
Changing Lifestyle Behaviors to Improve the Prevention and Management of Cardiovascular Disease

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Abstract

Up to 80 % of the risk for cardiovascular disease (CVD) in the general population is attributable to lifestyle factors. Hence, the modification of lifestyle behaviors is important for reducing cardiovascular risk in the context of primary and secondary CVD prevention. However, initiating and sustaining changes in lifestyle behaviors remains challenging, particularly for patients who have experienced a potentially life-threatening CVD event. This chapter reviews the evidence base for changing lifestyle behaviors that contribute most to the etiology, progression, and outcomes of CVD, that is, nutrition and dietary behaviors, physical activity, and smoking. Furthermore, the evidence in relation to the effectiveness of behavioral interventions and key factors to consider in the implementation of effective behavior and lifestyle change programs in clinical and non-clinical settings are discussed. Finally, the implications of these findings for future research and practice in the field are considered.

Keywords

Cardiovascular disease • Lifestyle • Behavior interventions • Risk factors

The Importance of Lifestyle Change

Introduction

The Importance of Behavior and Lifestyle to Cardiovascular Risk

Cardiovascular disease (CVD) is the leading cause of death and disability in both men and women in most countries around the world (Alwan 2011). Over the last 60 years, an extensive body of evidence has demonstrated the impact of key lifestyle behaviors on the pathophysiology, course, and short- and long-term outcomes of CVD (Fisher et al. 2011). Further, social and behavioral epidemiologic research has demonstrated the complex interplay between behavioral, psychological, social, and environmental factors, and how these factors – individually and collectively – influence lifestyle and, subsequently, disease progression, and quality of life and health outcomes (Begg et al. 2007; Fisher et al. 2011; World Health Organization 2003). Therefore, it is essential that any program designed to reduce the risk and/or progression of CVD addresses changes in key lifestyle behaviors, while keeping in mind important environmental and contextual factors that influence behavior and behavior change (Marrero et al. 2013). Indeed, most guidelines for the prevention and management of CVD in general practice, primary care, cardiac rehabilitation, and community and allied health services emphasize the importance of addressing lifestyle behaviors, specifically smoking, nutrition, healthy weight, physical activity, and alcohol use, and helping patients to address these (D’Agostino et al. 2008; Grundy et al. 1999; National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand 2012; Perk et al. 2012).

The seminal INTERHEART study identified 9 modifiable risk factors (smoking, lipid profile, hypertension, diabetes, obesity, diet, physical activity, alcohol consumption, and psychosocial factors) that account for over 90 % of the risk for acute myocardial infarction (MI) and CVD, with people's behavior and lifestyle being related to all of these (Yusuf et al. 2004). These risk factors are variously important in every geographic region and every racial and ethnic group worldwide and are apparent in men and women (Rosengren et al. 2004; Yusuf et al. 2004). While these are independent risk factors for CVD, many are interconnected with one another. For example, a sedentary lifestyle and poor nutrition are both major risk factors for overweight and obesity which in turn, lead to increased blood pressure, increased insulin resistance, and unfavorable lipid levels and thus to an elevated risk of CVD (World Health Organization 2002).

Despite the amount of evidence regarding CVD risk factors and the importance of lifestyle and behavior, there is a considerable evidence demonstrating the complexities and difficulties associated with implementing and maintaining lifestyle-related changes at the individual and population level. Indeed, behavior is shaped in positive and negative ways at an individual level (knowledge, cognitions, and attitudes) and an interpersonal or social level (including the influence of cultural and societal norms for different behaviors) and at the broader community level, as a result of people's living situations and their role/s at work and in the broader community. Traditionally, behavioral and social scientists assumed an individual's decision to make and maintain health behavior changes resulted from a rational decision-making process. However, it is now well known that one's lifestyle and associated behaviors, and any attempts to change these, are heavily influenced by the highly contextualized nature of behavior (Marrero et al. 2013). An individual's socioeconomic and social situation (Brofenbrenner 1977; Riley et al. 2011; Ryan and Deci 2000), cultural environment (Glanz et al. 2008; Riley et al. 2011), and the influence of advertising and marketing (Anderson et al. 2009; Lovato et al. 2003) can all have a substantial influence on an individual's health behaviors, motivation to change behavior, and relative success in being able to do so.

Principles of Lifestyle and Behavior Change

As already stated, health behaviors can be very difficult to change and to sustain in the longer term. For example, following a heart event, many individuals will make initial changes to their lifestyle, but maintenance is often poor, and relapse is common within 6–12 months of the event (Mendis et al. 2005; Rosamond et al. 2008). Key theories and models of health behavior, the change process, and of health more broadly, can contribute to a better understanding of the development of lifestyle behaviors the determinants of behavior change, and the change process itself (Glanz et al. 2008; Lippke and Ziegelmann 2008). The following section overviews key constructs from some of the most commonly used theoretical models and frameworks.

From the 1970s to the 1980s, on the intrapersonal factors that influence behavior such as a person's beliefs, knowledge, and skills. Such theories assume that lifestyle behaviors and behavior change are largely determined by cognitive and psychosocial factors at the individual level, with change being a result of rational, individualized decision-making. Examples of intrapersonal theories are the Health Belief Model, Theory of Planned Behavior, and the Transtheoretical Model of Behavior Change (Glanz et al. 2008). The Health Belief Model focuses on individual beliefs concerning their perceived susceptibility to the severity of a health issue and the perceived benefits and barriers that may result from taking action (Becker 1974; Janz and Becker 1984). The Transtheoretical Model proposes key steps that are involved in behavior change, including pre-contemplation, contemplation, preparation, action, and maintenance. The importance of identifying readiness to change is a key construct in this model (Prochaska and Velicer 1997). Consequently, proponents of this model argue that intervention strategies and programs be tailored according to a group or an individual's "stage of readiness." Accordingly, different intervention strategies are likely to be effective for one's specific stage of change. The Transtheoretical Model has been usefully applied to explain and predict changes in behaviors such as smoking, diet, physical activity, as well as alcohol and illicit drug use (Glanz et al. 2008). In contrast, interpersonal theories use the premise that a person's behavior is heavily influenced by one's personal, family, social relationships and context. Therefore, according to this level of theories, a person's social environment plays a very important role in determining his/her health behaviors. Attention to these influences can also assist an individual in changing health behaviors such as smoking, nutrition, and sedentariness.

The most popular interpersonal health behavior theory is Social Cognitive Theory (Bandura 2001; Stokols et al. 2003; Yusuf et al. 2004), and over the past 30 years, this model has influenced the development of many other theories and models. Social Cognitive Theory postulates one's attitudes, cognitions, and beliefs, environmental influences and behavior interact in a dynamic, reciprocal manner to influence behavior and behavior change (Bandura 2001). Intervention strategies based on this model are often derived from principles of learning that include observational learning, positive and negative reinforcement, and strategies that aim to improve self-control and self-efficacy. Socio-ecological models of health explain behavior by considering multi-level and diverse influences in people's lives, including individual, interpersonal, organizational, and broader environmental level influences and how all of these can interact to determine and influence lifestyle behaviors and the behavior change process. Indeed, there is now good evidence that health interventions are likely to be more successful when they are based on such a socio-ecological perspective (Brofenbrenner 1977; Glanz et al. 2008).

Much of the early research concerning the determinants of health behaviors was based on individual and intrapersonal theories of behavior. Hence, many of the intervention strategies incorporated into the lifestyle change counseling and intervention programs of the 1970s and 1980s focused on influencing individual factors such as knowledge, attitudes, self-efficacy, and skills. However, as multi-level and

socio-ecological models have gained momentum in more recent years, lifestyle change programs have increasingly adopted broader strategies that can help address individual, social, and environmental level factors, recognizing that these can influence the change process and the long-term sustainability of behavior change. For example, individuals wishing to increase their level of physical activity may have more success if intervention strategies are aimed not only at enhancing self-efficacy at the individual level but also at increasing social support from the family and work colleagues at the interpersonal level, combined with broader community-wide strategies that are likely to make increased levels of physical activity more achievable and sustainable.

Health Behavior Change to Reduce CVD Risk: What Works?

In the following section, we consider the evidence base concerning the effectiveness of behavioral interventions and lifestyle change programs in relation to the prevention and management of CVD and related chronic conditions. While a substantial evidence base has established the effectiveness of lifestyle change approaches as an important component of smoking cessation over more than 30 years (e.g., Barth et al. 2008; DiClemente et al. 1991), CVD prevention and lifestyle change programs related to diet and physical activity are not nearly as well established (Yach et al. 2005).

Smoking Cessation

Extensive research has been undertaken in general populations, as well as clinical populations, including individuals with CVD, and demonstrates that, when compared with interventions targeting other health behaviors, interventions targeting smoking have been relatively successful. For example, smoking cessation interventions have increased the likelihood of quitting from 28 to 66 %, when compared with usual care (Oldenburg et al. 2010). Group delivery of programs has been shown to be quite effective, although this mode of delivery is not as convenient or well received by many. Group-based programs incorporating standardized socio-behavioral intervention strategies have also been shown to be more effective when combined with pharmacological interventions such as nicotine replacement therapy (Pearson et al. 2000). The key elements of successful programs are typically related to program intensity and duration and the inclusion of components that address cognitive and behavioral skills and the prevention of relapse (Oldenburg et al. 2010). Although standardized self-help formats have some benefit, tailored self-help programs have been found to be even more successful. Programs delivered by various modes have been demonstrated to be effective, including via the telephone and, more recently, the Internet (Stokols et al. 2003). There are several reasons for the relative success of smoking cessation programs, especially when compared to other lifestyle risk factors (Oldenburg et al. 2010). First, the evidence

linking ongoing tobacco use to poor health outcomes is very well established, and programs can be delivered in a variety of modes and by a range of health professionals. However, it is important to note that although such interventions can significantly increase initial quit rates, absolute abstinence still remains very low, regardless of the type of intervention used. Indeed, the evidence shows that the majority of smokers will relapse several times before finally succeeding in quitting. Hence, persistence is the key to long-term success with smoking interventions (Rosengren et al. 2004).

Nutrition and Dietary Interventions

Although various aspects of nutrition and diet such as low intake of fruit and vegetables; high intake of (saturated) fat, sugar, and salt (World Health Organization 2002); and the consumption of a proinflammatory diet high in sugar, highly processed foods, and trans fats (O'Neil et al. 2015) have been consistently implicated as important risk factors for CVD, the effects of lifestyle-related interventions targeting these have been modest. Nonadherence is also much higher for nutritional advice when compared to other risk factor such as smoking and medication taking. One possible reason is that instigating and maintaining such changes can be complex in clinical populations, especially in combination with other components of a complex treatment plan (Burke et al. 1997). Group-based educational and lifestyle change programs have been somewhat successful in reducing total calories, total and saturated fat, and cholesterol levels when used in primary prevention (Burke et al. 1997). Individual counseling with a dietician has also shown positive results, with significant reduction in dietary fat and cholesterol consumption that was maintained after 7 years (Burke et al. 1997). Furthermore, dietary advice from a health professional has been linked to patients reaching their target LDL-cholesterol levels (Pearson et al. 2000). Another key to success is social and family involvement, with greater success attributed to their involvement, and community-based programs (as distinct to those conducted in more clinical settings) tend to be more successful, especially when they incorporate specific and practical dietary advice (Hooper et al. 2012).

Despite a substantial focus on dietary interventions that reduce dietary fat intake, the clinical outcomes of these studies remain mixed. In a recent systematic review, nutritional interventions aimed at influencing dietary fat – that is, reducing and/or modifying total fat intake – did demonstrate a significant reduction in the incidence of combined cardiovascular events but no clear effect on total mortality, despite reductions in weight, body mass index, total cholesterol, and LDL cholesterol (Hooper et al. 2012). Further, these effects were only reported for trials where participants were involved for more than 2 years, and overall, there was very little evidence to support a direct link between dietary intervention that focuses on modifying dietary fats and reductions in total mortality (Hooper et al. 2012).

Increasing Physical Activity

Increasing physical activity is associated with many health-related benefits including improvements in CVD risk markers as well as reducing many CVD risk factors. While the optimal amount of exercise required to achieve such benefits remains unclear, population-based interventions which encourage modest increases in physical activity among largely sedentary individuals have been shown to be effective. In more clinical populations, attrition from cardiac rehabilitation programs, and other kinds of programs, is usually very high (Burke et al. 1997). There is some evidence that adherence to an exercise regimen can be improved by incorporating strategies such as self-monitoring, regular prompting and verbal persuasion and by also having support from key family members and others (Burke et al. 1997). A recent review of the available evidence has demonstrated that good compliance with exercise training can improve objectively measured physiological and anthropometric factors including lipid profile among patients in comprehensive cardiac rehabilitation (Oldenburg et al. 2010). Although no reduction was found in body mass index, body composition changed significantly, with an increase in lean body mass and a reduction in adipose tissue. In studies with longer follow-up of exercise training and cardiac rehabilitation programs, and also with an emphasis on other lifestyle changes related to CVD risk, they have been able to demonstrate significant benefits in terms of both survival and quality of life (Oldenburg et al. 2010).

When composite diet and exercise interventions have been evaluated, similar small improvements have also been found in weight, BMI, and waist circumference. These findings have been corroborated by a recent review which systematically identified, synthesized, and graded a wide range of evidence about the relationship of intervention content to effectiveness in individual-level interventions for promoting changes in diet and/or physical activity in adults (Greaves et al. 2011). In summary, greater effectiveness of interventions was causally linked with targeting diet and physical activity, mobilizing social support, and the use of well-described and/or established behavior change techniques. Further, greater effectiveness was also associated with using multiple self-regulatory techniques such as goal-setting, prompting self-monitoring, providing feedback on performance, goal review, and providing a higher contact time or frequency of contacts.

Reducing Sedentariness

Recently, sedentary behavior has gained increasing attention as another risk factor for CVD, independent of physical activity. Key indicators of sedentariness include the amount of sitting time and the time spent watching TV and using a computer, talking on the phone, and driving. All of these have increased markedly in recent years, due to changing lifestyles and the significant increase in use of new technologies in most countries. Sedentariness has been linked to poor lipid

profiles, increased BMI, increased blood pressure, and other negative risk factors associated with an increased risk of CVD (León-Latre et al. 2014). As the deleterious effects of sedentary behavior are not necessarily negated by an overall increase in physical activity, this presents a novel challenge and opportunity within the context of disease prevention and control. Indeed, preliminary studies have linked reductions in sedentary behavior to positive changes to triglyceride levels, waist circumference, and inflammation (Ekblom-Bak et al. 2014; Ford and Caspersen 2012). As a relatively new concept, sedentary behavior is a potential modifiable risk factor for CVD that presents a promising avenue for future research and interventions, particularly through the use of more environmental interventions.

Multiple Risk Factor Interventions

The majority of adults engage in two or more lifestyle behaviors that increase their risk of CVD and related chronic conditions (King et al. 2015). More specifically, prevalence rates of multiple risk behaviors in adult populations worldwide have been reported as 68 % in England (Poortinga 2007) and 52 % in the United States (USA) (Coups et al. 2004). Further, interventions targeting multiple lifestyle behaviors can be more effective in terms of reducing disease risk compared to those focusing on a single risk factor (King et al. 2015). Such an approach also helps to address the complex interplay between lifestyle behaviors and risk factors for CVD. Indeed, a recent meta-analysis of multifactorial interventions in patients showed a reduction of 18 % in fatal cardiovascular events as well as a small but nonsignificant reduction in overall mortality and hospital readmissions (de Waure et al. 2013). Multiple risk factor interventions typically comprise multiple socio-behavioral strategies that variously target combinations of diet, exercise, weight loss, smoking cessation, and medication adherence.

Considerations for Intervention Success

Settings for Program Delivery

Lifestyle change programs can be delivered in a variety of settings, including health-care settings, workplaces, schools, and settings within the community. Some settings can be more conducive to recruitment of a large number of participants, for example, large numbers of working adults can be potentially reached in workplace settings (Hutchinson and Wilson 2012). However, the level of reach of an intervention does not necessarily translate to effectiveness. Indeed, there are well-established benefits in targeting “defined” populations for more intensive interventions with a specific focus on key lifestyle behaviors (Anderson et al. 2009a).

Level of Intervention

Primary prevention aims to prevent disease prior to clinical manifestation by minimizing exposure to the risks that contribute to disease risk. Secondary prevention aims to reduce the impact of a disease that has already occurred by detecting and treating disease as soon as possible to halt or slow its progress. Finally, tertiary prevention aims to reduce the impact of an ongoing and persistent illness by helping people manage long-term, often-complex health problems, thereby aiming to maximize quality of life and life expectancy. Lifestyle and behavior change programs can be designed and implemented to address each of these levels. Over the past 40 years, primary prevention efforts have been quite effective in substantially reducing death rates due to coronary heart disease (CHD) in many developed countries (de Waure et al. 2013; Ebrahim et al. 2011). Secondary prevention programs, for people at risk for coronary heart disease, have tended to have a focus on multiple risk factors, and there has been a trend for a modest reduction in the frequency of cardiac events and overall mortality (Angermayr 2010; de Waure et al. 2013; Lin et al. 2014) and modest measurable improvements in diet, exercise, and medication adherence (Cole et al. 2010). Finally, cardiac rehabilitation programs that address low physical activity and other lifestyle behaviors by incorporating counseling and education have demonstrated some significant health outcomes (de Waure et al. 2013; Oldridge 2012).

Features of Intervention and Program Delivery

In a recent review of behavioral interventions to improve the prevention and management of CVD, Oldenburg et al. (2010) reported that longer, more intensive interventions were generally more effective than brief interventions. However, longer, more intense programs tend to be more expensive, require more resources, and can have greater attrition rates. In their systematic review of intervention components promoting dietary and physical activity, Greaves et al. (Greaves et al. 2011) noted several important program factors, likely to affect the outcomes by moderating the relationship between program exposure, intensity, and effectiveness. For example, lower quality, lower intensity interventions are likely to result in higher rates of attrition. Hence, it is important to strike a balance between intensity, duration, and cost-effectiveness in order to maximize the efficacy of an intervention and its broader reach and scalability.

The delivery mode of a lifestyle intervention is also important to consider. For example, while physicians have the ability to provide advice and deliver programs for behavior change, most do not do this very well, other than to give generalized advice about what to do. This is despite the fact that physicians often have a “window of opportunity” within which to provide tailored advice and suggestions relevant to lifestyle change. Hence, it is important to consider alternative modes of program delivery. For example, some interventions may be better suited to being

delivered through technology-based platforms, whereas others may be better delivered by lay leaders or peers (Dale et al. 2008; Foster et al. 2007; Fisher et al. 2009). Of course, individuals will also have their own preferences in relation to different modes of delivery as well.

Potential of New Technologies

Rapid advances in interactive digital technologies have changed the way in which communication and social interaction occurs worldwide, and these advances have the potential to profoundly influence the design and delivery of lifestyle change programs. Recent years have seen the rapid uptake and use of the Internet, Facebook, Twitter, Wiki, and technology platforms using smartphones, tablets, and other devices. For example, while Facebook had approximately 1 million users at the end of its first year in existence in 2004, it now has well over 1 billion monthly active users (eMarketer Inc 2013). Technology also provides the flexibility of various modes of communication, including photos, videos, three-dimensional images, visual simulations, and even virtual reality. Hence, use of the Internet and mHealth interventions now offer opportunities to reach and engage with individuals worldwide and beyond traditional “communities” (Smith et al. 2014).

Wantland et al. (2004) pooled studies of web-based interventions containing nearly 12,000 participants, including cross-sectional, self-managed, and longitudinal intervention studies ranging from 3 to 78 weeks. When compared to interventions, utilizing more traditional means of delivery web-based interventions reported reaching an equal proportion of men and women and having lower than usual rates of attrition (21 %). However, although the average drop-out rate was relatively low, measures of program exposure and intensity were also modest. For example, participants showed significant variation in time spent per session and the number of times the intervention site was visited. Despite wide variation in intensity, nearly all of the studies showed an improvement in knowledge and/or behavioral outcomes. Some examples of improved outcomes were increase in exercise duration, 18-month weight loss maintenance, and increased utilization of health care (Wantland et al. 2004). In addition to improvements in knowledge and health behaviors, interactive health communication applications have also been shown to improve social support, self-efficacy, and clinical outcomes (Murray 2006).

The telephone provides another channel to promote participant access due to freedom from spatial and temporal restrictions, and positive behavioral outcomes observed in such programs have been linked to duration and intensity (number of calls) of the intervention (Eakin et al. 2007). Other key factors that may impact on the success of such programs may be targeting selected clinical samples and the use of theory-based models including the transtheoretical model, social cognitive theory, and motivational interviewing.

The use of new technologies, such as smartphones and apps, to deliver program content and messages often demonstrate a high degree of fidelity, standardization, and replicability, reducing the variability in content and delivery that is possible

when such programs are delivered by health professionals. For example, Mobile Health (mHealth) platforms are now using smartphones and computer tablets to deliver health behavior change programs to improve prevention and management of lifestyle-related chronic conditions such as CVD, with high reach, fidelity, and a good user experience (Oldenburg et al. 2015). Further, user engagement of Internet-based behavioral interventions for chronic disease is improved by addressing health concerns important to the individual and is further enhanced by incorporating personally tailored advice and feedback (Kelders et al. 2011; Schubart et al. 2011).

The emergence of computer software and the development of “expert systems” (originally developed in the 1990s) have also increased the sophistication of tailoring of programs (Kong et al. 2012; Latimer et al. 2010) and led to algorithm-driven approaches which combine the benefits of traditional mass media campaigns with individually tailored interventions to reach a very large number of individuals. By remembering preferences for content and mode of delivery, an algorithm-driven approach combined with new technologies that “crowd-source” feedback and “data” from thousands of participants in real time allows the delivery of program content to be adapted to multiple circumstances, contexts, and situations while remaining unique to individual users. Hence, while traditionally delivered health education and health promotion programs can be tailored for small numbers of individuals, new technologies can deliver highly personalized, standardized, and tailored messages to whole populations (Oldenburg et al. 2015) This is one of the reasons why the use of new technology for program delivery may be particularly advantageous in developing countries (Peiris et al. 2014).

The rapid evolution and uptake of smartphones and handheld computers will inevitably lead to increased uptake and use of social media for health programs, allowing individuals to interact with, shape, and even disseminate their own intervention messages through their social networks. However, it is vital that programs delivered using such platforms are designed and delivered with an understanding of the user experience, predicting how individuals will respond to, shape and share program content and the ramifications of this (Chou et al. 2013; Coley et al. 2013). For example, positive and derisive viewer comments could shape other users’ evaluations of the credibility of certain health messages delivered via new technologies (Walther et al. 2010).

Peer Support Interventions

Peer support delivery of lifestyle change programs incorporates appraisal, informational, and emotional support being provided by a peer who may live with the same condition as the recipient of the intervention (Peer support delivery of lifestyle change programs incorporates appraisal, informational, and emotional support being provided by a peer who may live with the same condition as the recipient of the intervention (Boothroyd and Fisher 2010)). Informational support can increase knowledge, understanding, and coping skills (Campbell et al. 2004).

Emotional support is based on empathic communications between individuals and their peer, designed to enhance self-confidence and self-esteem, reduce negative feelings, and improve relationships (Gray et al. 1997; Helgeson and Cohen 1996). Peer support delivery has been shown to be effective for a variety of clinical populations, with beneficial effects across a wide spectrum of health outcomes (Fisher et al. Dennis et al. 2002; Morrow et al. 1999), enhancing mental health (Repper and Carter 2011), and increasing health-related quality of life (Ashbury et al. 1998; Hibbard et al. 2002; Whalley et al. 2014). Verheijden et al. (2002) propose that the support derived from natural support networks, as distinct from the nonreciprocal relationship provided by health professionals, may help explain the beneficial effects.

Results from a recent systematic review suggested that peer support may improve self-efficacy in individuals with heart disease and may also have a beneficial effect on the health and well-being of those recovering from an MI (Parry and Watt-Watson 2010). Key determinants of the success of peer support interventions are the standardization of peer training, the mode of delivery, and the dose of the intervention as well as the peer to participant ratio.

Worthy of note is the increased delivery of peer support via mobile and web-based technologies and online communities. These involve peer support groups that connect using web chat and text messaging and target clinical outcomes and healthy behavior modifications (Wei et al. 2011). Online peer support may also be delivered via live chats and forums which allow users to talk to each other in real time or post topics for discussion. Although the evidence is not yet conclusive, Cotter et al. (2014) suggest that providing support via text or web provides participants with opportunities to discuss problems with others experiencing the same issues and receive immediate feedback, significantly improving engagement as well as behavioral and clinical outcomes.

Achieving Sustainability and Maintenance of Lifestyle Change

With some notable exceptions, the majority of published lifestyle change intervention trials have still only achieved modest outcomes, even when evaluated under controlled conditions. Further, the implementation and dissemination of such programs under more “real-world” settings is often poorly evaluated (Glanz et al. 2008), diluting already modest effects. The Diabetes Initiative of the Robert Wood Johnson Foundation in the United States evaluated the resources and supports for self-management of diabetes in various community settings. The program identified six key supports for program success: individualized assessment and tailored measurement; collaborative goal-setting; enhancement of key skills for disease management, health behaviors, and problem solving; continuity of high-quality, safe clinical care; ongoing follow-up and support; and a very important role for supportive community resources (Fisher et al. 2011). The authors concluded that the concept of “equifinality” is especially helpful for thinking about the way in which such programs can work for individuals in community settings. In other

words, different procedures, strategies, or programs can work in complementary ways to achieve similar ends or effects.

While no formal economic evaluation was conducted as part of most of these reviews, a number of authors note that interventions evaluated under very controlled conditions tend to be being too resource intensive for broader uptake (Ebrahim et al. 2006). Further investigation of the cost-effectiveness of lifestyle interventions is very important in order to allow for priority setting and for governments and major donors to justify spending resources on modifying behavioral risk factors and lifestyle change programs. The World Health Organization has recognized the importance of reducing lifestyle risk factors in cost-effective ways, stating in their 2002 World Health Report that their ultimate goal is to help governments of all countries to raise the healthy life expectancy of their populations. However, the cost-effectiveness of lifestyle interventions to improve quality of life and life expectancy from preventable chronic diseases should also be established in resource poor countries before recommending their widespread uptake.

Conclusions and Practical Implications

With a few notable exceptions, most published lifestyle intervention trials have achieved only modest outcomes. Further, even when evaluated under controlled conditions, their wider implementation and dissemination is seldom evaluated (Glanz et al. 2008; Oldenburg and Glanz 2008). Moreover, intensive lifestyle change interventions for people with minimal risk might not be particularly cost-effective. Therefore, more population-based or upstream social and economic interventions to reduce cardiovascular risk are likely to be more cost-effective. Given the increasing pressures on limited resources for health care and prevention in most countries, and the increasing burden of chronic diseases, it is important that resources are prioritized for populations where the interventions will be most effective and with the greatest reach.

If properly designed and implemented, lifestyle change interventions have excellent potential to reduce CVD risk and to improve the quality of life and health outcomes of those who already have CVD. Despite requiring more rigorous research, early evidence points to the likely cost-effectiveness of some lifestyle change interventions, even when compared to more traditional medical interventions. The use of new technologies is an especially exciting recent development, especially when combined with more traditional delivery approaches used by health professionals, peer leaders, and others in health-care and community settings. Given the very rapid increase of disease burden attributable to chronic noncommunicable disease as a result of lifestyle behaviors in developing regions of the world, these kinds of approaches urgently need further development and adaptation to the growing health needs and challenges of the 80 % of the world's population living in these regions of the world (Beaglehole and Bonita 2008).

In conclusion, lifestyle interventions and programs have been shown to have positive effects on many different health behaviors, thereby also having a substantial effect on ameliorating cardiovascular risk. Future research on interventions and their delivery will inform how to better combine the various intervention components, their intensity, and duration in order to strengthen program delivery and maximize long-term outcomes.

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