cardiovascular risk. Cochrane Database of Systematic Reviews [Internet]. 2013; (12). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD002128.pub5/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD002128.pub5/asset/CD002128.pdf?v=1&t=hts41ee3&s=d0e133ca0027edc72f62ec1ab49d30b8a63ef395.
62. He Feng J, Li J, MacGregor Graham A. Effect of longer-term modest salt reduction on blood pressure. Cochrane Database of Systematic Reviews [Internet]. 2013; (4). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004937.pub2/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD004937.pub2/asset/CD004937.pdf?v=1&t=hyksre5s&s=bde923df434d91419aab2b8bbd1a3fa58200a53f.
63. National Health and Medical Research Council. Australian Dietary Guidelines. In: National Health and Medical Research Council, editor. Canberra: National Health and Medical Research Council; 2013.
64. Siri-Tarino PW, Sun Q, Hu FB, Krauss RM. Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. The American Journal of Clinical Nutrition. 2010.
65. Chowdhury R, Warnakula S, Kunutsor S, Crowe F, Ward HA, Johnson L, et al. Association of Dietary, Circulating, and Supplement Fatty Acids With Coronary RiskA Systematic Review and Meta-analysis. Annals of Internal Medicine. 2014;160(6):398-406.
66. Astrup A, Dyerberg J, Elwood P, Hermansen K, Hu FB, Jakobsen MU, et al. The role of reducing intakes of saturated fat in the prevention of cardiovascular disease: where does the evidence stand in 2010? The American Journal of Clinical Nutrition. 2011;93(4):684-8.
67. Siri-Tarino PW, Sun Q, Hu FB, Krauss RM. Saturated fat, carbohydrate, and cardiovascular disease. The American Journal of Clinical Nutrition. 2010;91(3):502-9.
68. Gillingham L, Harris-Janz S, Jones PH. Dietary Monounsaturated Fatty Acids Are Protective Against Metabolic Syndrome and Cardiovascular Disease Risk Factors. Lipids. 2011;46(3):209-28.

69. He K, Song Y, Daviglus ML, Liu K, Van Horn L, Dyer AR, et al. Accumulated Evidence on Fish Consumption and Coronary Heart Disease Mortality: A Meta-Analysis of Cohort Studies. Circulation. 2004;109(22):2705-11.
70. Estruch R, Ros E, Salas-Salvadó J, Covas M-I, Corella D, Arós F, et al. Primary Prevention of Cardiovascular Disease with a Mediterranean Diet. New England Journal of Medicine. 2013;368(14):1279-90.
71. Remig V, Franklin B, Margolis S, Kostas G, Nece T, Street JC. Trans Fats in America: A Review of Their Use, Consumption, Health Implications, and Regulation. Journal of the American Dietetic Association. 2010;110(4):585-92.
72. Oyebode O, Gordon-Dseagu V, Walker A, Mindell JS. Fruit and vegetable consumption and all-cause, cancer and CVD mortality: analysis of Health Survey for England data. Journal of Epidemiology and Community Health. 2014.
73. He FJ, Nowson CA, MacGregor GA. Fruit and vegetable consumption and stroke: meta-analysis of cohort studies. The Lancet. 2006;367(9507):320-6.
74. Ebrahim S, Taylor F, Ward K, Beswick A, Burke M, Davey Smith G. Multiple risk factor interventions for primary prevention of coronary heart disease. Cochrane Database of Systematic Reviews [Internet]. 2011; (1). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD001561.pub3/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD001561.pub3/asset/CD001561.pdf?v=1&t=hz21xv3f&s=9edbb78a5bf19618316f897fb267a67dbfef3b18.
75. Goldstein MG, Whitlock EP, DePue J. Multiple behavioral risk factor interventions in primary care: Summary of research evidence. American Journal of Preventive Medicine. 2004;27(2, Supplement):61-79.
76. Australian Bureau of Statistics. 6202.0 - Labour Force, Australia, Jul 2014 2014 [Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/6202.0Main%20Features2Jul%202014?opendocument&tabname=Summary&prodno=6202.0&issue=Jul%202014&num=&view=.
77. Anderson LM, Quinn TA, Glanz K, Ramirez G, Kahwati LC, Johnson DB, et al. The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review (Structured abstract). American Journal of Preventive Medicine [Internet]. 2009; 37(4):[340-57 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/cldare/articles/DARE-12009109211/frame.html

http://ac.els-cdn.com/S0749379709004863/1-s2.0-S0749379709004863-main.pdf?_tid=dbd9c8b6-bf9e-11e3-b645-00000aacb35f&acdnat=1397017656_76ee281d45400ac4090e2421cba4bf91.
78. Schulte PA, Wagner GR, Blanciforti LA, Cutlip RG, Krajnak KM, Luster M, et al. Work, Obesity, and Occupational Safety and Health. American Journal of Public Health. 2007;97(3):428-36.
79. Carnethon M, Whitsel LP, Franklin BA, Kris-Etherton P, Milani R, Pratt CA, et al. Worksite Wellness Programs for Cardiovascular Disease Prevention: A Policy Statement From the American Heart Association. Circulation. 2009;120(17):1725-41.
80. Pelletier B, Boles M, Lynch W. Change in Health Risks and Work Productivity Over Time. Journal of Occupational and Environmental Medicine. 2004;46(7):746-54.

81. Holden L, Scuffham PA, Hilton MF, Ware RS, Vecchio N, Whiteford HA. Which Health Conditions Impact on Productivity in Working Australians? Journal of Occupational and Environmental Medicine. 2011;53(3):253-7 10.1097/JOM.0b013e31820d1007.
82. Collins JJ, Baase CM, Sharda CE, Ozminkowski RJ, Nicholson S, Billotti GM, et al. The Assessment of Chronic Health Conditions on Work Performance, Absence, and Total Economic Impact for Employers. Journal of Occupational and Environmental Medicine. 2005;47(6):547-57 10.1097/01.jom.0000166864.58664.29.
83. Groeneveld IF, Proper KI, van der Beek AJ, Hildebrandt VH, van Mechelen W. Lifestyle-focused interventions at the workplace to reduce the risk of cardiovascular disease--a systematic review. Scandinavian Journal Of Work, Environment & Health. 2010;36(3):202-15.
84. Aneni EC, Roberson LL, Maziak W, Agatston AS, Feldman T, Rouseff M, et al. A Systematic Review of Internet-Based Worksite Wellness Approaches for Cardiovascular Disease Risk Management: Outcomes, Challenges & Opportunities. PLoS ONE. 2014;9(1):1-11.
85. Chan Osilla K, Van Busum K, Schnyer C, Wozar Larkin J, Eibner C, Mattke S. Systematic Review of the Impact of Worksite Wellness Programs. American Journal of Managed Care. 2012;18(2):e68-e81.
86. Engbers LH, van Poppel MNM, Chin A Paw MJM, van Mechelen W. Worksite Health Promotion Programs with Environmental Changes: A Systematic Review. American Journal of Preventive Medicine. 2005;29(1):61-70.
87. Freak-Poli Rosanne LA, Cumpston M, Peeters A, Clemes Stacy A. Workplace pedometer interventions for increasing physical activity. Cochrane Database of Systematic Reviews [Internet]. 2013; (4). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD009209.pub2/abstract

http://onlinelibrary.wiley.com/store/10.1002/14651858.CD009209.pub2/asset/CD009209.pdf?v=1&t=hts43da7&s=8bace13cdaeb918aaddfde3b83b19ed72a7487b5.
88. Wantland JD, Portillo JC, Holzemer LW, Slaughter R, McGhee ME. The Effectiveness of Web-Based vs. Non-Web-Based Interventions: A Meta-Analysis of Behavioral Change Outcomes. J Med Internet Res. 2004;6(4):e40.
89. Koch-Weser S, Bradshaw YS, Gualtieri L, Gallagher SS. The Internet as a Health Information Source: Findings from the 2007 Health Information National Trends Survey and Implications for Health Communication. Journal of Health Communication. 2010;15(sup3):279-93.
90. Samoocha D, Bruinvels JD, Elbers AN, Anema RJ, van der Beek JA. Effectiveness of Web-based Interventions on Patient Empowerment: A Systematic Review and Meta-analysis. J Med Internet Res. 2010;12(2):e23.
91. Hotta K, Kinumi K, Naito K, Kuroki K, Sakane H, Imai A, et al. An intensive group therapy programme for smoking cessation using nicotine patch and internet mailing supports in a university setting. International Journal of Clinical Practice. 2007;61(12):1997-2001.
92. Jung H, Lee B, Lee J-E, Kwon Y-H, Song H. Efficacy of a programme for workers with metabolic syndrome based on an e-health system in the workplace: a pilot study. Journal of Telemedicine and Telecare. 2012;18(6):339-43.

93. Kang JY, Cho SW, Sung SH, Park YK, Paek YM, Choi TI. Effect of a continuous diabetes lifestyle intervention program on male workers in Korea. Diabetes Research and Clinical Practice. 2010;90(1):26-33.
94. Watson AJ, Singh K, Myint-U K, Grant RW, Jethwani K, Murachver E, et al. Evaluating a web-based self-management program for employees with hypertension and prehypertension: A randomized clinical trial. American Heart Journal. 2012;164(4):625-31.
95. Kohl 3rd HW, Craig CL, Lambert EV, Inoue S, Alkandari JR, Leetongin G, et al. The pandemic of physical inactivity: global action for public health. The Lancet. 2012;380(9838):294-305.
96. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. The Lancet. 2012;380(9838):219-29.
97. Warburton DER, Nicol CW, Bredin SSD. Health benefits of physical activity: the evidence. Canadian Medical Association Journal. 2006;174(6):801-9.
98. Wen CP, Wai JPM, Tsai MK, Yang YC, Cheng TYD, Lee M-C, et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. The Lancet. 2011;378(9798):1244-53.
99. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Global physical activity levels: surveillance progress, pitfalls, and prospects. The Lancet. 2012;380(9838):247-57.
100. Australian Bureau of Statistics. National Health Survey: First Results, 2014-15. Canberra: Australian Bureau of Statistics; 2015.
101. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention (CDC), National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition, Physical Activity and Obesity. Nutrition, Physical Activity and Obesity Data, Trends and Maps web site. Atlanta, GA2015 [cited 2016 20/9/2016]. Available from: http://www.cdc.gov/nccdphp/DNPAO/index.html.
102. Group DPPR. Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. New England Journal of Medicine. 2002;346(6):393-403.
103. Ali MK, Echouffo-Tcheugui JB, Williamson DF. How effective were lifestyle interventions in real-world settings that were modeled on the Diabetes Prevention Program? Health affairs. 2012;31(1):67-75.
104. Van den Berg MH, Schoones JW, Vlieland TPV. Internet-based physical activity interventions: a systematic review of the literature. J Med Internet Res. 2007;9(3):e26.
105. Almeida FA, You W, Harden SM, Blackman KC, Davy BM, Glasgow RE, et al. Effectiveness of a worksite-based weight loss randomized controlled trial: the worksite study. Obesity (Silver Spring, Md) [Internet]. 2015; 23(4):[737-45 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/730/CN-01068730/frame.html

http://onlinelibrary.wiley.com/store/10.1002/oby.20899/asset/oby20899.pdf?v=1&t=il1pf4m3&s=385b7b4f76933f81d6d0bb64f0325fa4abee1804.
106. Bennett JB, Broome KM, Schwab-Pilley A, Gilmore P. A web-based approach to address cardiovascular risks in managers: results of a randomized trial. Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine [Internet]. 2011; 53(8):[911-8 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/503/CN-00810503/frame.html

http://graphics.tx.ovid.com/ovftpdfs/FPDDNCJCKHALHP00/fs046/ovft/live/gv023/00043764/00043764-201108000-00013.pdf.
107. Deitz D, Cook RF, Hersch RK, Leaf S. Heart healthy online: an innovative approach to risk reduction in the workplace. Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine [Internet]. 2014; 56(5):[547-53 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/131/CN-00993131/frame.html

http://graphics.tx.ovid.com/ovftpdfs/FPDDNCGCKBIEOA00/fs046/ovft/live/gv023/00043764/00043764-201405000-00014.pdf.
108. Bort-Roig J, Gilson ND, Puig-Ribera A, Contreras RS, Trost SG. Measuring and Influencing Physical Activity with Smartphone Technology: A Systematic Review. Sports Medicine. 2014;44(5):671-86.
109. U.S. Bureau of Labor Statistics. Charts from the American time use survey 2016 [updated December 20, 2016. Available from: https://www.bls.gov/tus/charts/.
110. Kirk MA, Rhodes RE. Occupation correlates of adults' participation in leisure-time physical activity: a systematic review. American journal of preventive medicine. 2011;40(4):476-85.
111. Davies CA, Spence JC, Vandelanotte C, Caperchione CM, Mummery WK. Meta-analysis of internet-delivered interventions to increase physical activity levels. International Journal of Behavioral Nutrition and Physical Activity. 2012;9(1):1-13.
112. Seo D-C, Niu J. Evaluation of Internet-Based Interventions on Waist Circumference Reduction: A Meta-Analysis. Journal of medical Internet research. 2015;17(7):e181.
113. Hutchesson MJ, Rollo ME, Krukowski R, Ells L, Harvey J, Morgan PJ, et al. eHealth interventions for the prevention and treatment of overweight and obesity in adults: a systematic review with meta-analysis. Obesity Reviews. 2015;16(5):376-92.
114. Vandelanotte C, Spathonis KM, Eakin EG, Owen N. Website-Delivered Physical Activity Interventions: A Review of the Literature. American Journal of Preventive Medicine. 2007;33(1):54-64.
115. Zacharia S, Funk M, Alshuwaiyer G, Gwin S, Taylor EL, Branscum P. Internet-based Physical Activity Interventions at the Worksite: A Systematic Review. American Journal of Health Studies. 2013;28(3):114-26.
116. Malik SH, Blake H, Suggs LS. A systematic review of workplace health promotion interventions for increasing physical activity. British Journal of Health Psychology. 2014;19(1):149-80.
117. van den Berg MH, Vliet Vlieland TPM, Schoones JW. Internet-Based Physical Activity Interventions: A Systematic Review of the Literature. Journal of Medical Internet Research. 2007;9(3):8-.
118. Higgins JPT, Altman DG, Gøtzsche PC, Jüni P, Moher D, Oxman AD, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ. 2011;343:d5928.
119. Chen YC, Tsao LI, Huang CH, Yu YY, Liu IL, Jou HJ. An Internet-based health management platform may effectively reduce the risk factors of metabolic syndrome among career women. Taiwanese journal of obstetrics & gynecology [Internet]. 2013; 52(2):[215-21 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/337/CN-00919337/frame.html

http://ac.els-cdn.com/S1028455913000673/1-s2.0-S1028455913000673-main.pdf?_tid=db973122-c057-11e3-ba4b-00000aab0f27&acdnat=1397097113_24008737720901d2c9e10856c19f026a.
120. Maruyama C, Kimura M, Okumura H, Hayashi K, Arao T. Effect of a worksite-based intervention program on metabolic parameters in middle-aged male white-collar workers: A randomized controlled trial. Preventive Medicine. 2010;51(1):11-7.
121. Morgan PJ, Collins CE, Plotnikoff RC, Cook AT, Berthon B, Mitchell S, et al. Efficacy of a workplace-based weight loss program for overweight male shift workers: The Workplace POWER (Preventing Obesity Without Eating like a Rabbit) randomized controlled trial. Preventive Medicine. 2011;52(5):317-25.
122. Aittasalo M, Rinne M, Pasanen M, Kukkonen-Harjula K, Vasankari T. Promoting walking among office employees--evaluation of a randomized controlled intervention with pedometers and e-mail messages. BMC Public Health. 2012;12(1):403-13.
123. Napolitano MA, Fotheringham M, Tate D, Sciamanna C, Leslie E, Owen N, et al. Evaluation of an internet-based physical activity intervention: a preliminary investigation. Annals of behavioral medicine [Internet]. 2003; 25(2):[92-9 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/630/CN-00558630/frame.html.
124. Robroek SJW, Polinder S, Bredt FJ, Burdorf A. Cost-effectiveness of a long-term Internet-delivered worksite health promotion programme on physical activity and nutrition: a cluster randomized controlled trial. Health Education Research. 2012;27(3):399-410.
125. Sternfeld B, Block C, Quesenberry Jr CP, Block TJ, Husson G, Norris JC, et al. Improving Diet and Physical Activity with ALIVE: A Worksite Randomized Trial. American Journal of Preventive Medicine. 2009;36(6):475-83.
126. Tate DF, Wing RR, Winett RA. Using Internet technology to deliver a behavioral weight loss program. Jama [Internet]. 2001; 285(9):[1172-7 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/153/CN-00328153/frame.html

http://jama.jamanetwork.com/data/Journals/JAMA/4774/JOC01569.pdf.
127. Thorndike AN, Sonnenberg L, Healey E, Myint-U K, Kvedar JC, Regan S. Prevention of Weight Gain Following a Worksite Nutrition and Exercise Program: A Randomized Controlled Trial. American Journal of Preventive Medicine. 2012;43(1):27-33.
128. Poirier J, Bennett WL, Jerome GJ, Shah NG, Lazo M, Yeh H-C, et al. Effectiveness of an Activity Tracker-and Internet-Based Adaptive Walking Program for Adults: A Randomized Controlled Trial. Journal of Medical Internet Research. 2016;18(2):e34.
129. Carr LJ, Karvinen K, Peavler M, Smith R, Cangelosi K. Multicomponent intervention to reduce daily sedentary time: a randomised controlled trial. BMJ Open. 2013;3(10):e003261-e.
130. Hughes SLDSW, Seymour RBP, Campbell RTP, Shaw JWP, Fabiyi CMPH, Sokas RMDMPH. Comparison of Two Health-Promotion Programs for Older Workers. American Journal of Public Health. 2011;101(5):883-90.
131. Marshall AL, Leslie ER, Bauman AE, Marcus BH, Owen N. Print versus website physical activity programs: A randomized trial. American Journal of Preventive Medicine. 2003;25(2):88.
132. Hager RL, Hardy A, Aldana SG, George JD. Evaluation of an Internet, Stage-Based Physical Activity Intervention. American Journal of Health Education. 2002;33(6):329-37.

133. Puig-Ribera A, Bort-Roig J, González-Suárez AM, Martínez-Lemos I, Giné-Garriga M, Fortuño J, et al. Patterns of Impact Resulting from a ?Sit Less, Move More? Web-Based Program in Sedentary Office Employees. PLoS ONE. 2015;10(4):e0122474.
134. Suggs S, Blake H, Bardus M, Lloyd S. Effects of text messaging in addition to emails on physical activity among university and college employees in the UK. Journal of Health Services Research & Policy. 2013;18(1):56-64.
135. Andersen LL, Sundstrup E, Boysen M, Jakobsen MD, Mortensen OS, Persson R. Cardiovascular health effects of internet-based encouragements to do daily workplace stair-walks: randomized controlled trial. Journal Of Medical Internet Research. 2013;15(6):e127-e.
136. Spittaels H, Bourdeaudhuij I, Brug J, Vandelanotte C. Effectiveness of an online computer-tailored physical activity intervention in a real-life setting. Health education research [Internet]. 2007; 22(3):[385-96 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/846/CN-00608846/frame.html

http://her.oxfordjournals.org/content/22/3/385.full.pdf.
137. Pressler A, Knebel U, Esch S, Kölbl D, Esefeld K, Scherr J, et al. An internet-delivered exercise intervention for workplace health promotion in overweight sedentary employees: a randomized trial. Preventive medicine [Internet]. 2010; 51(3-4):[234-9 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/417/CN-00768417/frame.html

http://ac.els-cdn.com/S0091743510002872/1-s2.0-S0091743510002872-main.pdf?_tid=6b381344-d9f3-11e5-9dda-00000aab0f02&acdnat=1456207700_69bfce12f6d2905e7e548b66d12cf99a.
138. Cook RF, Billings DW, Hersch RK, Back AS, Hendrickson A. A field test of a web-based workplace health promotion program to improve dietary practices, reduce stress, and increase physical activity: randomized controlled trial. Journal Of Medical Internet Research. 2007;9(2):e17-e.
139. Irvine AB, Philips L, Seeley J, Wyant S, Duncan S, Moore RW. Get Moving: A Web Site That Increases Physical Activity of Sedentary Employees. American Journal of Health Promotion. 2011;25(3):199-206.
140. Dekkers JC, van Wier MF, Ariëns GAM, Hendriksen IJM, Pronk NP, Smid T, et al. Comparative effectiveness of lifestyle interventions on cardiovascular risk factors among a Dutch overweight working population: A randomized controlled trial. BMC Public Health. 2011;11(1):49-59.
141. Slootmaker SM, Chinapaw MJM, Schuit AJ, Seidell JC, Van Mechelen W. Feasibility and effectiveness of online physical activity advice based on a personal activity monitor: randomized controlled trial. Journal Of Medical Internet Research. 2009;11(3):e27-e.
142. van Wier MF, Dekkers JC, Hendriksen IJ, Heymans MW, Ariens GA, Pronk NP, et al. Effectiveness of phone and e-mail lifestyle counseling for long term weight control among overweight employees. J Occup Environ Med. 2011;53(6):680-6.
143. Reijonsaari K, Vehtari A, Kahilakoski O-P, van Mechelen W, Aro T, Taimela S. The effectiveness of physical activity monitoring and distance counseling in an occupational setting -- Results from a randomized controlled trial (CoAct). BMC Public Health. 2012;12(1):344-53.
144. Compernolle S, Vandelanotte C, Cardon G, De Bourdeaudhuij I, De Cocker K. Effectiveness of a web-based, computer-tailored, pedometer-based physical activity

intervention for adults: a cluster randomized controlled trial. Journal of Medical Internet Research. 2015;17(2):e38-e 1p.
145. Cook RF, Hersch RK, Schlossberg D, Leaf SL. A Web-based health promotion program for older workers: randomized controlled trial. Journal Of Medical Internet Research. 2015;17(3):e82-e.
146. Plotnikoff RC, McCargar LJ, Wilson PM, Loucaides CA. Efficacy of an E-mail intervention for the promotion of physical activity and nutrition behavior in the workplace context. American Journal of Health Promotion. 2005;19(6):422-39.
147. Plotnikoff RC, Pickering MA, McCargar LJ, Loucaides CA, Hugo K. Six-month follow-up and participant use and satisfaction of an electronic mail intervention promoting physical activity and nutrition. American Journal of Health Promotion. 2010;24(4):255-9 5p.
148. van Wier MF, Ariëns GAM, Dekkers JC, Hendriksen IJM, Smid T, van Mechelen W. Phone and e-mail counselling are effective for weight management in an overweight working population: a randomized controlled trial. BMC Public Health. 2009;9:1-12.
149. Van Wier MF, Dekkers JC, Hendriksen IJM, Heymans MW, Ariens GAM, Pronk NP, et al. Effectiveness of phone and e-mail lifestyle counseling for long term weight control among overweight employees. Journal of Occupational and Environmental Medicine. 2011;53(6):680-6.
150. Plotnikoff RC, Pickering MA, McCargar LJ, Loucaides CA, Hugo K. Six-month follow-up and participant use and satisfaction of an electronic mail intervention promoting physical activity and nutrition. American Journal Of Health Promotion: AJHP. 2010;24(4):255-9.
151. Robroek SJW, Lindeboom DEM, Burdorf A. Initial and sustained participation in an internet-delivered long-term worksite health promotion program on physical activity and nutrition. Journal Of Medical Internet Research. 2012;14(2):e43-e.
152. Higgins J, Green S, editors. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]: The Cochrane Collaboration; 2011.
153. Greaves CJ, Sheppard KE, Abraham C, Hardeman W, Roden M, Evans PH, et al. Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. BMC Public Health. 2011;11(1):1-12.
154. Freak-Poli RLA, Cumpston M, Peeters A, Clemes SA. Workplace pedometer interventions for increasing physical activity. Cochrane Database of Systematic Reviews. 2013(4).
155. Webb T, Joseph J, Yardley L, Michie S. Using the internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. Journal of medical Internet research. 2010;12(1):e4.
156. Michie S, Abraham C, Whittington C, McAteer J, Gupta S. Effective techniques in healthy eating and physical activity interventions: a meta-regression. American Psychological Association; 2009.
157. van Sluijs EMF, van Poppel MNM, Twisk JWR, van Mechelen W. Physical activity measurements affected participants' behavior in a randomized controlled trial. Journal of Clinical Epidemiology. 2006;59(4):404-11.
158. Faul F, Erdfelder E, Lang A-G, Buchner A. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior research methods. 2007;39(2):175-91.

159. National Health and Medical Research Council. Healthy eating for adults - eat for health and wellbeing bruchure. Canberra: National Health and Medical Research Council; 2013.
160. National Health and Medical Research Council. Eat For Health 2017 [Available from: https://www.eatforhealth.gov.au/.
161. Department of Health. Is your family missing out on the benefits of being active every day? http://wwwhealthgovau/internet/main/publishingnsf/. Canberra: Commonwealth of Australia; 2014.
162. Marshall AL, Owen N, Bauman AE. Mediated approaches for influencing physical activity: update of the evidence on mass media, print, telephone and website delivery of interventions. Journal of Science and Medicine in Sport. 2004;7(1, Supplement 1):74-80.
163. Noar SM, Benac CN, Harris MS. Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. Psychological bulletin. 2007;133(4):673.
164. Wilson EAH, Makoul G, Bojarski EA, Bailey SC, Waite KR, Rapp DN, et al. Comparative analysis of print and multimedia health materials: A review of the literature. Patient Education and Counseling. 2012;89(1):7-14.
165. Hill A-M, McPhail S, Hoffmann T, Hill K, Oliver D, Beer C, et al. A Randomized Trial Comparing Digital Video Disc with Written Delivery of Falls Prevention Education for Older Patients in Hospital. Journal of the American Geriatrics Society. 2009;57(8):1458-63.
166. The Diabetes Prevention Program (DPP) Research Group. The Diabetes Prevention Program (DPP). Description of lifestyle intervention. 2002;25(12):2165-71.
167. Group DPPR. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl j Med. 2002;2002(346):393-403.
168. Ajzen I. The theory of planned behavior. Organizational behavior and human decision processes. 1991;50(2):179-211.
169. Bandura A. Human agency in social cognitive theory. American psychologist. 1989;44(9):1175.
170. Rosenstock IM. Why People Use Health Services. The Milbank Memorial Fund Quarterly. 1966;44(3):94-127.
171. Carpenter CJ. A Meta-Analysis of the Effectiveness of Health Belief Model Variables in Predicting Behavior. Health Communication. 2010;25(8):661-9.
172. Marlow SP, Stoller JK. Smoking Cessation. Respiratory Care. 2003;48(12):1238-56.
173. Bandura A. Health Promotion by Social Cognitive Means. Health Education & Behavior. 2004;31(2):143-64.
174. Prochaska JO, Velicer WF. The Transtheoretical Model of Health Behavior Change. American Journal of Health Promotion. 1997;12(1):38-48.
175. Bartholomew LK, Parcel GS, Kok G, Fernández ME, Fern?ndez ME. Planning Health Promotion Programs : An Intervention Mapping Approach. Hoboken, UNITED STATES: John Wiley & Sons, Incorporated; 2010.
176. Tremblay MS, Warburton DER, Janssen I, Paterson DH, Latimer AE, Rhodes RE, et al. New Canadian Physical Activity Guidelines. Applied Physiology, Nutrition, and Metabolism. 2011;36(1):36-46.
177. Health UDo, Services H. 2008 physical activity guidelines for Americans: Be active, healthy, and happy! http://www health gov/paguidelines. 2008.
178. Bull F, Biddle S, Buchner D, Ferguson R, Foster C, Fox K. Physical activity guidelines in the UK: review and recommendations. School of Sport, Exercise and Health Sciences, Loughborough University. 2010.

179. Kesaniemi YA, Danforth E, Jensen MD, Kopelman PG, LefÈbvre P, Reeder BA. Dose-response issues concerning physical activity and health: an evidence-based symposium. Medicine & Science in Sports & Exercise. 2001;33(6):S351-S8.
180. Wolever TMS, Jenkins DJ, Vuksan V, Jenkins AL, Wong GS, Josse RG. Beneficial Effect of Low-Glycemic Index Diet in Overweight NIDDM Subjects. Diabetes Care. 1992;15(4):562-4.
181. Spieth LE, Harnish JD, Lenders CM, et al. A low–glycemic index diet in the treatment of pediatric obesity. Archives of Pediatrics & Adolescent Medicine. 2000;154(9):947-51.
182. Bouché C, Rizkalla SW, Luo J, Vidal H, Veronese A, Pacher N, et al. Five-Week, Low–Glycemic Index Diet Decreases Total Fat Mass and Improves Plasma Lipid Profile in Moderately Overweight Nondiabetic Men. Diabetes Care. 2002;25(5):822-8.
183. Barclay AW, Petocz P, McMillan-Price J, Flood VM, Prvan T, Mitchell P, et al. Glycemic index, glycemic load, and chronic disease risk—a meta-analysis of observational studies. The American Journal of Clinical Nutrition. 2008;87(3):627-37.
184. Brand-Miller J, Hayne S, Petocz P, Colagiuri S. Low–Glycemic Index Diets in the Management of Diabetes. A meta-analysis of randomized controlled trials. 2003;26(8):2261-7.
185. National Health and Medical Research Council. Australian Guidelines to Reduce Health Risks from Drinking Alcohol. Canberra: National Health and Medical Research Council; 2009.
186. Begg SJ, Vos T, Barker B, Stanley L, Lopez AD. Burden of disease and injury in Australia in the new millennium: measuring health loss from diseases, injuries and risk factors. The Medical Journal Of Australia. 2008;188(1):36-40.
187. Whiteman DC, Webb PM, Green AC, Neale RE, Fritschi L, Bain CJ, et al. Cancers in Australia in 2010 attributable to modifiable factors: summary and conclusions. Australian and New Zealand Journal of Public Health. 2015;39(5):477-84.
188. Zwar N, Richmond R, Borland R, Peters M, Litt J, Bell J, et al. Supporting smoking cessation: a guide for health professionals. Melbourne: The Royal Australian College of General Practitioners. 2011.
189. Australian Government Department of Health. quitenow webpage 2017 [cited 2017 Decemeber 6]. Available from: http://www.quitnow.gov.au/.
190. Australian Bureau of Statistics. National survey of mental health and wellbeing: summary of results. Canberra: Australian Bureau of Statistics,; 2008.
191. Choi L, Liu Z, Matthews CE, Buchowski MS. Validation of Accelerometer Wear and Nonwear Time Classification Algorithm. Medicine and science in sports and exercise. 2011;43(2):357-64.
192. Sasaki JE, John D, Freedson PS. Validation and comparison of ActiGraph activity monitors. Journal of Science and Medicine in Sport. 2011;14(5):411-6.
193. Godin G, Shephard R. A simple method to assess exercise behavior in the community. Can J Appl Sport Sci. 1985;10(3):141-6.
194. Amireault S, Godin G. The Godin-Shephard leisure-time physical activity questionnaire: validity evidence supporting its use for classifying healthy adults into active and insufficiently active categories. Perceptual and motor skills. 2015;120(2):604-22.
195. Church TS, Thomas DM, Tudor-Locke C, Katzmarzyk PT, Earnest CP, Rodarte RQ, et al. Trends over 5 Decades in U.S. Occupation-Related Physical Activity and Their Associations with Obesity. PLOS ONE. 2011;6(5):e19657.

196. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al. Recommendations for blood pressure measurement in humans and experimental animals. Circulation. 2005;111(5):697-716.
197. Stewart A, Marfell-Jones M, Olds T, Ridder dH. International Society for Advancement of Kinanthropometry. International standards for anthropometric assessment Lower Hutt, New Zealand: International Society for the Advancement of Kinanthropometry. 2011:50-3.
198. Organization WH. Obesity: preventing and managing the global epidemic: World Health Organization; 2000.
199. Ashwell M, Gibson S. Waist-to-height ratio as an indicator of 'early health risk': simpler and more predictive than using a 'matrix'based on BMI and waist circumference. BMJ open. 2016;6(3):e010159.
200. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. Obesity reviews. 2012;13(3):275-86.
201. Lee CMY, Huxley RR, Wildman RP, Woodward M. Indices of abdominal obesity are better discriminators of cardiovascular risk factors than BMI: a meta-analysis. Journal of clinical epidemiology. 2008;61(7):646-53.
202. Andreoli A, Garaci F, Cafarelli FP, Guglielmi G. Body composition in clinical practice. European Journal of Radiology. 2016;85(8):1461-8.
203. Mialich MS, Sicchieri JMF, Junior AAJ. Analysis of Body Composition: A Critical Review of the Use of Bioelectrical Impedance Analysis. International Journal of Clinical Nutrition. 2014;2(1):1-10.
204. Yamashita K, Kondo T, Osugi S, Shimokata K, Maeda K, Okumura N, et al. The Significance of Measuring Body Fat Percentage Determined by Bioelectrical Impedance Analysis for Detecting Subjects With Cardiovascular Disease Risk Factors. Circulation Journal. 2012;76(10):2435-42.
205. Kyle UG, Genton L, Karsegard L, Slosman DO, Pichard C. Single prediction equation for bioelectrical impedance analysis in adults aged 20–94 years. Nutrition. 2001;17(3):248-53.
206. Kyle UG, Genton L, Hans D, Pichard C. Validation of a bioelectrical impedance analysis equation to predict appendicular skeletal muscle mass (ASMM). Clinical Nutrition. 2003;22(6):537-43.
207. Chang C-H, Ferris DL, Johnson RE, Rosen CC, Tan JA. Core self-evaluations: A review and evaluation of the literature. Journal of Management. 2012;38(1):81-128.
208. Judge TA, Erez A, Bono JE, Thoresen CJ. The Core Self-Evaluations Scale: Development of a Measure. Personnel Psychology. 2003;56(2):303-31.
209. Baker MK, Kennedy DJ, Bohle PL, Campbell D, Wiltshire JH, Singh MAF. Core self-evaluation as a predictor of strength training adoption in older adults. Maturitas. 2011;68(1):88-93.
210. Wiesner M, Chen V, Windle M, Elliott MN, Grunbaum JA, Kanouse DE, et al. Factor Structure and Psychometric Properties of the Brief Symptom Inventory–18 in Women: A MACS Approach to Testing for Invariance Across Racial/Ethnic Groups. Psychological assessment. 2010;22(4):912-22.
211. Franke GH, Jaeger S, Glaesmer H, Barkmann C, Petrowski K, Braehler E. Psychometric analysis of the brief symptom inventory 18 (BSI-18) in a representative German sample. BMC medical research methodology. 2017;17(1):14.

212. Maruish ME. Use of Psychological Testing for Treatment Planning and Outcomes Assessment : Volume 3: Instruments for Adults. Mahwah, UNITED STATES: Lawrence Erlbaum Associates, Incorporated; 2004.
213. Lovibond PF, Lovibond SH. The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behaviour research and therapy. 1995;33(3):335-43.
214. Henry JD, Crawford JR. The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. British Journal of Clinical Psychology. 2005;44(2):227-39.
215. Crawford J, Cayley C, Lovibond PF, Wilson PH, Hartley C. Percentile Norms and Accompanying Interval Estimates from an Australian General Adult Population Sample for Self-Report Mood Scales (BAI, BDI, CRSD, CES-D, DASS, DASS-21, STAI-X, STAI-Y, SRDS, and SRAS). Australian Psychologist. 2011;46(1):3-14.
216. Collins CE, Boggess MM, Watson JF, Guest M, Duncanson K, Pezdirc K, et al. Reproducibility and comparative validity of a food frequency questionnaire for Australian adults. Clinical Nutrition. 2014;33(5):906-14.
217. Petersen KS, Smith JM, Clifton PM, Keogh JB. Dietary intake in adults with type 1 and type 2 diabetes: validation of the Dietary Questionnaire for Epidemiological Studies version 2 FFQ against a 3-d weighed food record and 24-h urinalysis. British Journal of Nutrition. 2015;114(12):2056-63.
218. Xinying PX, Noakes M, Keogh J. Can a food frequency questionnaire be used to capture dietary intake data in a 4 week clinical intervention trial? Asia Pacific journal of clinical nutrition. 2004;13(4).
219. Young MD, Collins CE, Callister R, Plotnikoff RC, Doran CM, Morgan PJ. The SHED-IT Weight Loss Maintenance trial protocol: A randomised controlled trial of a weight loss maintenance program for overweight and obese men. Contemporary clinical trials. 2014;37(1):84-97.
220. Laboratories ACoPSfCPF. Statement AT: Guidelines for the Six-Minute Walking-Test. Am J Respir Crit Care Med. 2002;166:111-7.
221. Bennell K, Dobson F, Hinman R. Measures of physical performance assessments: Self-Paced Walk Test (SPWT), Stair Climb Test (SCT), Six-Minute Walk Test (6MWT), Chair Stand Test (CST), Timed Up & Go (TUG), Sock Test, Lift and Carry Test (LCT), and Car Task. Arthritis Care & Research. 2011;63(S11):S350-S70.
222. Bean JF, Kiely DK, LaRose S, Alian J, Frontera WR. Is Stair Climb Power a Clinically Relevant Measure of Leg Power Impairments in At-Risk Older Adults? Archives of Physical Medicine and Rehabilitation. 2007;88(5):604-9.
223. Paul SS, Canning CG. Five-repetition sit-to-stand. Journal of physiotherapy. 2014;60(3):168.
224. Bohannon RW. Test-retest reliability of the five-repetition sit-to-stand test: a systematic review of the literature involving adults. The Journal of Strength & Conditioning Research. 2011;25(11):3205-7.
225. Li X, Forman DE, Kiely DK, LaRose S, Hirschberg R, Frontera WR, et al. Validity of an Exercise Test Based on Habitual Gait Speed in Mobility-Limited Older Adults. Archives of Physical Medicine and Rehabilitation. 2012;93(2):344-50.
226. Reuter SE, Massy-Westropp N, Evans AM. Reliability and validity of indices of hand-grip strength and endurance. Australian Occupational Therapy Journal. 2011;58(2):82-7.

227. Bellace JV, Healy D, Besser MP, Byron T, Hohman L. Validity of the Dexter Evaluation System's Jamar Dynamometer Attachment for Assessment of Hand Grip Strength in a Normal Population. Journal of Hand Therapy. 2000;13(1):46-51.
228. Seo D-i, Kim E, Fahs CA, Rossow L, Young K, Ferguson SL, et al. Reliability of the One-Repetition Maximum Test Based on Muscle Group and Gender. Journal of Sports Science & Medicine. 2012;11(2):221-5.
229. Borg GA. Psychophysical bases of perceived exertion. Med sci sports exerc. 1982;14(5):377-81.
230. Razali NM, Wah YB. Power comparisons of shapiro-wilk, kolmogorov-smirnov, lilliefors and anderson-darling tests. Journal of statistical modeling and analytics. 2011;2(1):21-33.
231. Quade D. Rank analysis of covariance. Journal of the American Statistical Association. 1967;62(320):1187-200.
232. Cohen J. Eta-squared and partial eta-squared in fixed factor ANOVA designs. Educational Research Review. 1973;33(1):107-12.
233. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults' participation in physical activity: review and update. Medicine & Science in Sports & Exercise. 2002;34(12):1996-2001.
234. Martin KA, Sinden AR. Who will stay and who will go? A review of older adults' adherence to randomized controlled trials of exercise. Journal of Aging and Physical Activity. 2001;9(2):91-114.
235. Carnethon MR. Physical Activity and Cardiovascular Disease: How Much is Enough? American journal of lifestyle medicine. 2009;3(1 Suppl):44S-9S.
236. Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL, Lin N, Lewis R, et al. Using pedometers to increase physical activity and improve health: a systematic review. Jama. 2007;298(19):2296-304.
237. Zhou B. Effect of body mass index on all-cause mortality and incidence of cardiovascular diseases--report for meta-analysis of prospective studies open optimal cut-off points of body mass index in Chinese adults. 2002.
238. Huxley R, Mendis S, Zheleznyakov E, Reddy S, Chan J. Body mass index, waist circumference and waist: hip ratio as predictors of cardiovascular risk—a review of the literature. European journal of clinical nutrition. 2010;64(1):16-22.
239. Crawford J, Cayley C, Lovibond PF, Wilson PH, Hartley C. Percentile norms and accompanying interval estimates from an Australian general adult population sample for self-report mood scales (BAI, BDI, CRSD, CES-D, DASS, DASS-21, STAI-X, STAI-Y, SRDS, and SRAS). Australian Psychologist. 2011;46(1):3-14.
240. Hallgren M, Kraepelien M, Öjehagen A, Lindefors N, Zeebari Z, Kaldo V, et al. Physical exercise and internet-based cognitive–behavioural therapy in the treatment of depression: randomised controlled trial. The British Journal of Psychiatry. 2015;207(3):227-34.
241. Donkin L, Christensen H, Naismith SL, Neal B, Hickie IB, Glozier N. A systematic review of the impact of adherence on the effectiveness of e-therapies. Journal of medical Internet research. 2011;13(3).
242. Albert B. Health Promotion by Social Cognitive Means. Health Education & Behavior. 2004;31(2):143-64.
243. Courtney MM, David R. Bassett, Jr., Eugene CF, Hollie AR, Dixie LT. Effect of Adding Online Social Support Tools to an Adult Walking Program: A Pilot Randomized Controlled Trial. Health Promotion Practice. 2016;18(1):84-92.

244. Laranjo L, Arguel A, Neves AL, Gallagher AM, Kaplan R, Mortimer N, et al. The influence of social networking sites on health behavior change: a systematic review and meta-analysis. Journal of the American Medical Informatics Association. 2015;22(1):243-56.
245. Foster D, Linehan C, Kirman B, Lawson S, James G. Motivating physical activity at work: using persuasive social media for competitive step counting. Proceedings of the 14th International Academic MindTrek Conference: Envisioning Future Media Environments; Tampere, Finland. 1930510: ACM; 2010. p. 111-6.
246. Maher CA, Lewis LK, Ferrar K, Marshall S, De Bourdeaudhuij I, Vandelanotte C. Are Health Behavior Change Interventions That Use Online Social Networks Effective? A Systematic Review. Journal of Medical Internet Research. 2014;16(2):e40.
247. Facebook. Company Info California: Facebook; 2018 [Available from: https://newsroom.fb.com/company-info/.
248. Alley SJ, Schoeppe S, Rebar AL, Hayman M, Vandelanotte C. Age differences in physical activity intentions and implementation intention preferences. Journal of Behavioral Medicine. 2017.
249. Broekhuizen K, Kroeze W, van Poppel MN, Oenema A, Brug J. A systematic review of randomized controlled trials on the effectiveness of computer-tailored physical activity and dietary behavior promotion programs: an update. Annals of Behavioral Medicine. 2012;44(2):259-86.
250. Prestwich A, Sniehotta FF, Whittington C, Dombrowski SU, Rogers L, Michie S. Does theory influence the effectiveness of health behavior interventions? Meta-analysis. Health Psychology. 2014;33(5):465-74.
251. Michie S, Abraham C, Whittington C, McAteer J, Gupta S. Effective techniques in healthy eating and physical activity interventions: a meta-regression. Health Psychology. 2009;28(6):690.
252. Gorin AA, Powers TA, Koestner R, Wing RR, Raynor HA. Autonomy support, self-regulation, and weight loss. Health Psychology. 2014;33(4):332-9.
253. Adams N, Little TD, Ryan RM. Self-Determination Theory. Development of Self-Determination Through the Life-Course: Springer; 2017. p. 47-54.
254. Williams GC, Grow VM, Freedman ZR, Ryan RM, Deci EL. Motivational predictors of weight loss and weight-loss maintenance. Journal of personality and social psychology. 1996;70(1):115.
255. Kinnafick F-E, Thøgersen-Ntoumani C, Duda JL, Taylor I. Sources of autonomy support, subjective vitality and physical activity behaviour associated with participation in a lunchtime walking intervention for physically inactive adults. Psychology of Sport and Exercise. 2014;15(2):190-7.
256. Gagné M, Deci EL. Self-determination theory and work motivation. Journal of Organizational behavior. 2005;26(4):331-62.

7 Appendix

7.1 Appendix 1- Systematic review search terms.

Table 6.1: Systematic review search terms

Umbrella term	Search terms
Workplace	Employe$ OR Corporation OR Workplace OR Worksite$ OR Company OR worker$ OR staff OR occupation$ OR job$
Behaviour	Behaviour$ OR Behavior$ OR lifestyle OR Habit OR wellness OR Health$ OR Health promotion OR Fitness
Physical activity	Physical Activity OR Exercise OR aerobic OR anaerobic OR training OR weight training OR resistance training OR fitness OR incidental activity
On-line	web$ OR internet$ OR online OR computer OR mobile OR e-health OR ehealth$ OR world wide web

7.2 Appendix 2: Telephone screen

Participant's Name:_____

TELEPHONE SCREENING FORM
(RevUP Study)

Investigator Review:

- ☐ Eligible
- ☐ Ineligible
- ☐ On hold

Comments:

Date of Telephone Call: _____Interviewer: _____

Source of Subject:
_____

The aim of this study is to see how effective a lifestyle change program, which involves the delivery of online educational material and personalised follow up, is in changing lifestyle behaviour. I would like to give you a brief overview of how the lifestyle intervention study is designed. The research involves a 24-week commitment from you. At the start of the study you will be randomised (like the toss of a coin) into one of two groups. One group will receive the online educational material and personalised follow up immediately. This will involve an initial assessment of your health, physical activity levels and dietary intake. You will then be required to follow the online program for twelve weeks, which will involve listening to a 20 minute audio/video seminar and participating in an online one-on-one behavioural counselling session each week. At the end of the 12-week program you will be re-assessed for physical activity and dietary behaviour. You will then continue to implement the things you have learned throughout the program for a further 12 weeks, before we re-assess your diet and physical activity to see how you are going long-term.

The other group will go on a wait-list for 12 weeks, and be offered the lifestyle change program between weeks 12 and 24.

At the first visit, we will provide you with some questionnaires to fill out regarding your current exercise, diet, health status and demographic information. A test of your initial fitness and strength will be carried out on the major muscles of the body**.** We will also do some active tests of your balance and mobility. On another day you will also be required to attend a pathology collection centre (whichever one is most convenient for you) to give a blood sample. These assessments will be repeated at 12-weeks, and at the end of the 24-weeks to measure any changes.

I will need to ask you some questions to determine whether you are eligible to participate in the study. Are you interested in proceeding with this screening?
YES NO

If NO, why not?
_____

2. Name:
_____

3. Phone
number_____

4. Address_____
_____

_____

5. What is your date of birth ? _____/_____/_____How old are you now ?
____ years

6. Can you walk at least the length of the room without the assistance of another person ?
YES NO

If NO, why not ? _____

_____

7. Are you an employee of the Uniting Church in Australia
YES NO

Synod / Area _____

_____

Exclude if no to either of the above - END HERE (If not sure, continue with screening)

"Thank you Mr / Mrs……., based on this information you are not eligible for this particular study but if another study is more suitable, may we keep your contact information and call you?"

YES NO

"Thank you for your assistance"

OR continue screening

2. Do you take any medications?
YES NO

Medications	Dose	Frequency	Reason

3. Do you have any chronic illnesses or conditions?
YES NO

Disease	Date of onset/ diagnosis	Currently stable or controlled

4. Do you have a pacemaker?
YES NO

5. Do you have angina (chest pain)?
YES NO

If yes, when was your last attack? Date _____/_____/_____

How often do the attacks occur?_____

What usually brings on your angina?_____

What is your usual treatment?_____

6. Have you ever had a heart attack ?
YES NO
If YES, please specify: Date _____/_____/_____

7. Do you have or have you had a hernia?
YES NO

If YES specify: _____

_____

_____

2. Do you have hemorrhoids?
YES NO

If YES specify: _____

_____

_____

3. Do you have arthritic joints?
YES NO

If YES specify: _____

_____

_____

4. Have you had a blood clot in the lung or leg in the last 6 *months ?*
YES NO

If YES, give details: _____

_____

5. Do you have any other chronic disease which is out of control or has changed rapidly in the last 6 months ? YES NO

If YES, give details: _____

_____

6. Have you had an amputation ?
YES NO

If YES, give details: _____

_____

2. Are you currently participating in any other research studies?
YES NO

If YES, what are they ? _____
Type: _____
Frequency: _____
Time: _____

3. If accepted for this study are you willing to be randomised to one of two groups
where you may be required to participate in online education sessions?

YES NO

Are you available to participate in this study for a continuous 24 week period?

YES NO

If NO, why not : _____

4. Are you willing to:

Attend a central Sydney/Melbourne location for 3 assessment days: one at baseline, one at 12 weeks, and one at 24 weeks?
YES NO

Attend a Pathology Centre to give a blood and urine sample: once at baseline, once at 12 weeks, and once at 24 weeks?
YES NO

If NO, why not: _____

If YES, would transportation be difficult for you?
YES NO

Explain transport
needs_____

_____
____

Thank you for answering all of these questions. The chief investigator of the study is Doctor Jonathan Freeston. He will review this questionnaire and we will notify you as whether you are eligible for further screening for this study. Do you have any further questions about the study?

Comments:
_____

_____
_____

_____
_____

If on HOLD, reason:

TELEPHONE RESPONSE IF ELIGIBLE

After reviewing your telephone screening questionnaire, we have decided that you are **potentially eligible** to participate in the research study examining the effects of a online lifestyle modification program.

May I have the name and address of your GP to send a medical information release form?

Name: _____

Address: _____

_____

_____

Phone: _____

Could you tell me the name of a friend or family member to contact in case of emergency?

Name: _____

Phone: _____

Relationship to you: _____

You will receive an information pack in the mail. This will include:

1. Information about the study

1. A letter for you to send to your GP
2. Information about the upcoming assessment days
3. Permission slip for you to sign and give to your doctor

Baseline Assessment at .....am on ...../ ..... / ..... at ……

Blood and Urine on ...../ ..... / ..... at .....(Closest collection centre)

If you have any questions or concerns about the study before we contact you again, please call Dr Jonathan Freeston on 02 9351 9258. If he is unable to take your call, please leave a message and he will call you back. Thank you very much.TELEPHONE RESPONSE IF ON HOLD

After reviewing your telephone screening questionnaire, unfortunately we have found that you are not eligible to participate in our research study at this time. This is because:

1. Need more medical information (go to option a.)
2. Other:_____ (go to option b.)

a. May I have the name and address of your GP so I could obtain more information about your health?

Name: _____

Address: _____

_____

_____

Phone: _____

b. We would however, like your permission to contact you again on

DATE FOR RE-CONTACT (in 6 months time):
_____/_____/_____

regarding your availability for this study or another study.

THANK YOU FOR YOUR INTEREST

PERMISSION TO RE-CONTACT YES NO

TELEPHONE RESPONSE IF PERMANENTLY INELIGIBLE

After reviewing your telephone screening questionnaire, unfortunately we have found that you are not eligible to participate in our research study. This is because:
(reason)_____

_____

_____

Would you give us permission to contact you about other studies that may come up in the future.

THANK YOU FOR YOUR INTEREST

PERMISSION TO RE-CONTACT YES NO

7.3 Appendix 3: Informed Consent form

THE UNIVERSITY OF SYDNEY

ABN 15 211 513 464

Discipline of Exercise, Health & Performance School of Exercise & Science Sport Faculty of Health Sciences

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REV UP: A HEALTHY LIFESTYLE INTERVENTION PROGRAM

PARTICIPANT INFORMATION STATEMENT

(1) What is the study about?

You are invited to take part in a research study that will investigate the effectiveness of a healthy lifestyle intervention program.

Lifestyle intervention programs have been used successfully to modify physical activity levels and eating behaviour in order to improve health in a range of populations. These programs however, have typically involved high numbers of face to face meetings leading to large program delivery costs and low accessibility to regional and remote areas.

Given recent technological developments, it is possible to deliver large proportions of these lifestyle intervention programs via online methods using the internet and email to reduce costs and improve accessibility to more people in more locations.

Our main aim is to find out if the delivery of this lifestyle intervention program will increase physical activity levels and improve healthy eating among staff members of this multi-site organisation. The results from this study will guide future lifestyle modification prescription in larger studies.

(2) Who is carrying out the study?

The study is being conducted by Dr Jonathan Freeston at The University of Sydney.

(3) What does the study involve?

In order to participate in this study you must be working for the Uniting Church in Australia and be willing to participate in a 52-week study.

The study will last for a total of 52 weeks. If you agree to participate in this study, you will be asked to sign the Participant Consent form. You will then undergo the following procedures:

Assessment
You will be assessed before beginning the trial, at 12 weeks, at 24-weeks and at 52 weeks. We expect the assessment to take up to 2.5 hours. For each assessment, you will need to avoid ingesting food or fluids for 12 hours prior to the test, avoid the consumption of alcohol for 12 hours prior to the test, avoid exercise, strenuous exertion and taking a sauna 8 hours prior to the test. Please also note that testing can not be carried out if you have a fever. Each testing session will include:

Questionnaires to gather demographic information such as ethnicity, employment and education as well as personal health information such as smoking and alcohol use.

Questionnaires to evaluate your physical activity levels, eating behaviour, and mood.

THE UNIVERSITY OF SYDNEY

Tests of your muscle strength, walking endurance (walking as far as you can in 6 minutes), walking speed over 2 m, balance, stair climbing (time taken to climb one flight of stairs), chair stand performance (time taken to rise 5 times in a row), handgrip strength. Body Composition: We will measure your height, weight and waist circumference. We will also measure total body weight and fat free mass using bioelectrical impedence analysis. An electrode will be placed on your right hand and foot before a low-level electrical current is passed through your body. This will not cause any discomfort nor impose any risk.

Blood pressure: Your blood pressure will be measured using an automatic cuff. There may be minor discomfort during the inflation of the cuff, but this will not impose any risk.

Blood Samples Collection
Blood samples (40 ml or about 8 teaspoons) will be taken to assess your blood fats and glucose levels. You will be required to fast for a period of eight hours prior to attending the facility.

Actigraph Monitors: You will be asked to wear a small activity monitor on your wrist (about the size of a watch) and one on a belt. This will measure your activity over the period of a week and will not interfere with your daily routine or pose any risk. You will need to write down the times that you take the monitors off (e.g. to shower) and put them back on. A log sheet will be provided for this.

After wearing the actigraph monitors for a period of eight days, you will be asked to return the monitors and log sheet to the University of Sydney, Cumberland Campus. During this visit you will also be asked to repeat the strength and walking endurance tests as described above. We expect this to take approximately 30 minutes each visit.

Healthy Lifestyle Intervention Program
After you complete the screening process and baseline assessment (above) you will be randomly allocated (like the toss of a coin) to one of two different groups. Neither you nor the researchers will be able to decide which group you join. One group will receive lifestyle modification material delivered online and receive regular email follow-up. The other group will go on a wait-list and maintain their normal lifestyle and will be offered the lifestyle program after completing the post-intervention assessments.

The lifestyle intervention program requires that each week you download and listen to a 20 minute podcast and complete a number of activities relating to the week's topic.

The risks of participating in this study are:

Blood sampling: This is a very common procedure and causes little discomfort or risk. Rarely blood may leak from a vein, but applying pressure over the vein easily stops this. However, a bruise may still appear at the site. The risks and discomforts will be minimised, as highly experienced people will perform this procedure under sterile conditions. The total amount of blood taken over the study is small and will not result in any harm.

Exercise testing: There is a small risk of musculoskeletal soreness or injury during physical function tests. This is very rare during the kind of strength and gait testing proposed here. As with any exercise testing, there are possible risks of injury or a heart attack. You will be closely supervised by a trained and experienced health professional during all testing procedures. Physical activity may cause some muscle soreness, dizziness or fatigue. To minimise these risks, we will carefully monitor you throughout your training, and take care to gradually increase your exercise volume to maximise your safety.

THE UNIVERSITY OF SYDNEY

During each test procedure, and at regular weekly intervals throughout the study, we will ask you to inform us of any negative symptoms that you may experience. It is important that you contact the study staff immediately if there are any unusual health experiences, injury or bad effects. This notification should take place whether or not you believe that the problem is related to the lifestyle intervention or from some other cause. Prior to any testing, your GP will review your medical history and the study protocols to make sure that you are medically ready for the study procedures. For this to occur, we will provide you with documents to take to your GP, outlining the nature of the study and the inclusion/exclusion criteria. The GP will then review these documents and provide information regarding your suitability for the study.

(4) How much time will the study take?

You will be assessed on four occasions, at baseline, 12 weeks, 24-weeks at 52 weeks. We expect each assessment to take up to 2.5 hours. The lifestyle intervention program requires that each week you download and listen to a 20 minute podcast and complete a number of activities relating to the week's topic.

(5) Can I withdraw from the study?

Being in this study is completely voluntary - you are not under any obligation to consent and - if you do consent - you can withdraw at any time without affecting your relationship with The University of Sydney or The Uniting Church in Australia.

(6) Will anyone else know the results?

All aspects of the study, including results, will be strictly confidential and only the researchers will have access to information on participants.

A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

(7) Will the study benefit me?

While we intend that this research study furthers medical knowledge and may improve lifestyle modification prescription in the future, it may not be of direct benefit to you. We expect that the lifestyle intervention will increase your physical activity levels and improve your eating behaviour and consequently may reduce your risk of disease and also provide you with improved strength, fitness and function.

(8) Can I tell other people about the study?

You are welcome to tell other people about the study.

(9) What if I require further information about the study or my involvement in it?

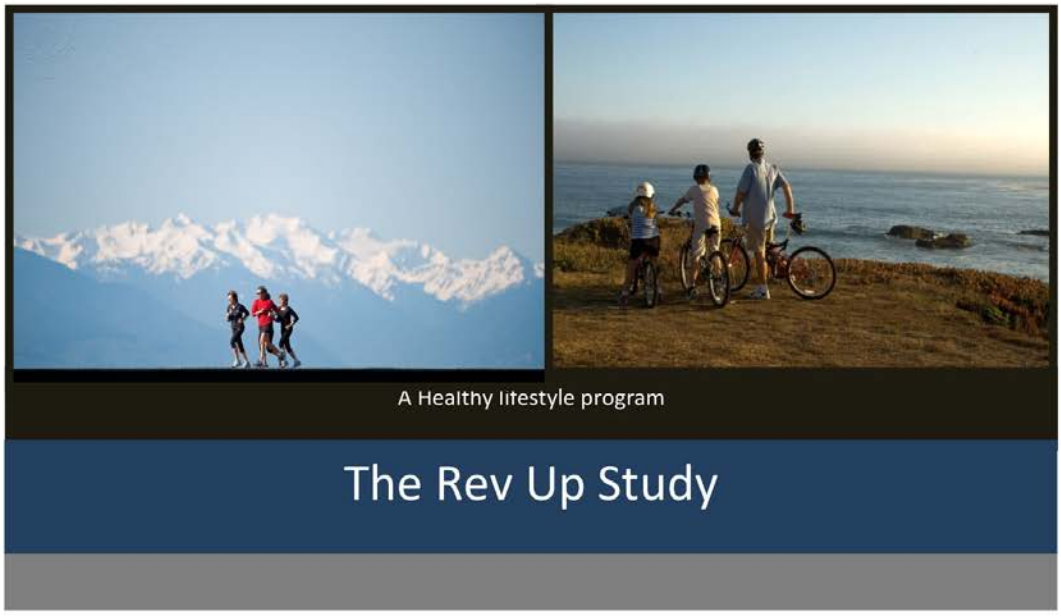
When you have read this information, Dr Freeston will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Dr Freeston, Lecturer on 02 9351 9528.

(10) What if I have a complaint or any concerns?

Any person with concerns or complaints about the conduct of a research study can contact The Manager, Human Ethics Administration, University of Sydney on +61 2 8627 8176 (Telephone); +61 2 8627 8177 (Facsimile) or ro.humanethics@sydney.edu.au (Email).

This information sheet is for you to keep

7.4 Appendix 4: REVUP newsletters



Welcome to the RevUP study.

We have developed this internet-based lifestyle program specifically for uniting church workers in New South Wales

The Goal...

Reduce your risk of lifestyle related diseases through improvement of modifiable risk factors.

To help you reach this goal, we will:

1) Send you regular information, tips, and advice via email and video log.
2) Tailor your exercise goals to match your current level of activity.
3) Educate you on healthy eating choices.
4) Help you to monitor your progress over duration of the study.

Why a lifestyle intervention?

There are many facets to a healthy life. The REV UP program is designed to help you to make smarter and healthier choices in some of these areas. Particularly we will focus on exercise, nutrition and overcoming barriers to living a healthy lifestyle.

Increasing your activity level and moving more can help in a number of ways.

Being more active can:

- Help you feel, look, and sleep better.
- Make you more physically fit. It will be easier for you to do your daily tasks, like climbing stairs and keeping up with your kids/grandkids.
- Help you lose weight and keep it off.
- Improve bone and muscle strength; improve joint health, flexibility, and balance.
- Lower your risk for heart disease and diabetes.

Being more active may:

- Raise HDL cholesterol (the "good" cholesterol/fat in your blood).
- Lower triglycerides (improves heart health).
- Lower blood pressure.
- Lower blood sugar and make your body more sensitive to insulin.

'Congratulations on taking the first step to a healthier lifestyle. We designed this program to help you to improve your lifestyle habits in simple steps'

Dr Jonathan Freestone, Ph.D

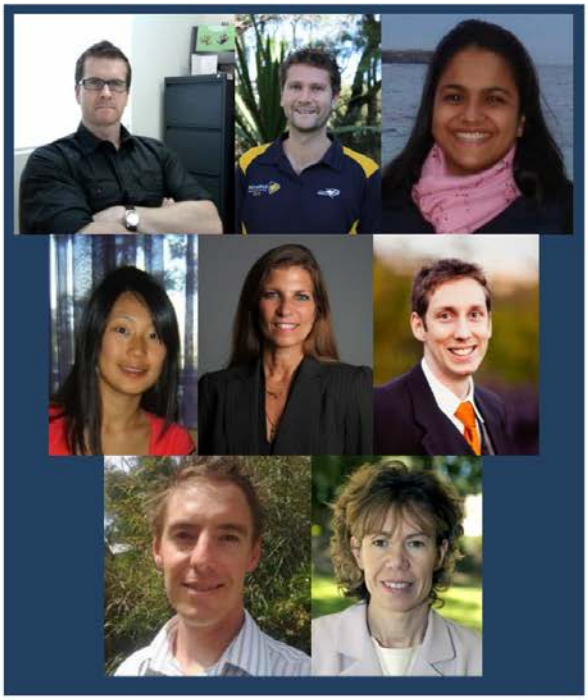
Benefits of eating healthy

Lifestyle programs similar to this have shown good results in improving the healthy behaviours of participants.

Good nutrition is an important part of living a healthy lifestyle and is vital for good health and wellbeing. Healthy eating for life can help you:

- Maintain a healthy weight
- Reduce your risk of chronic diseases (like heart disease, type 2 diabetes, high blood pressure and some types of cancers.
- Improve energy levels

Meet the team.



We have assembled a team of experts to help you as you work through the program.

With expertise in nutrition, exercise, behaviour change and medicine we are ready and willing to answer any questions you have during the program.

You will have contact with most of these people over the course of the program either face to face, via email or over the phone.

Your exercise expert.

Tim will be your primary contact throughout the project. He is an exercise physiologist and will guide you through the program via email. If you have any questions as you work through the program please feel free to send him an email at **exss_revup@sydney.edu.au**

Stay safe while revving up!

Research has shown that appropriate exercise is safe for most people. However, it is important to keep safety in mind while you are exercising.

Listen to your body and signals of pain, tiredness, and discomfort.

If you have a question about safety please contact your doctor.

Also you can speak with our exercise physiologist, Tim.

Exercising in hot weather can put additional strain on your body. Symptoms of heat illness include:

- Weakness
- Nausea
- Cramps
- Headache
- Irritability
- General discomfort

DO NOT exercise, or stop if:

- Your pulse is racing
- You have a fever
- You have calf pain
- You have chest pain
- You are nauseated while you are exercising
- You feel confused or disorientated
- You feel dizzy or faint
- You have blurred vision
- You feel suddenly short of breath
- You feel suddenly very weak or tired
- Numbness or loss of feelings in the hands and/or feet
- Shortness of breath or difficulty breathing
- An irregular heart beat
- Sudden joint or bone pain

If you experience these symptoms you should STOP exercising immediately and seek medical attention

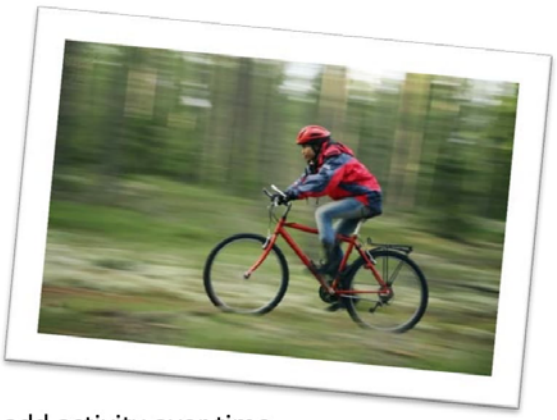
To avoid heat problems:

- Exercise during the cooler parts of the day
- Drink water before and during exercise
- Wear a hat and protective clothing, light coloured, loose fitting clothes are good
- Avoid alcohol, tea, or coffee before exercise
- Take frequent breaks, and ease off on how hard you are working if necessary.

So what can you expect of the RevUp program as we get started?

First of all, you can succeed!

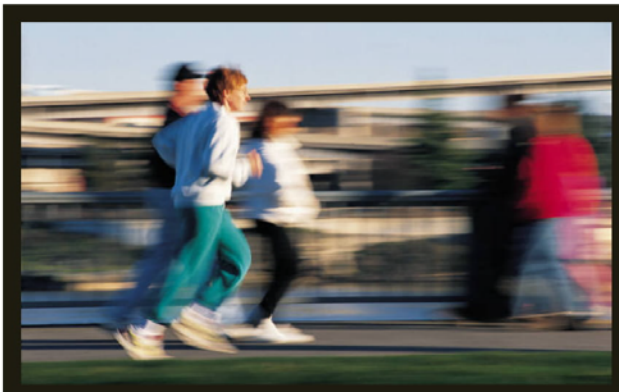
The following are key reasons why this lifestyle program can and will work for you:



- This program is built of well researched principles of lifestyle change.
- Most of you will likely choose walking as your activity, although other activities that make you breathe harder will work too.
- The starting point is where you are right now. **No judgement, no questions asked.** You will gradually add activity over time.
- You will be asked to keep track of your activity levels and to plan where to add activity to your week.
- Keeping track is important because it will help you understand your current activity habits.
- Planning ahead to include activity in your week is also very important because these things do not just happen by chance. We need to plan ahead for when we expect to do physical activity.
- Your progression will be slow and safe with increases of no more than 30 minutes per week. That is less than 5 minutes per day.

The next steps…

Start thinking about ways to make positive changes to your activity and eating habits. *You will receive an email newsletter every week in addition to a short video. Next week we will begin to look at getting active.*



Goal

The goal is for you to work up to doing a minimum of **150 minutes of moderate activity** each week, aiming for **300 minutes** after 3 months.

A Healthy lifestyle program

1. Getting Active.

The Rev Up Study 1

Getting started

One of the goals of this program is to help you improve your levels of physical activity. It is one the easiest and cheapest things you can do to make a dramatic difference to your health.

The new national guidelines are to reach 300 minutes of moderate activity every week.

How hard should moderate activity feel?

- Moderate activity is the level of a brisk walk, or walking as if you were late for an appointment.
- Moderate activity should make you breathe harder without feeling out of breath.

Quick tips!

- The 300 minutes should be divided over the whole week
- Bouts of ten minutes or longer count towards reaching the 300 minute total.
- Pick activities that you enjoy. For example, walking, golf (without the cart), biking, swimming, dancing and much more.

Refer to the safety guide before you begin.

How do I start?

Each week you should try and gradually increase the amount of physical activity that you do.

However, work up to your activity goal **slowly**. A good rule of thumb is to increase by no more than 30 minutes each week. This would mean adding five extra minutes on six days of the week.

Remember to pick activities you enjoy. Also,

- Choose types of physical activity that are of moderate intensity (i.e. brisk walking)
- Pick activities you could do with other people
- Spread the activity over most days of the week
- Ask your friends, family or neighbours to be active with you
- Look for activities you can do close to home or close to work.

'Making a commitment to get active really helped me to stay motivated'

-John

Starting a program can be hard!

Making a plan and setting goals can help you. We will cover goal setting in-depth next week, but in the meantime try to answer some of these questions to help get moving.

What makes regular exercise important to me?

_____

_____

_____

What types of physical activity do I like to do?

_____

_____

_____

Are there activities that I did in the past that I can take up again?

_____
_____
_____

Who can I ask for support?

_____
_____
_____

Do I need special clothes or equipment?

_____
_____
_____

How long will these activities take?

_____
_____
_____

When and where can I do these activities?

_____
_____
_____

Do I have a wet (or hot) weather alternative?

_____
_____
_____

The physical activity goal

Your physical activity goal is a reachable, weekly goal. So what exactly is it?

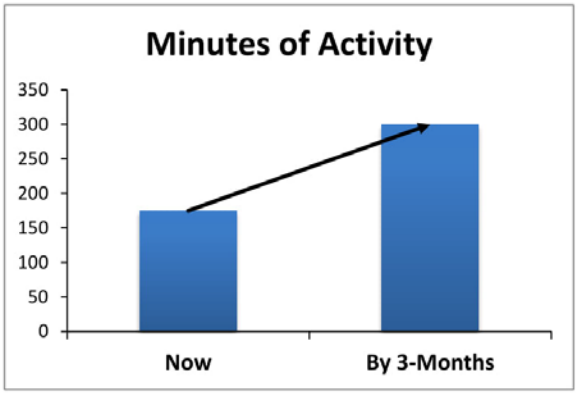
NAME, in the initial assessment you told us that you are doing about 175 minutes of moderate or vigorous exercise a week.

This is a great start! You are receiving most of the health benefits of exercise already. We would like to increase this level towards 300 minutes of moderate exercise per week.

Why 300 minutes per week?

Getting your 300 minutes of exercise every week is the recommendation from the National government department of health and aging.

In many scientific studies, those who reach this physical activity level regularly get many health benefits



Your goal for this week:

Try filling this in for your goal this week!

Starting _____ (date)

I will _____(activity),

for _____ minutes _____ times this week.

A Healthy lifestyle program

2. Goal Setting

What is goal setting?

Goal setting is just planning a journey. It is a simple as knowing where you are now and knowing where you want to be. The tricky bit is bridging the gap!

Why is goal setting important?

The great thing about goal setting and one of the reasons why it is so effective is that it allows us to tackle a big task in bite sized pieces. It gives us clear direction and focus and can help us steer clear of distractions.

Although we focus on activity goals in this study, feel free to use goal setting in other areas as well! It has been effectively used in nutrition, smoking and other health areas!

Setting SMART goals

Not all goals are well thought out. The SMART acronym is a great way to develop effective goals. Each goal should have an element of these five principles in it.

S-SPECIFIC →Describe what you will do and how you will do it.

- The more specific you are the better. If your goal is non-defined how will you know when you reach it?
- 'I will walk ten minutes a day, 5 days of the week. I will walk quickly enough that I am breathing heavily'

M-MEASUARBLE → Can you have an objective measure of your goal?

- Avoid term such as 'get fit' or 'eat healthier'. Have an objective measure of your goal such as minutes walked, or pieces of fruit eaten.
- This will enable you to keep track of our goal as you progress.

A-ACHIEVABLE → Can you meet this goal?

- Pick a goal you think you can meet, for example, I will increase my activity by 3 minutes a day
- By gradually adding minutes, you can reach the goal of 150 minutes of activity

R-REWARDING → Is this goal meaningful for me?

- Try to consider the health benefits that come with moving more and eating healthier.
- 'I will exercise 150 minutes per week so that I can keep up with my grandchildren'

T-TIMELINE→ How long will this goal take?

- Think short and long term
- Short term goals can be as little as a week. Long term goals should be monthly. Your short term goals should be working towards your longer term goals.

Learning to set your own goals will help you to be successful

One of the most important things you can do with your goal is write it down, and stick is somewhere you will be reminded of it frequently. Stick it to the fridge, to the bathroom mirror or make it your computer background. The more you see it, the more likely you are to work at it.

Process goals vs results goals

A process goal is one centred around an action such as 'going jogging for 30 minutes, 5 times per week'. This is a great goal! Until you don't feel like going jogging. Then it will fall apart quickly.

Setting results based goals should help to add in a little extra motivation. Add in the reason why you are going jogging three times per week. A good example of a results based goal is 'I will jog for 30 minutes, five times per week to reduce my weight to 70kg.'

Process goals make great short term goals. But don't forget the reason why you are working hard!

Why do people fail at sticking to their goals?

There are many reasons why people fail to reach their goals. Some are avoidable, other not so. Here are a few common reasons why people don't quite make it.

- Setting too many goals at one time. Stick with just one or two, so you can stay focused on them.
- Not scheduling time to work on your goals.
- Not coming up with an action plan to reach your goal.

Take Action!

Last week we set a goal for increasing your physical activity. This is something we definitely want to keep working towards. This week let's take that goal and build it into a long term plan to reach (or exceed!) the recommended 300 weekly minutes of moderate intensity exercise. Use the table below to draft out some short term weekly goals. If 300 minutes is too much or too little, set your own 12 week goal that you believe you can reach.

Total minutes of each week	Timeline	Small goals
	Week 4	
	Week 5	
	Week 6	
	Week 7	
	Week 8	
	Week 9	
	Week 10	
	Week 11	
300	Week 12	

A Healthy lifestyle program

3. Healthy Eating- Fruits and Vegetables

REV UP Study 3

This week we are going to explore fruit and vegetable intake, and how a few simple changes can make a big difference to both how you feel, but also to your metabolic health.

What is so great about fruits and vegetables?

Fruits and vegetables are nutrient dense and carry an abundance of vitamins, minerals, dietary fibre and antioxidants, all for very low kilojoules!

How many serves should of fruits and vegetables should I be eating for good health?

The recommended daily intake for most adults is at least 2 serves of fruit and 5 serves of vegetables. This will vary slightly with age.

Recommended average daily intake of **fruit**:

Adult	19-50 years	51-70 years	70+ years
Men	2	2	2
Women	2	2	2

Recommended average daily number of **vegetable** serves:

Adult	19-50 years	51-70 years	70+ years
Men	6	5 ½	5
Women	5	5	5

What is a serve?

One serve of fruit is150g (350kJ) of fresh fruit or:

- One medium apple, banana, orange or pear
- 2 small apricots, kiwi fruits or plums
- 1 cup diced, cooked or canned fruits (unsweetened)
- ½ tablespoons (30g) dried fruit
- 125ml (1.2cup) unsweetened fruit juice

One serve of vegetables is 75g (100-350kJ) or:

- ½ cup cooked green or orange vegetables (e.g. broccoli, spinach, carrots, pumpkin)
- ½ cup cooked, dried or canned beans (with no added salt), peas or lentils
- 1 cup green leafy or raw salad vegetables
- ½ cup sweet corn
- ½ medium potato or other starchy vegetables
- 1 medium tomato

☑ **Get more essential fibre**

in your diet by enjoying whole fruits more often instead of drinking fruit juices

☑ **Versatility of vegetables!**

You can do almost anything with vegetables! Eat them raw, grate them, slice them, stir-fry them, boil them or bake them. Perfect as a quick snack or a main ingredient for meals… the options are endless!

Colour your plate!

A wide variety of fruit and vegetable are grown and available in Australia. There is plenty of choice throughout the year. Choosing fruits in season provides better value and better quality. Eating seasonally also adds more variety to your diet throughout the year. Choosing different coloured fruits and vegetables increases the variety of nutrients, which can enhance your overall health!

How do I start?

1. Eat a variety of fruits each week, for example:
   - Apples and pears
   - Citrus fruits such as oranges and mandarins
   - Tropical fruits such as banana and pineapple
   - Berries
   - Grapes
   - Stone fruits such as apricots and peaches

2. Eat a variety of vegetables every day, for example:
   - Dark green vegetables such as spinach and broccoli
   - Orange vegetables such as sweet potato, pumpkin and carrots
   - Leafy green vegetables such as broccoli, cauliflower, cabbage and brussel sprouts
   - Salad vegetables such as lettuce, tomato, cucumber and capsicum
   - Legumes such as dried peas, beans, lentils and chickpeas

3. Fill half your plate with vegetables at each meal or eating occasion.

For example add baked beans & slices of grilled tomato on toast for breakfast, have a cup of salad at lunch and half a plate of vegetables with dinner.

4. Have fruits and raw vegetables sticks as snacks.

5. Add frozen or tinned vegetables, peas or beans to meals, casseroles or sauces
Add grated vegetables or fruit to pikelets, pancakes, scones and muffins

Taking Action!

Making a plan and setting goals can help you get started. This week try to aim for **2** fruits and **5** vegetables every day. Give it a try and see how you go! Use the checklist below to help keep track of your progress.

To do this week:

Goal: I will increase my fruit and vegetable intake each day by:

- ✓ _____
- ✓ _____
- ✓ _____

Starting _____**(date)**

Problems I might have and what I will do to solve them:

_____

_____

Before the next session, answer these questions:

Did you achieve these goals? ☐Yes ☐No ☐Almost

What problems did you have making changes to your diet?

_____

_____

What could you do differently next week?

Checklist: To help you keep track of your fruit and vegetable intake throughout the week, place a tick in the boxes for all the foods you eat each day.

Food type	Number of serves	Serves eaten	Day of the week						
			Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Fruits	**2**	1							
		1							
Vegetables	**5**	1							
		1							
		1							
		1							
		1							

A Healthy lifestyle program

4. The Glycemic Index

REV UP Study 4

This week in the newsletter will focus on carbohydrates. What's good, what's bad and how to make sense of them all.

What are carbohydrates?

Carbohydrates are broken down into glucose in the body and used for energy. Glucose is the main fuel for brain function.

Carbohydrates include:

- Starch (found in cereal, grains & starchy vegetables)
- Sugar (added sugar and naturally occurring sugars)
- Fibre

What's in the grain (cereal) group?

Grains and cereals are great sources of carbohydrates which give the body energy, fibre and vitamins.

The grain group includes:

- Breads
- Breakfast cereals
- Rice
- Pasta
- Noodles
- Polenta
- Couscous
- Oats

What is a serve?

One serve of grain (or cereal) is 500kj. This is equivalent to:

1 slice (40g)	Bread
½ medium (40g)	Roll or flat bread
½ cup (75-120g)	Cooked rice, pasta, noodles, barley, buckwheat, semolina, polenta, bulgur or Quinoa
½ cup (120g)	Cooked porridge
2/3 cup (30g)	Wheat cereal flakes
¼ cup (30g)	Muesli
3 (35g)	Crispbreads
1 (60g)	Crumpet
1 small (35g)	English muffin or scone

What are the best types of carbohydrate?

Go for smart low glycemic index carbohydrates that are digested slowly in the body. This helps you to feel fuller for longer and reduces your chances of overeating throughout the day.

Carbohydrates are also found in:

- Milk, yoghurt, custard, ice-cream
- Fruits
- Starchy vegetables (e.g. potatoes, corn, taro and parsnip)
- Sugars, honey, jams
- Soft drinks and confectionary
- Snack foods like potato chips
- Biscuits, cakes and pastries

How many serves of grain foods should I be eating for good health?

The average recommended daily number of grain serves per day for adults is

	19-50 years	51-70 years	70+ years
Men	6	6	4 ½
Women	6	4	3

What is the Glycemic Index?

The Glycemic Index (GI) orders foods containing carbohydrate on a scale of 0 to 100 according to their effects on blood sugar (glucose) levels after eating.

The GI index is an easy way to help us make better choices when choosing a carbohydrate food to eat.

Why should I go for low GI smart carbs?

Eating 2 pieces of fruit and 5 serves of vegetables everyday can help to:

- Fill you up and keep you feeling fuller for longer
- Maintain a healthy weight
- Prevent and manage obesity
- Manage blood glucose levels
- Protect you from diabetes
- Improve cognitive performance
- Sustain energy levels for longer

How do I start?

Aim for at least one low GI food at each meal and snack. Examples of some common low GI foods:

- Bread: Heavy wholegrain, heavy fruit and pumpernickel bread
- Breakfast cereal: Rolled oats, untoasted muesli and oat bran
- Spaghetti and pasta: all types
- Grains: Barley, buckwheat and burghul/bulgur
- Rice: Basmati or doongara
- Starchy vegetables: Carisma potatoes, sweet potato and corn
- Legumes: all types, canned an dried including kidney beans, baked beans, chickpeas and lentils

Half your plate should be filled with vegetables and/or salad, and one quarter filled with carbohydrate foods, preferably wholegrain and low GI choices.

Look for the Glycemic Index symbol program when reading food labels to help make healthier choices easier.

For a complete list of products that carry the GI symbol, visit www.gisymbol.com

Putting it all together.

Lowering the GI of your diet is simple! Just start by swapping and replacing high GI foods with low GI foods. Adding a low GI food to a meal can lead to a decrease in the overall GI for that meal.

Traffic Light GI list

Use the simple traffic light list below to help you "slow" your consumption of medium and high GI foods, and instead "Go!" for low GI foods more often.

- Low GI – Values less than 55. The best choices when following a Low GI diet.
- Medium GI – Values between 56-69. The next best choices. Approach with caution
- High GI – values more than 70. Eat occasionally.

Food Group	Low GI (Best choice)	GI	Medium GI (Approach with caution)	GI	High GI (Eat occasionally)	GI
Breads	Dense wholegrain & heavy mixed grain breads	35-53	Wholemeal rye bread	58	White bread/ wholemeal	71
			Light rye bread	68	breads	75
	Sourdough wheat	54	Multigrain sandwich breads	65	Lebanese bread	77
	Sourdough rye	48	Crumpets	69	Scone	92
Breakfast Cereals	Traditional porridge oats	52-58	Weetbix	69	Instant oat porridge	82
	Muesli	30-55	All Bran Wheat Flakes	60	Cornflakes	77
	Goodness Superfoods ® varieties	36-39	Just Right	62	Rice bubbles	92
	Guardian		Nutrigrain	66	Coco Pops	77
	All Bran	37	Sultana Bran	64	Puffed wheat	80
		44	Froot Loops	69	Honey Smacks	71
Grains	Spaghetti & pasta	38-49	Gnocchi	68	Instant white rice	87
	Vermicelli	35	Couscous (most brands)	65	Quick brown rice	80
	Rice noodles (fresh)	40	Arborio (risotto) rice	69	Medium grain white rice	75
	Basmati & Doongara (CleverRice)	54-58	Medium grain brown rice	59	Jasmine Rice	79
	white rice			68	Calrose white rice	83
	Low GI brown Rice	54				
Dairy & Alternatives	Skim milk/Fat reduced milk	30-32	Ice-cream, regular, full fat	61	Rice milk	79-92
	Soy milk	17-46	Oat milk	69		
	Diet yoghurts	14-40				
	Fat reduced custard	37-43				
	Low fat ice-cream	24-55				

Food Group	Low GI (Best choice)	GI	Medium GI (Approach with caution)	GI	High GI (Eat occasionally)	GI
Legumes & Starchy Vegetables	Baked beans, canned in tomato sauce	49	Sweet potatoes (orange flesh)	61	Most potatoes *e.g. New potato. Instant mashed potatoes Sebago, Desiree*	78-101
	Soy beans	14-20	Most potatoes *e.g. Pontiac, Nicola, Almera mashed potatoes*	56-74		
	Kidney beans, butter beans, chickpeas	36-37				
	Green lentils	37				
	Peas, frozen boiled	48				
	Corn	48				
	Carisma potatoes	53				
	- - - - - - - - - - - - - - - - - - - -	- - - - -				
	Broccoli, cauliflower, capsicum, celery, leeks, mushrooms, silverbeets, yellow squash	*No GI rating**				
Fruit	Apple, orange, peach, pear, strawberries, grapefruit, banana, mango, grapes	25-53	Sultanas	56	Watermelon	80
			Paw paw	56	Rockmelon	70
			Pineapple	66		
			Cherries	63		

* These vegetables contain very low carbohydrates, therefore they don't have a GI value – so *"GO"* for it!

For a more comprehensive list of foods and GI values visit http://www.glycemicindex.com/foodSearch.php

Take action!

Making a plan and setting goals can help you get started. This week try to aim to include at least one smart low GI food at each meal/snack. Give it a try and see how you go! Use the checklist below to help keep track of your progress.

To do this week:

Goal: I will have at least one low GI food at each meal/snack by

- ✓ _____
- ✓ _____
- ✓ _____

Starting _____**(date)**

Problems I might have and what I will do to solve them:

_____

_____

Before the next session, answer these questions:

Did you achieve these goals? ◯ Yes ◯ No ◯ Almost

What problems did you have making changes to your diet?

_____

_____

What could you do differently next week?

_____

_____

Checklist: to help you keep track of your fruit, vegetable & low GI grain intake throughout the week, place a tick in the boxes for all the foods you eat each day. Note: the number of serve from each food group will depend on your age, gender, energy needs and activity level. Please refer to the beginning of the handout for the recommended number of serves.

Food type	Number of serves	Serves eaten	Day of the week						
			Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Fruits	**2**	1							
		1							
Vegetables	**5**	1							
		1							
		1							
		1							
		1							
Low GI grains (cereals)	**3-6**	1							
		1							
		1							
		1							
		1							
		1							

A Healthy lifestyle program

5. Healthy Eating- Protein & Fat

REV UP Study 5

The topic for this week is protein and fat. We will look at lean sources of protein, as well as the difference between good fats and bad fats.

Protein is an important structural component of cells in the body and is used for growth and repair. Protein rich foods are good sources of iodine, iron, zinc, vitamins particularly B12 and essential fatty acids. They can also help you to feel full and therefore eat less.

Dairy foods and alternatives provide calcium, which is a mineral, needed for healthy bones, teeth and proper function of the heart, muscles and nerves. They are also a good source of many nutrients including protein, iodine, vitamin A, vitamin D, riboflavin, Vitamin B12 and zinc.

Recommended average daily intake of lean meat serves:

Adult	19-50 years	51-70 years	70+ years
Men	3	2 ½	2 ½
Women	2 ½	2	2

Recommended average daily number of dairy serves:

Adult	19-50 years	51-70 years	70+ years
Men	2 ½	2 ½	3 ½
Women	2 ½	4	4

What's in the lean meat and poultry, fish, eggs, tofu, nuts and seeds and legumes/beans group?

Examples include:

- Lean meats
  - Beef, lamb, veal, pork & kangaroo
- Poultry
  - Chicken, turkey, duck, emu, goose & bush birds
- Fish and seafood
  - Fish, prawns, crab, lobster, mussels, oysters, scallops & clams
- Eggs
  - Chicken & duck eggs
- Nuts and seeds
  - Almonds, pine nuts, walnuts etc.
- Legumes & beans
  - All beans, lentils, chickpeas, split peas & tofu.

The goal is to include some "good" fats and eat less "bad" fats by choosing lean meats and low fat dairy foods.

What makes up a serve?

- One serve of lean protein (500-600kJ) is:
- 65g cooked lean meats such as beef or lamb (about 90-100g raw)*
- 80g cooked lean poultry such as chicken
- 100g cooked fish fillet (115g raw) or one small can of fish.
- 2 large eggs
- 1 cup (150g) cooked or canned legumes/beans such as lentils or chick peas.
- 170g tofu
- 30g nuts or seeds.

**With a weekly limit of 455g*

What's in the reduced-fat milk, yoghurt, cheese and/or alternative group?

Examples include:

- **Milk –** plain, flavoured, long life milks, powdered milk, evaporated milk, soy beverages (fortified with at least 100mg calcium/100mL)
- **Yoghurt** – plain and flavoured, soy yoghurt (calcium fortified)
- **Cheese** – all hard cheeses such as cheddar, red Leicester, Gloucester, Edam, Gouda Soy cheeses (calcium fortified)

One serve of **low fat dairy foods** (500-600KJ) is:

- 1 cup (250ml) fresh, UHT long life, reconstituted powdered milk or buttermilk
- ½ cup (120ml) evaporated milk
- 2 slices (40g) 4x3x2cm cube hard cheese such as cheddar cheese
- ½ cup (120g) ricotta cheese
- ¾ cup (200g) yoghurt
- 1 cup (250ml) soy, rice or other cereal drink with at least 100mg of added calcium per 100ml

Why choose lean protein and low fat dairy foods?

Meats and dairy foods contain ***saturated fats*** (often referred as "bad" fats), which have been linked with high cholesterol and increased risk of heart disease.

We need some fats in our diet for good health, but too much or the wrong type of fat can contribute to:

- High blood cholesterol
- High blood pressure
- Insulin resistance
- Heart disease
- Weight gain

There are three main types of dietary fat:

Saturated fats – limit these	Monounsaturated fats – include small amounts	Polyunsaturated fats – include small amounts
• Fatty meats • Full-cream milk • Full-fat cheese • Butter and cream • Take-away & fast food • Cakes • Biscuits • Chocolate • Palm oil	• Canola oil • Olive oil • Avocadoes • Monounsaturated margarine • Most nuts	• Fish and seafood • Sunflower oil • Soybean oil • Corn oil • Polyunsaturated margarine • Some nuts (e.g. walnuts) • Sunflower, safflower, sesame seeds

What is a serve of **unsaturated fats/oils/spreads?**

A standard serve of unsaturated fats/oils/spreads is:

- 10g monounsatureated spread (e.g. canola or olive oil based margarines)
- 10g polyunsatured spread (e.g. safflower, sunflower based margarines)
- 7g polyunsaturated oil (e.g. corn or soybean oil)
- 10g tree nuts or peanuts or pastes/butters

How much fat can I have?

It's important to keep saturated intake to a minimum and to replace foods containing saturated fats with foods that contain unsaturated fats. The amount of unsaturated fats will depend on individual energy needs.

While some types of fat are better for your heart and blood vessels such as ***unsaturated (monounsaturated and polyunsaturated) fats***, all will cause weight gain if eaten in excess. If you're trying to lose weight it will help to eat less fat by using less and choosing low fat varieties.

The *recommended dietary allowance for unsaturated fats* per day include:

Adult	19-50 years	51-69 years	70+ years
Men	4 (28-40g)	4 (28-40g)	2 (14-20g)
Women	2 (14-20g)	2 (14-20g)	2 (14-20g)

Take Action!

Making a plan and setting goals can help you get started. This week try to **focus on "good" fats and eat less "bad" fat by choosing** lean meats **and** low fat dairy foods every day. Give it a try and see how you go! Use the checklist below to help keep track of your progress.

To do this week:

Goal: I will reduce saturated "bad" fats in my diet and replace with small amounts of unsaturated "good" fats by:

✓ _____

✓ _____

✓ _____

Starting _____(date)

Problems I might have and what I will do to solve them:

_____

_____

Before the next session, answer these questions:

Did you achieve these goals? ☐Yes ☐No ☐Almost

What problems did you have making changes to your diet?

_____

_____

What could you do differently next week?

How do I start?

low fat dairy foods:

1. *When shopping:*

   Buy lean cuts of meat. Limit processed meats (such as bacon, salami and sausages)
   Aim to include fish at least twice per week
   Buy low-fat dairy products. For healtier alterantives, choose:

✓Skim, no fat or low fat milk	*instead of*	✗ full cream milk
✓No fat or low fat yoghurt	*instead of*	✗ full fat yoghurt
✓Light or reduced fat cheese	*instead of*	✗ regular fat cheese

2. *When preparing and cooking food:*

   Trim all visible fat before cooking
   Remove skin from chicken
   Limit amount of deep fried foods
   Use low fat cooking methods such as grill, dry roast, steam, microwave or barbecue where possible, instead of frying or deep-frying
   Try using cooking sprays rather than pouring large amounts of oil

3. *When serving:*

   Fill a quarter of your plate with lean protein at meals
   Have low fat dairy foods as a snack, dessert or part of a meal
   (e.g. a glass milk, a tub of yoghurt, custard and cheese slices)

4. *When eating out:*

   Limit intake of high saturated foods such as biscuits, cakes, pastries, desserts, pies, unprocesed meats, fast foods, burgers, pizza, fried foods, buttery or creamy dishes, potoato chips, crips and other savoury snacks.

5. **Tips for using monounsaturated and polyunsatured ("good") fats**

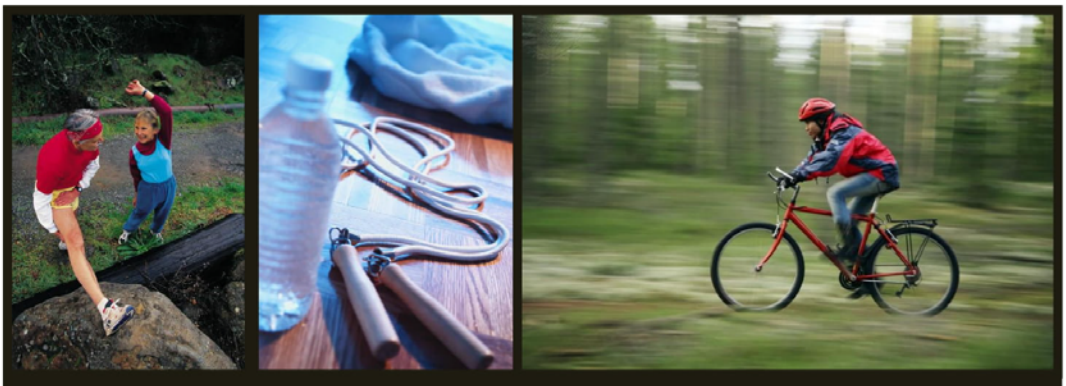
   Use small amounts of unsaturated oils in cooking such as spray or liquid olive, canola or sunflower oil instead of butter or lard

   On bread or toast, use a thin layer of unsaturated margarine, natural nut butter or or try a slice of avocado instead of butter

   Enjoy a handful of nuts as a snack or sprinkle on top of salads or stir-fries

Checklist: To help you keep track of your intake throughout the week, place a tick in the boxes for all the foods you eat each day. Note: the number of serves from each food group will depend on your age, gender energy needs and activity level, please refer to beginning of each handout for the recommended number of serves for you.

Food type	Number of serves	Serves eaten	Day of the week						
			Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Fruits	2	1							
		1							
Vegetables	5	1							
		1							
		1							
		1							
		1							
Low GI grains (cereals)	3-6	1							
		1							
		1							
		1							
		1							
		1							
Lean meats	2-3	1							
		1							
		1							
Low fat dairy	2 ½ -4	½							
		½							
		1							
		1							
		1							
Fats and oils	2-4	1							
		1							
		1							
		1							



What keeps you from reaching your physical activity goals?

There are many challenges to starting and staying physically active. Identifying the things that keep you from being active will help you think of solutions.

Different barriers may come up throughout the program. Some people have an easy transition from inactive to active, others find it a breeze.

The great thing is that the longer you stick at it, the easier it becomes. The average time it takes for someone to develop a habit (or to feel like the activity is 'automatic') is 66 days.

This week is a simple activity designed to give you some practical ways to help overcome the common reason why people choose to bail out on being active.

Here are some common issues many people face:

- Not feeling motivated or "no willpower"
- No time / too busy
- Bad weather
- Feeling uncomfortable
- Nobody to be "active" with
- No enjoyment
- Exercise makes me feel sore
- I'm too old
- Out of shape
- Tired and/or no energy
- No confidence

Dealing with Barriers.

Do any of these barriers apply to you? Have a read through and tick those that apply to you.

☐ Not feeling motivated' or 'No willpower'
You are not alone, in a recent study many people reported being too busy or having no will power as the main reason for not being physically active.

- Make the decision to be active
- Choose something you like to do
- Focus on doing the activity, rather than the results

☐ No time / Too Busy

- Be active in small bouts, try doing 10 minutes at time
- Take active breaks at work or at home
- Try to substitute activities for things you already do, like walking to work
- Try to schedule in time to be active
- Remember that being active is important for your health – make it a priority

☐ Bad Weather

- Plan Ahead, check the weather forecast in advance
- Make a list of activities you can do in different weather conditions. For example, if it is raining I will walk in the shopping centre, or if it is going to be hot I will be active early or late in the day.

☐ I don't enjoy it

- Try to pick an activity you like
- Try being active in an nice environment and enjoy the outdoors (e.g. park, near the ocean)
- Try to exercise with friends or family members to make it more fun
- Use physical activity as an chance for socialising
- Try making any activity you choose more fun, for example listen to your favourite music while you walk

☐ I feel uncomfortable

- Physical activity can be anything you want to do, not just going to a gym
- Choose activities you are comfortable with
- Don't compare yourself to others

☐ I have no one to be active with

- Join a class, walking group, or club
- Invite friends or family member to be active with you

☐ Exercise makes me feel sore

- Start slowly
- Try not to exercise too hard in short period of time
- Alternate activities so that you aren't doing the same things all the time
- Make sure you do some light activity (slower walking) at the beginning and end of your physical activity session

What about you? What are some of the main things that keep you from reaching your activity goal?

It helps to be specific. For example, if I am too tired to get up early in the morning to exercise one way to work on this could be to fit in exercise in the evening, or look try going to bed earlier.

What is the main thing that keeps you from being active?

_____

_____

_____

What could you do about this?

_____

_____

_____

Turning inactive into active!

Here are some suggestions on turning those inactive moments of your day into active one.

At Home:

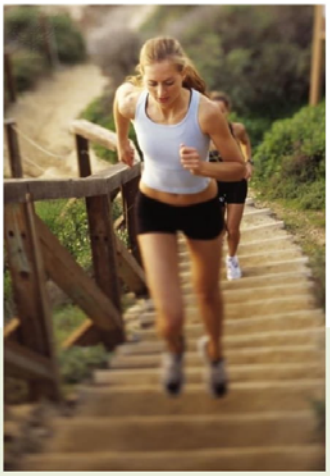
- Limit the time you spend sitting
- Limit your TV watching
- Try to be active while watching TV
- Stand up and move around during commercials
- Do ironing while watching TV

Transportation:

- Take active transport (bike, walk)
- Stand while waiting for the bus
- Walk to visit a neighbour rather than calling them
- Walk up and down stairs a couple of times a day to break up sitting
- Make several trips when collecting groceries from the car
- Wash your car

At work:

- Stand to answer the phone
- Take a 5-minute break to walk around every hour
- Hand-deliver a message (rather than email or phone)
- Take the stairs
- In tall buildings walk two flights and take the elevator the rest of the way
- Use a bathroom on a different floor
- Eat lunch away from your desk



For fun:

- Choose active recreation when you can (lawn bowling, fishing, walk on the beach)
- Go for a picnic and bush walk instead of a drive
- Consider doing some active volunteer work

Decreasing your inactivity could help you in the long run. So take every chance to be active!

Risky drinking and smoking are two of the most prominent health risks in modern Australian society. We call these modifiable risk factors, because they are within the individual's control. From an economic perspective, diseases and complications stemming from these two risk factors is estimated to exceed $46 billion per year in Australia alone.

The good news is that smoking rates have decreased since 1990 across all age groups.

However, in all but one age group (aged 12-17), excessive alcohol intake has increased. Part of this increase could be attributed to the general lack of understanding around what a safe and appropriate intake of alcohol is.

Alcohol

Drinking in Australia often seems to be our national pastime. Whether it be a glass of wine with dinner or a few beers down the pub, 90% of Australians have consumed alcohol in their lifetime, with 40% of us drinking weekly and 8% drinking daily. The highest proportion of daily drinkers are over 60.

Having the odd drink here and there may actually be beneficial to the body. Moderate intake (1-2 standard drinks) a few times per week may reduce risk of coronary heart disease. It is when we exceed this level of moderation that things change.

Long term risks of excessive alcohol intake include

- Cirrhosis of the liver
- Cancer
- Heart disease
- Alcohol dependence
- Depression
- Family and relationship problems
- Alcohol related brain injury

Guidelines released in 2009 from the National Health and Medical Research Council can be split into two simple rules.

Guideline 1

For healthy men and women, drinking no more than two standard alcoholic drinks on any given day reduced the lifetime risk of disease or injury.

Guideline 2

For healthy men and women, drinking no more than four standard alcoholic drinks on a single occasion reduces the risk of alcohol-related injury arising from that occasion

Take stock of your intake

The following are indicators that you may need some assistance because of your drinking

- If you cannot control when you start or stop drinking
- If you cannot control how much you drink
- If you suffer nausea, vomiting and headaches after drinking
- If you are verbally or physically abusive
- If you are unable to meet family, personal and work commitments after drinking
- If you suffer legal or financial problems as a result of your drinking
- If your doctor, family members, friends or workmates have told you that they are worried about your drinking.

Strategies to help control your intake

- Set yourself a limit. Stick to it.
- Start with a non-alcoholic drink. Alternate your drinks between non and alcoholic
- Drink slower
- Try lower alcohol content drinks
- Eat before and while you drink
- Count and measure your drinks – know the standard drinks sizes.
- Find alternatives, particularly if drinking has occupied a lot of your time. Use this time to develop new healthy activities.

For more information about drinking check out www.drinkwise.org.au

DrinkWiseAustralia

Smoking

Tobacco use in Australia causes a higher burden of disease than any other behaviour risk factor, accounting for 7.8% of total disease burden. Tobacco alone accounted for an estimated 15 500 deaths in 2003. It reduces not only life expectancy, but also quality of life.

After 12 hours, almost all the nicotine is out of your system. After 24 hours the level of carbon monoxide in your bloodstream has dropped significantly, increasing the oxygen in your blood.

Half of all lifetime smokers will die of a smoking related disease, and half of these will be in the 35-69 year old age bracket.

While the smoking rates are on the decline, there are still many people who choose to smoke, or lack the resources to quit. Quitting smoking has both long term and immediate benefits.

If you choose to quit your body will begin to repair

- After a few days your sense of smell and taste will improve
- After five days most nicotine by products are gone
- Within two months your lungs will stop producing extra phlegm cause by the smoke
- After 12 months your risk of dying from heart disease is half of that of someone who continued to smoke.

What resources are available for more information?

- Talk to your GP. They are the best equipped expert to give you tailored and specific advice on the best strategy for you
- Ring the Quitline on **13 78 48** and visit the quitnow website www.quitnow.gov.au
- Try the Quit Now: My QuitBuddy app available for ios and android.

DASS 21 NAME _____ DATE _____

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all - NEVER

1 Applied to me to some degree, or some of the time - SOMETIMES

2 Applied to me to a considerable degree, or a good part of time - OFTEN

3 Applied to me very much, or most of the time - ALMOST ALWAYS

		N	S	O	AA	FOR OFFICE USE D	A	S
1	I found it hard to wind down	0	1	2	3			
2	I was aware of dryness of my mouth	0	1	2	3			
3	I couldn't seem to experience any positive feeling at all	0	1	2	3			
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3			
5	I found it difficult to work up the initiative to do things	0	1	2	3			
6	I tended to over-react to situations	0	1	2	3			
7	I experienced trembling (eg, in the hands)	0	1	2	3			
8	I felt that I was using a lot of nervous energy	0	1	2	3			
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3			
10	I felt that I had nothing to look forward to	0	1	2	3			
11	I found myself getting agitated	0	1	2	3			
12	I found it difficult to relax	0	1	2	3			
13	I felt down-hearted and blue	0	1	2	3			
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3			
15	I felt I was close to panic	0	1	2	3			
16	I was unable to become enthusiastic about anything	0	1	2	3			
17	I felt I wasn't worth much as a person	0	1	2	3			
18	I felt that I was rather touchy	0	1	2	3			
19	I was aware of the action of my heart in the absence of physicalexertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3			
20	I felt scared without any good reason	0	1	2	3			
21	I felt that life was meaningless	0	1	2	3			
	TOTALS							

DASS Severity Ratings

The DASS is a **quantitative** measure of distress along the 3 axes of depression, anxiety[1] and stress[2]. It is not a categorical measure of clinical diagnoses.

Emotional syndromes like depression and anxiety are intrinsically dimensional - they vary along a continuum of severity (independent of the specific diagnosis). Hence the selection of a single cut-off score to represent clinical severity is necessarily arbitrary. A scale such as the DASS can lead to a useful assessment of **disturbance**, for example individuals who may fall short of a clinical cut-off for a specific diagnosis can be correctly recognised as experiencing considerable symptoms and as being at high risk of further problems.

However for clinical purposes it can be helpful to have 'labels' to characterise degree of severity relative to the population. Thus the following cut-off scores have been developed for defining mild/moderate/severe/ extremely severe scores for each DASS scale.

Note: the severity labels are used to describe the full range of scores in the population, so 'mild' for example means that the person is above the population mean but probably still way below the typical severity of someone seeking help (ie it does not mean a mild level of disorder.

The individual DASS scores do not define appropriate interventions. They should be used in conjunction with all clinical information available to you in determining appropriate treatment for any individual.

[1]Symptoms of psychological arousal
[2]The more cognitive, subjective symptoms of anxiety

DASS 21 SCORE

DEPRESSION SCORE	ANXIETY SCORE	STRESS SCORE

	Depression	Anxiety	Stress
Normal	0 - 4	0 - 3	0 - 7
Mild	5 - 6	4 - 5	8 - 9
Moderate	7 - 10	6 - 7	10 - 12
Severe	11 - 13	8 - 9	13 - 16
Extremely Severe	14 +	10 +	17 +

A Healthy lifestyle program

8. Mental health

The Rev Up Study 8

Mental health and Australians

ABS statistics found that 45% of the Australian population aged 16-85 have experienced a mental health disorder sometime during their lifetime, with 20% experiencing it in the last 12 months.

Worryingly, only 35% of those affected used mental health services in the last 12 months.

We will focus on the two most common areas of mental ill health in Australia; Depression and Anxiety.

Depression: More than just the blues.

We have all felt depresses at one time or another. Depression becomes an illness when it turns from just a passing feeling to a severe mood state, when it interferes with our ability to be function at work or home and when it sticks around for two weeks or more.

There are many signs and symptoms of depression. It affects each person differently. Experiencing some of these symptoms from time to time does not necessarily mean that a person is depressed.

Signs and Symptoms of Depression

- Lowered self-esteem
- Insomnia or broken sleep
- Changes in appetite or weight
- Less ability to control emotions
- Varying emotions across the day (feeling worse in the morning and better as the day progresses)
- Reduced capacity to experience pleasure, can't enjoy what is happening now, don't look forward to fun things later
- Reduced sex drive
- Poor concentration and memory
- Reduced motivation
- Lowered energy

What causes depression?

In general cases, depression is not caused by one single event, but a mix of recent events and longer term personal factors which can cause chemical imbalances in the brain. These can be things such as life events, personality, family history, medical illness, and drug and alcohol use. Sometimes no cause of depression can be found. The most important thing is to recognise the symptoms and seek help.

Anxiety

We all get anxious and stressed. This is a normal response to a pressure situation.

Anxiety is when these feelings don't subside or exist with no particular reason or cause. For a person experience anxiety these feelings are difficult to control or the stress response is out of proportion to the stressor. Some of the common types of anxiety disorders include:

- Persistent, excessive or unrealistic worries
- Compulsions and obsessions which can't be controlled
- Intense worry about social situations
- Panic attacks & phobias

Signs and Symptoms of Anxiety

There are many different types of anxiety and therefore many different symptoms. Some of the most common are:

- Hot and cold flushes
- Pounding heart
- Tightening in the chest
- Obsessive thinking and compulsive behaviour
- Snowballing worries.

Using the DASS 21 Questionnaire

The Depression Anxiety Stress Scales (or DASS) questionnaires are a series of questionnaires that health professionals use to help identify depression, anxiety and stress. It is not for diagnosis, but a useful tool that will help to identify possible issues.

The activity this week is to answer the DASS-21 questionnaire and calculate your score. We won't collect this information- it is for you to use. If you do score highly on the DASS questionnaire, it would be a great idea to speak to your GP or check out the links below.

Getting Help

GP's can be an excellent source of help for depression and anxiety, and can co-ordinate specialist help if you need it. There are also some excellent online resources to find more information on depressions, anxiety and other similar mental health disorders.

- www.beyondblue.org.au
- www.mantherapy.org.au
- www.blackdoginstitute.org.au

A Healthy lifestyle program

9. Strengthening your exercise program

The Rev Up Study 9

Research has shown that being active has many benefits. On the flip side, being inactive has many detriments.

Physical inactivity has been identified by the World Health Organisation as the fourth leading risk factor for global mortality.[(a)] The simplified reason for this is that a sedentary lifestyle increases the risk of non-communicable diseases such as cardiovascular disease, cancer, and diabetes as well as their underlying risk factors such as high blood pressure, high blood sugar levels, and being overweight.

A large evidence base exists showing that 300 minutes of moderate intensity exercise is enough to begin to improve fitness and reduce disease risk.

Regular physical activity could help:

- ✓ Lower blood pressure
- ✓ Maintain body weight
- ✓ Improve fitness
- ✓ Improve quality of life
- ✓ Decrease fatigue
- ✓ Improve balance

(a) WHO Global Recommendations on Physical Activity for Health Report, 2010

You have been working through the program now for 9 weeks. Now is a good time to revisit your goals.

One of the goals of the program is to get you up to 300 minutes per week of exercise. This is the recommended amount of exercise for gaining health benefits. For fitness and sports benefits you will need to increase this.

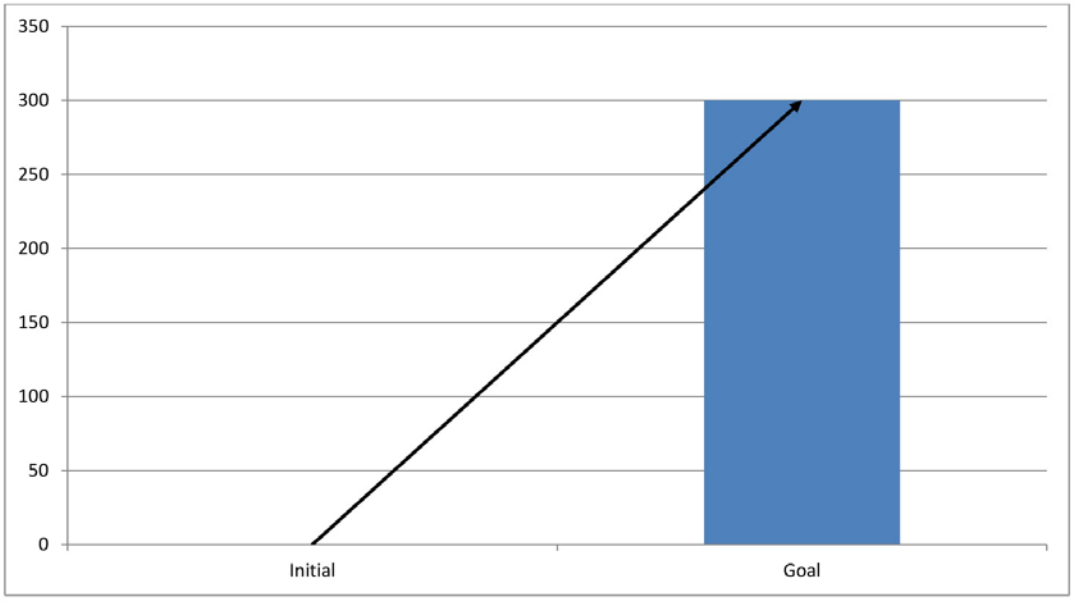
Have you reached 300 minutes each week?

If you haven't reached it yet, don't worry

- The important thing is to make a little bit of progress each week.
- Don't let minor set-backs get in the way of you improving your long-term health, keep recording what you do each week.

If you have reached 300 minutes per week

- Congratulations! You are already on your way to improving your chances of a longer, healthier life.
- The more you do, the more you benefit. Keep progressing if you can.



Reached 300 minutes? Where to from here?

If you have reached the 300 minutes per week of moderate intensity exercise, don't stop there! The next step is to aim for either 300 minutes per week of moderate exercise, or adding in some vigorous intensity exercise.

Vigorous intensity exercise is anything that requires rapid breathing and a substantial increase in heart rate.

Examples include:

- Running
- Fast cycling
- Fast swimming
- Competitive sports
- Walking briskly up hill

What are the benefits of vigorous exercise?

Vigorous exercise has a few extra benefits over moderate intensity exercise.

- Vigorous exercise is more beneficial at reducing heart disease risk than moderate exercise
- Less duration to achieve benefit is required than moderate intensity (300 mins vs 150 mins)
- Improved fitness benefits

How to start with some vigorous exercise?

Start slowly, and only progress if you feel comfortable and safe. Add in some vigorous bouts to your normal moderate intensity exercise. An easy way to do this is to add some steep hills to your walking route.

Try small bursts of less than 10 minute at first, and build up duration as your fitness improves.

Have you been reaching guidelines for nutrition?

In previous weeks we looked at the recommended serves of the different food groups. Let's refresh the guidelines.

- 2 serves of fruit
- 5 serves of vegetables
- 3-6 serves of low GI cereals/grains
- 2 ½ serves of lean protein
- 2 ½ serves of dairy
- Less than 4 serves of fats/oils

Why aim for these guidelines?

There is good data that supports that individuals who follow a diet that is rich in fruits and vegetables, whole grains, plant sources of fats and protein, and fish have reduced risk of chronic disease and have improved health outcomes.

Particularly:

- Daily vegetable intake is associated with a reduced risk of coronary heart disease and stroke
- Evidence suggests that there is reduced risk of some cancers with a diet high in vegetables and fruits
- Consuming fish at least twice a week is associated with a reduced risk of stroke, dementia, and cardiovascular disease.

Take Action!

If you haven't reached 300 minutes of exercise per week yet, let's work out why.

What is limiting me from reaching my 300 minutes?

_____

_____

_____

How can I overcome this roadblock?

_____

_____

_____

If you are ready for it, list some ways to introduce vigorous exercise into your weekly activity.

_____

_____

_____

I will aim to get ____ mins of vigorous exercise this week.

This week I will try to:

- ☐ Eat regular meals, with servings of vegetables with each meal.
- ☐ Avoid adding salt to my food or cooking.
- ☐ Use lower fat cooking methods (grilling, stir-fry, steaming etc.)
- ☐ Limit my intake of takeaway (Aim for one or less per week).
- ☐ Choose wholegrain low GI breads and cereals.
- ☐ Eat reduce or low fat dairy products.

A Healthy lifestyle program

10. Meal Planning

The Rev Up Study 10

Good nutrition is an important part of living a healthy lifestyle. Over the last 10 weeks you have learnt a few things about making healthier carbohydrate, protein and fat choices. This week we will look at meal planning, and how that can help you to maintain healthy eating for life.

Let's revisit some of the benefits of eating healthy.

- ✓ Maintain a healthy weight
- ✓ Reduce your risk of chronic diseases (like heart disease, type 2 diabetes, high blood pressure, osteoporosis and some type of cancers)
- ✓ Improve your self-esteem
- ✓ Improve energy levels
- ✓ Achieve optimal health throughout life

Five steps to healthy eating.

Step 1. Meal planning

- Can help you prepare and cook healthy meals and snacks while saving you time, money and stress.
- It will help you get organized with shopping and keep you on track with getting in your serves of fruits and vegetables.
- Spend some time writing down some quick ideas for breakfast, lunches, dinners and snacks.
- Be realistic and flexible. Not every meal has to be planned ahead. Start with planning easy meals like breakfast.
- Check out the sample meal plan on the next page to give you some more ideas.

Why should I 'go for 2 & 5'?

Eating 2 pieces of fruit and 5 serves of vegetables everyday can help

- ✓ Maintain a healthy weight
- ✓ Protect your from heart disease, some types of cancers and Type 2 diabetes
- ✓ Reduce constipation
- ✓ Reduce blood pressure
- ✓ Reduce blood cholesterol

☑ Keep a fruit bowl in your kitchen and a container of cut-up vegetables such as carrot sticks, celery sticks, capsicum strips, broccoli florets and cucumber slices in the refrigerator

Australian Government
National Health and Medical Research Council
Department of Health and Ageing

www.eatforhealth.gov.au

EATFORHEALTH

FOLLOWING THE RECOMMENDATIONS IN THE AUSTRALIAN DIETARY GUIDELINES

The sample meal plan outlined below provides the nutritional and energy requirements for a MAN aged 19-50 years of average height, healthy weight and light activity

BREAKFAST

Wholemeal toast with baked beans and grilled tomato

(2 slices of wholemeal bread, ½ can of baked beans, 1 medium tomato)

Glass of milk

(1 cup/250ml reduced fat milk)

MORNING BREAK

Apple

(1 medium apple)

Coffee with milk

(200mL – small/medium size)

LUNCH

Roast beef, salad and cheese sandwich

(2 x slices of wholemeal bread, 65g roast beef, 20g/1 slice reduced fat cheese, 1 cup mixed salad)

AFTERNOON BREAK

Coffee with milk

(200mL - small/medium size)

Unsalted mixed nuts

(30g – small handful)

EVENING MEAL

Grilled fish on rice with lemon juice and vegetables

(100g fillet of fish, 1 cup cooked rice, squeeze of lemon, 1 small boiled potato, ½ cup cooked zucchini, ½ cup cooked broccoli)

EVENING SNACK

Fruit salad (tinned or fresh) and reduced fat yoghurt

(1 cup mixed fruit plus small tub/100g yoghurt)

Drink plenty of water throughout the day

(Available from: http://www.eatforhealth.gov.au/sites/default/files/files/the_guidelines/adg_sample_meal_plan_men.pdf)

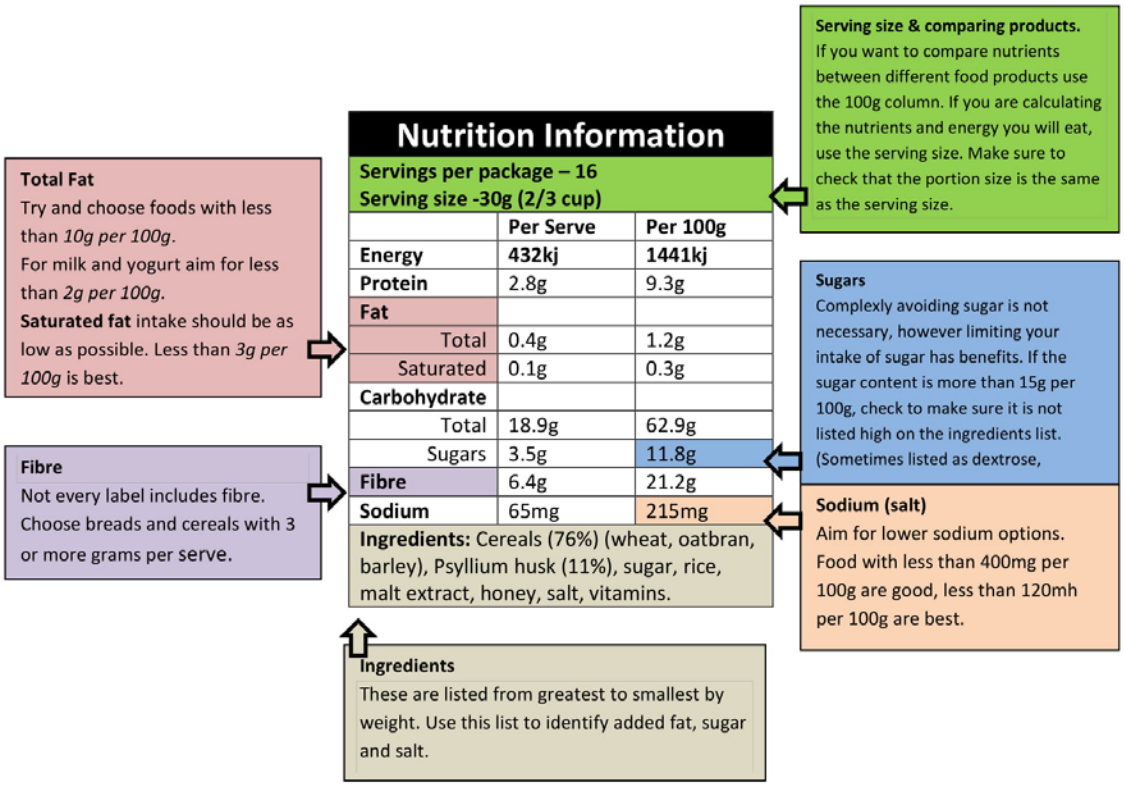
Five steps to healthy eating.

Step 2: Be a smart shopper

How to be a smarter shopper. Follow these simple steps

- Meal planning will make food shopping quicker and easier as you know exactly what you need.
- Make a shopping list ahead of time, and try to stick to it.
- Don't go shopping when you are hungry.

Step 3: How to understand food labels



Five steps to healthy eating.

Step 4: Prepare nutrition meals by adapting recipes

Adapt your favourite not so healthy meals into heart friendly ones by swapping some ingredients.

- By making a few changes to your recipes you can help make them healthier
- Experiment and try new recipes. Choose suitable recipes that:
  - Use lots of vegetables and fruits
  - Use low GI carbohydrates
  - Use lean cuts of meat and fish
  - Use low fat dairy products
  - Use small amounts of fats and oils
  - Limit salt

Here are some swapping ideas.

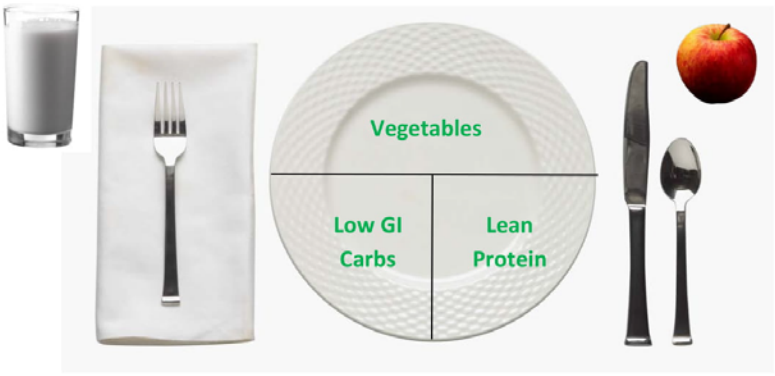
When the recipe calls for:	Replace with
Butter or oil	✓ Small amounts of unsaturated margarines or spray oil ✓ Small amounts of avocado ✓ All-natural nut butters
Mayonnaise	✓ Natural low fat yoghurt and lemon juice ✓ Reduced fat varieties
Full fat milk	✓ Reduced, low or no fat plain milk (e.g. liquid, evaporated, UHT or powdered) ✓ Calcium fortified soy milk
Meat, poultry, fish, seafood	✓ Use 'lean' cuts of meat and trim all visible fat before cooking. Go for heart smart choices. e.g. **Meat** - beef, lamb, mutton, veal, pork, venison, rabbit, emu, kangaroo, buffalo, goat. **Poultry** – chicken, turkey, duck and other game birds trimmed of visible fat and skin removed **Fish** – fresh, frozen, canned fish (in spring water or healthy oil, reduced salt). Include oily varieties e.g. salmon, blue mackerel, tuna, sardine, herring
Rice, noodles, pasta, grains and cereals, potatoes	✓ **Rice** – Doogara, Basmati, wild rice, traditional Japanese rice such as koshikari ✓ **Noodles** – Durum wheat pasta cooked 'al dente'; fresh rice noodles, mung bean cellophane noodles. ✓ **Grains and cereals** – rolled oats, pearl barley, buckwheat, quinoa, oat bran ✓ **Potatoes** – Carisma or Nicola, sweet potato with skin

Five steps to healthy eating.

Step 5: Eat mindfully

It seems strange to think about your eating, but many people only think when they are hungry. Using a bit of brain power can change your eating habits; even the ones you didn't know you had.

- Eat regularly and don't skip meals as you will likely overeat at the next meal.
- Eat slowly. Enjoy the meal!
- Sit down to eat
- Focus on what's in front of you and limit other activities or distractions while eating, such as TV watching, reading or working at your computer.



Choose nutrition foods from the main food groups every day and stay hydrated:

- Plenty of vegetables
- 2 pieces of fruit
- Low GI wholegrain, high fibre grains and cereals
- Lean meats and low fat dairy foods
- Small amounts of good unsaturated fats, oils and /or spreads
- Drink plenty of water

Take Action!

How will eating better benefit me?

Write down how improved nutrition would benefit you. Think about your health and fitness levels, how you feel about yourself, how better nutrition would affect your family and relationships, your work performance, your quality of life and any other reasons that are important to you.

_____

_____

_____

Making a plan and setting goals can help you get started. This week try to follow the 5 steps to healthy eating. Give it a try and see how you go! Use the checklist below to keep track of your progress.

To do this week:

Goal: I will continue to eat better and adopt healthy eating habits by:

- ✓ _____
- ✓ _____
- ✓ _____

Starting: _____ (date)

Problems I might have and what I will do to solve them:

_____

_____

Before next session, answer these questions:

Did you achieve these goals? ___Yes ___ No ___Almost

What problems did you have making changes to your diet?

_____

_____

_____

What could you do differently next week?

_____

_____

Meal Planner

Meal	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast							
Lunch							
Dinner							
Snack Ideas							

A Healthy lifestyle program

11. Setbacks and Positive thought

The Rev Up Study 11

Have you reached your goals?

Setbacks happen when you do not meet your goal. This is a completely normal and expected part of trying to be more active.

Remember it is how you respond to set backs that will hurt or help your progress.

Remember:

1. **Setbacks are normal**
2. **One or two mistakes do not ruin everything**
3. **Don't be too hard on yourself.**

Setbacks - So what to do?

When setbacks happen, it is important to learn from them and then move forward.

- Try thinking about what happened and learn from your mistake
  - Try to be specific, and think about what led up to the problem
  - E.g. I was too tired to get up to go for a walk in the morning
- Try to think of solutions for the specific problem
  - Can I go to bed earlier?
  - Can I schedule exercise for a different time?
- Try to get active again as soon as possible
- Focus on the positive changes you have made
- Talk to someone supportive

What was the one thing that kept you from being active this week?

_____
_____
_____

Now, try to be specific. For example, many people often feel tired and this can make physical activity hard

If: I feel too tired to do a 30-minute walk.

I will: do 3 ten minute walks

When: in the morning before work, at lunch time and after dinner.

Where: close to home and around my neighbourhood.

Plan: Go to bed 10 minutes earlier; get up 10 minutes earlier to walk. Bring my sneakers to work so I can walk at lunch.

Setbacks – Moving forward.

Try completing this for one of the reasons you have not achieved a goal.

If: _____

I will: _____

When: _____

Where: _____

Plan: _____

Do you give yourself credit?

It's normal to have set backs or times when you don't follow your goals. Do you ever pat yourself on the back for something you did right?

Try not to focus only on your mistakes, without paying attention to your successes.

By giving yourself credit, you will build your self-confidence and help you meet your goals

Give yourself credit! Remember, even the little things you do are a positive change.

List some positive changes you have made since you joined the study:

_____

_____

_____

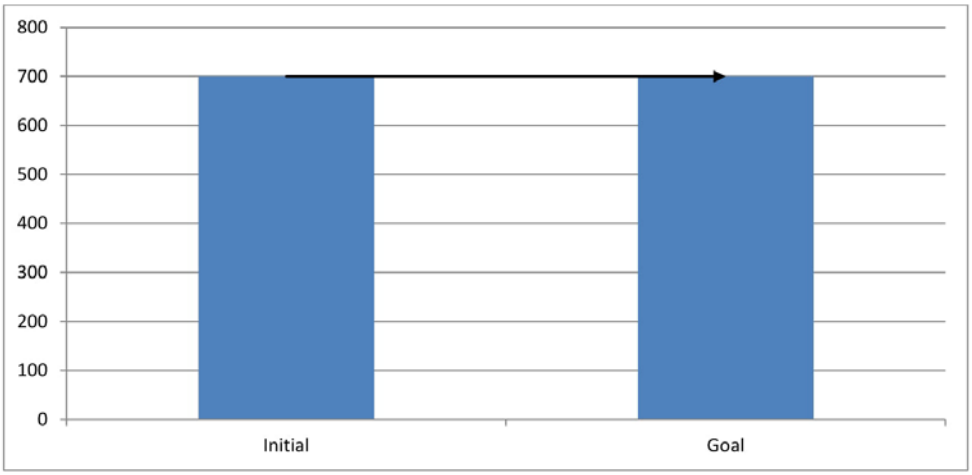
Congratulations!

Congratulations on reaching the end of the 12 week program.

We hope that the things you have learnt over the last 12 weeks will enable and empower you to make positive changes to your lifestyle, reduce your risk of chronic disease and improve your general wellbeing.

Don't let the changes you have adopted stop here. Reflect on the benefits that you have received from adjusting your lifestyle and use those to motivate you further.

Did you reach your goals?



At the beginning of the program we set the goal of achieving 300 minutes of moderate activity exercise per week. This is the recognised minimum for health improvements.

If you have reached your 300 minutes per week let's look at how your risk of chronic disease has changed.

If you have gone from sedentary to active and continue to remain active you have:

- Reduced your risk of premature cardiovascular related death by 20-35%
- Reduced your relative risk of colon cancer by 30-40%
- Reduced your risk of developing type 2 diabetes

Just to name a few!

Most of these changes you can't feel right now. The benefits that most people report when they become active are:

- Improved sleep
- More energy
- Improved mood and resilience to stress and depression
- Improved fitness

Taking action!

What do you think was the most valuable thing you learnt over the last 12 weeks?

_____
_____
_____

How do you think you will go with maintaining a healthy lifestyle?

_____
_____
_____

Have you got any further changes to your lifestyle planned?

_____
_____
_____

Where to find more information.

This will be the last of the newsletters you will receive for this program. That doesn't mean you have to stop learning. There are many great resources for you to continue to educate yourself on health and wellbeing. Remember, your GP should be your primary point of contact for your health.

Healthy eating

- http://www.eatforhealth.gov.au/
- http://www.glycemicindex.com/

Getting active

- http://exerciseismedicine.org.au/
- http://www.healthyactive.gov.au/

Smoking

- http://www.quitnow.gov.au/

Alcohol

- http://www.drinkwise.org.au

Mental health

- http://www.mentalhealth.org.au/
- http://www.beyondblue.org.au/

7.5 Appendix 5: Consort Checklist.

CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	Page 13
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	Page 13
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	Page 91, Chapter 3 – Extended Methodology
	2b	Specific objectives or hypotheses	Page 13
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	Page 86, 3.2. Study design
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	n/a
Participants	4a	Eligibility criteria for participants	Page 84, 3.3 Inclusion and Exclusion criteria
	4b	Settings and locations where the data were collected	Page8 4, 3.2 Study design
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Page 91, 3.7 & Appendix 4
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Page 109, 3.10 Outcome measures

	6b	Any changes to trial outcomes after the trial commenced, with reasons	n/a
Sample size	7a	How sample size was determined	Page 85, 3.4 Participants
	7b	When applicable, explanation of any interim analyses and stopping guidelines	n/a
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	Page 86, 3.4.2 Randomisation
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Page 86, 3.4.2 Randomisation
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Page 86, 3.4.2 Randomisation
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Page 86, 3.4.2 Randomisation
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	Page 86, 3.4.2 Randomisation
	11b	If relevant, description of the similarity of interventions	n/a
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	Page 119, 3.11 Statistical Analysis
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	Page 119, 3.11 Statistical Analysis
Results			
Participant flow (a diagram is	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	Page 122, Figure 4.1

strongly recommended)	13b	For each group, losses and exclusions after randomisation, together with reasons	Page 121, 4.1 Baseline data, Page 141. 5.9 Attrition
Recruitment	14a	Dates defining the periods of recruitment and follow-up	Page 84, 3.2, Study design.
	14b	Why the trial ended or was stopped	Page 84, 3.2, Study design.
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Page 123, Table 4.1
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	Chapter 4, Results (In each table heading)
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Chapter 4, Results.
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	Chapter 4, Results
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	n/a
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	Page 142, 5.10 Limitations
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	Page 141, 5.10 Limitations
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	Page 136, Chapter 5: Discussion
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	Page 136, Chapter 5: Discussion
Other information			

Registration	23	Registration number and name of trial registry	n/a
Protocol	24	Where the full trial protocol can be accessed, if available	n/a
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	n/a