Promotion of healthy nutrition in primary and secondary cardiovascular disease prevention: A Clinical Consensus Statement from the European Association of Preventive Cardiology

Vassilios S Vassiliou, MD, PhD, FESC[1], Vasiliki Tsampasian MSc, MD[1], Ana Abreu, MD, FESC [2]; Donata Kurpas, MD [3]; Elena Cavarretta, MD, PhD [4, 5]; Martin O'Flaherty, MD, PhD [6]; Zoé Colombet, PhD [6]; Monika Siegrist, PhD [7]; Delphine De Smedt, MD, PhD [8] and Pedro Marques-Vidal, MD, PhD, FESC [9]

[1]Department of Medicine, University of East Anglia, Norwich and Norfolk and Norwich University Hospital, NR4 7UQ, UK

[2] Cardiovascular Rehabilitation Centre, Department of Cardiology, University Hospital Centre of North Lisbon, Av. Prof. Egas Moniz MB, 1649-028 Lisboa, Portugal

[3] Department of Family Medicine, Wrocław Medical University, 1 Syrokomli Street, 51-141 Wrocław, Poland

[4] Department of Medical-Surgical Sciences and Biotechnologies, Sapienza University of Rome, corso della Repubblica 79, 04100 Latina, Piazzale Aldo Moro 5, 00185 Roma, Italy

[5] Mediterranea Cardiocentro, Napoli, Italy

[6] Institute of Population Health, University of Liverpool, Waterhouse Building, Block B, Brownlow Street, Liverpool, L69 3GF, UK

[7] Department of Prevention and Sports Medicine, School of Medicine, University Hospital 'rechts der Isar', Technical University of Munich, Munich, Germany

[8] Ghent University, Faculty of Medicine and Health Sciences, Department of Public Health and Primary Care, Campus UZ Gent, Corneel Heymanslaan 10 - 4K3, B-9000 Gent, Belgium

[9] Internal Medicine, Lausanne University Hospital and University of Lausanne, Rue du Bugnon 46, CH-1011 Lausanne, Switzerland

Emails

Vassilios Vassiliou	v.vassiliou@uea.ac.uk
Vasiliki Tsampasian	v.tsampasian@uea.ac.uk
Donata Kurpas	donata.kurpas@umw.edu.pl
Elena Cavarretta	elena.cavarretta@uniroma1.it
Ana Abreu	AnanAbreu@hotmail.com
Martin O' Flaherty	MoFlaher@liverpool.ac.uk
Zoé Colombet	Zoe.Colombet@liverpool.ac.uk
Monika Siegrist	Monika.Siegrist@mri.tum.de
Delphine De Smedt	Delphine.desmedt@ugent.be
Pedro Marques-Vidal	Pedro-Manuel.Marques-Vidal@chuv.ch

ORCID

Vassilios Vassiliou	0000-0002-4005-7752
Vasiliki Tsampasian	0000-0003-1534-7587

Donata Kurpas 0000-0002-6996-8920
Elena Cavarretta 0000-0003-0221-6000
Ana Abreu 0000-0003-0786-7830
Martin O' Flaherty 0000-0001-8944-4131
Zoé Colombet 0000-0001-6179-7517
Monika Siegrist 0000-0001-9357-5185
Delphine De Smedt 0000-0001-7035-8508
Pedro Marques-Vidal 0000-0002-4548-8500

Correspondence to
Pedro Marques-Vidal
Office BH10-642
Centre Hospitalier Universitaire Vaudois
Rue du Bugnon 46
CH-1011 Lausanne
Switzerland
Phone : +41 (0)21 314 09 34
Email : Pedro-Manuel.Marques-Vidal@chuv.ch

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Abstract

Background: Poor dietary habits are common and lead to significant morbidity and mortality. However, addressing and improving nutrition in various cardiovascular settings remains suboptimal. This paper discusses practical approaches to how nutritional counselling and promotion could be undertaken in primary care, cardiac rehabilitation, sports medicine, paediatric cardiology and public health.

Discussion: Nutrition assessment in primary care could improve dietary patterns and use of e-technology is likely to revolutionise this. However, despite technological improvements, the use of smartphone apps to assist with healthier nutrition remains to be thoroughly evaluated. Cardiac rehabilitation programmes should provide individual nutritional plans adapted to the clinical characteristics of the patients and include their families in the dietary management. Nutrition for athletes depends on the sport and the individual and preference should be given to healthy foods, rather than nutritional supplements. Children with familial hypercholesterolaemia and congenital heart disease benefit the most from nutrition counselling in the short and long term. Finally, policies taxing unhealthy foods and promoting healthy eating at the population or workplace level effectively prevent cardiovascular diseases. Within each setting, gaps in knowledge are provided.

Conclusion: This Clinical Consensus Statement contextualises the clinician's role in nutrition management in primary care, cardiac rehabilitation, sports medicine and public health, providing practical examples of how this could be achieved.

Keywords: nutrition; e-counselling; implementation; prevention; cardiovascular disease

1. Introduction

Poor dietary habits remain one of the leading causes of non-communicable diseases worldwide[1]. Switching to a healthier diet will help reduce cardiovascular risk factors[2] and cardiovascular events[3]. Despite this, dietary recommendations are irregularly applied in clinical practice[4]. This lack of implementation stems from the limited training in nutrition provided during medical school[5], lack of time or inadequate reimbursement of nutrition provision[6], insufficient resource and community-based support, and patient barriers[7]..

For healthy nutritional habits to be promoted in all levels of primary and secondary care, healthcare providers working together with the public need to be active participants in a cycle of training, education and awareness. This will maximise the chances of implementing change and adopting important dietary measures that are crucial for the prevention of cardiovascular disease (**figure 1**). In this Clinical Consensus Statement, practical suggestions on providing nutritional counselling are given as proposals for public health professionals.

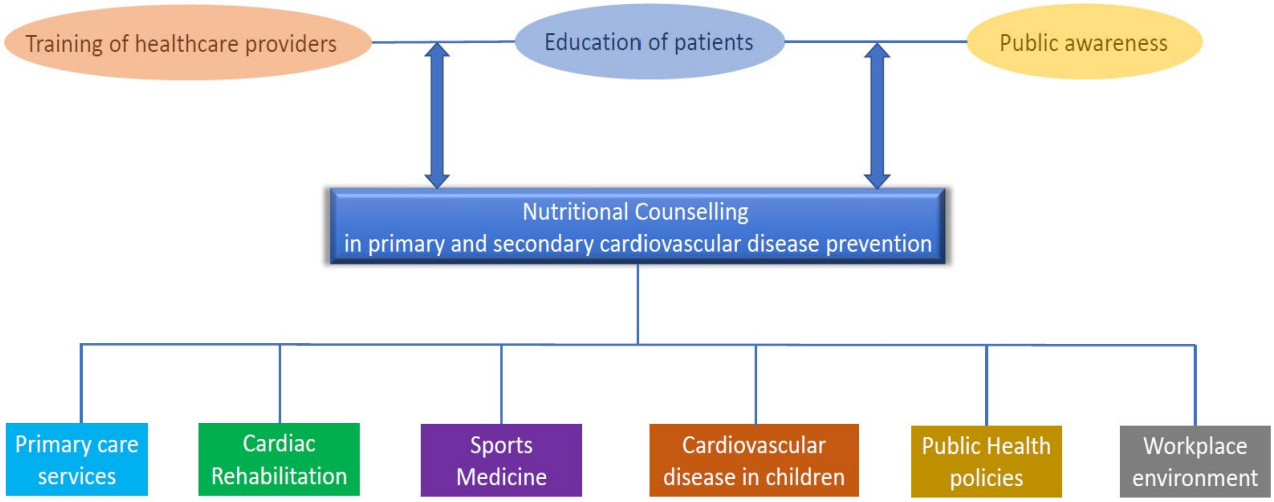


Figure 1 Nutritional counselling has a central role in cardiovascular disease prevention. Healthcare providers, patients and the public can contribute to all levels of primary and secondary care, provided they have the appropriate training, education and awareness.

2. Healthy nutrition in primary care

2.1. Rationale

Suboptimal nutrition leads to adverse effects in both acute and chronic diseases[8]. An unhealthy diet is implicated in the pathogenesis of seven of the ten leading causes of death worldwide, including heart disease, cancer, and diabetes[1]. On the contrary, better nutritional support and lifestyle approaches to

patients in primary care can have substantial short- and long-term benefits both for the patients and the healthcare system under which they are looked after[9]. In 2019, World Health Organisation issued a report on the importance of nutrition stating that appropriate investment in nutrition could save 3.7 million lives worldwide by the year 2025[10].

Primary care physicians' motivation to provide nutritional care varies according to practice and experience. Several studies investigating barriers to nutritional counselling in primary care practice found that physicians feel insufficiently trained in this[11]. However, educational events (including Continuous Medical Education courses), mentorship schemes, and policies created by professional and government organisations all help increase this provision by increasing competence and confidence[12].

While there are exceptions, the most commonly encountered practice in a primary care setting is to screen for patients in need of nutritional counselling[13]. These are usually individuals with high risk or with already established chronic cardiovascular disease. Undoubtedly, offering such services to those in need is essential. However, primary care practices should aim to incorporate screening and counselling for all individuals. In this way, primary prevention will be at the centre of patients' healthcare, leading to significant benefits for them and their healthcare providers[14,15]. Nutrition-focused education and public awareness are essential for the maintenance of healthy eating habits that are beneficial for one's physical health and disease prevention[16,17]. Such measures are important for everyone and even more so for individuals at increased risk of acute or chronic disease, such as elderly or frail people, pregnant women and other groups vulnerable to illness[16,17].

Promotion of healthy dietary habits requires adopting a holistic approach towards a patient. Therefore, whilst dietitians and nutritionists routinely give nutritional advice, other team members such as nurses and allied healthcare professionals, also play a vital role[18]. A meaningful change towards healthy nutritional routines may significantly impact someone's life. A systematic review of 26 randomised controlled trials including 5,500 adults found that primary care dietary consultation effectively improved dietary quality, glycaemic control and weight control[19]. These effects can have immense benefits, especially for patients with a high cardiovascular risk.

2.2. Nutritional counselling in the primary care setting

Nutritional counselling is a two-way interaction; interpreting the assessment results, identifying nutritional problems, discussing goals with the patient and how to achieve them are all crucial facets of this. Its purpose is to help patients understand important information about the health effects of nutrition and focuses on practical measures to meet their nutritional needs. Moreover, it reinforces the importance of behaviour change towards healthy eating and optimal health[18]. The complexity of counselling means that nutritional counsellors should be formally educated. The use of appropriate materials to increase

understanding and retention, including illustrations, food models, home brochures, data collection forms, and referral forms, is encouraged.

The patient's current eating habits (e.g. during a 24-hour dietary recall, a short questionnaire or a rapid tool for diet assessment such as the Healthy Eating Index[20]) and knowledge should be evaluated when discussing nutrition. The primary care physician should provide education, ascertain patient willingness to change, agree on the pace of change, and support these changes. It should be appreciated that food plays many roles in people's lives and choosing what to eat can have emotional and social pleasure or stress. Furthermore, patients should be reminded that permanent changes occur slowly and following a continuous interaction between the primary care physician and the individual[21]. The challenge is achieving meaningful clinical results, improving quality of life, and encouraging a positive attitude to behaviour change by ensuring that patients understand the relevant information, accept the need for nutritional modification and work towards a new goal. Adhering to change is essential to maintaining healthy nutrition. Ongoing feedback from both the patient and the physician and allowing the appropriate amount of time for serial consultations can significantly improve adherence to behavioural and lifestyle changes[18]. In addition, personal, economic, psychological, and emotional considerations should also be addressed and managed as these are essential factors that may impact on compliance and treatment continuation.

Face-to-face appointments may not always be an option, and e-counselling through virtual consultation has become increasingly used. The development of new technology in e-counselling provides an important opportunity for patients with limited access to consultations[18]. Virtual consultations have the advantages of being easily accessible and often more convenient and can reduce barriers related to patient withdrawal, geographic distance, time constraints and socioeconomic status. In addition, smartphone applications have recently been used to improve nutrition knowledge and contribute to behavioural changes beyond weight loss[22,23] . Such applications using artificial intelligence can provide accurate and near-real-time dietary assessments and positively influence chronic disease health outcomes. Nevertheless, these applications do not always provide personalised advice tailored to the individual and do not establish a rapport with the patient like the clinicians do. Therefore, they should be a complementary tool to the physician's assessment and not a replacement of it. Relying solely on apps might exclude specific tech-poor segments of the population, such as the elderly or deprived socio-economic groups which might not have the knowledge or the access to the technology. Table 1 summarises the primary healthcare professionals' key objectives in providing nutritional counselling.

Table 1. Key messages for effective nutritional counselling in primary care

Primary healthcare physicians should aim to:
Seek formal and informal training in nutrition and nutritional counselling • Attend educational events (including Continuous Medical Education courses) • Participate in relevant mentorship schemes • Keep up to date with professional recommendations, national and international guidance and policies
Educate patients regarding the value of nutrition in cardiovascular health • Ensure there is appropriate time allowed for consultation when booking appointments, especially for patients at high risk of cardiovascular disease • When necessary, use appropriate materials (illustrations, food models, home brochures, data collection forms) to increase understanding and retention
Undertake a thorough and personalised evaluation of the patient's nutritional patterns • Assess the patient's current eating habits and morphometric parameters as weight, height, body mass index (BMI), abdominal circumference • Discuss and agree with the patient on areas for improvement • Together with the patient, establish feasible goals that will lead to improvement of their daily nutritional intake • Encourage communication and ongoing feedback to identify and tackle with issues that may occur
Provide holistic approach • Appreciate that changes in eating habits may cause emotional and psychological stress • Provide individualised support and encourage continuous interaction • Liaise effectively with other primary health care providers (including dietitians, nutritionists, clinical psychologists) that may have valuable input in patients' care • Where appropriate, offer the option of e-counselling or refer the patient to smartphone applications (complementary to the consultation) for further reading, education, monitoring

2.3. Knowledge gaps

There is a lack of concise data collection from primary care practices across Europe regarding the implementation of nutritional counselling in cardiovascular disease prevention. Large national and international epidemiological studies are needed to better evaluate current practices and identify areas for improvement.

Most nutrition and diet apps focus on monitoring diet and estimating nutrient content. However, many apps have not been validated for primary care practice, and no specific apps are currently recommended. Research into the long-term impact of applications focusing on nutritional e-consulting (critical in primary care practice) is also limited[24] and further work in this area should be undertaken.

3. Nutritional care in cardiac rehabilitation programmes

3.1. Rationale

Rehabilitation programmes have seen an increasing number of complex patients with diabetes, hypertension and dyslipidaemia, all exacerbated by poor nutrition. All patients starting a cardiac

rehabilitation program would benefit from individualised assessment, evaluation, and precision intervention when it comes to nutritional advice in order to facilitate and maintain a successful outcome[25,26]. If nutrition can be successfully addressed during rehabilitation, it is expected to lead to a better quality of life, better cardiovascular risk management and increased survival[27].

Despite the cardioprotective benefit of individualised nutritional plans in patients with established disease, adherence and compliance remain major issues in clinical practice[28]. Maintaining healthy dietary habits in the long run can be very difficult, with many patients relapsing to earlier eating habits as early as six months after participating in a cardiac rehabilitation programme[29,30]. This is a recognised issue, which according to the European Association of Preventive Cardiology, has five dimensions: the patient, the disease, the healthcare provider, the therapy, and the healthcare system. Each of these dimensions should be optimised simultaneously in order to achieve the best possible adherence to therapy and maximise the benefits of it[31].

The success of achieving the best possible results not only for the short but also for the long-term requires a multi-disciplinary team approach that will support the patients to make and maintain significant changes in their eating habits. All members of the multi-disciplinary team that comprises the cardiac rehabilitation programme, including physicians, nurse practitioners, clinical psychologists and other allied health professionals have a vital role in this. Importantly, comprehensive nutritional assessment and counselling by a registered dietitian are invaluable in the evaluation, education and management of patients with cardiovascular disease[32,33]. Similarly to the assessment of the patient in primary care, adopting a holistic approach is essential, especially for the appropriate individualised management of patients with complex underlying cardiac pathology.

3.2. Nutrition as a core component of the cardiac rehabilitation programme

Before establishing a cardiac rehabilitation nutritional plan, information regarding the dietary intake and behaviours of the patient must be collected in addition to the diagnosis and comorbidities of the individual. This includes estimates of daily energy intake and food sources of saturated and *trans*-fat, cholesterol, sodium, and other micronutrients. Food intake habits, number of meals, snacks, frequency of meals outside the home and alcohol consumption should be collected, for example using short questionnaires. Weight, height, and abdominal circumference should be measured to compute body mass index and abdominal obesity, as well as other clinical conditions that might require specific dietary counselling, such as impaired renal function or weight modifications in sarcopenia. The collection of this information will allow assessing the targets for nutritional intervention.

Nutritional intervention should be individualized according to the identified target areas, like obesity, diabetes, hypertension and dyslipidaemia, and discussed with the patient, who always needs to be involved in the treatment decision process. Both the patient and their family/ health care providers (where appropriate) should be educated regarding the nutritional plan. It will be fundamental to transmit

how crucial is adequate nutritional change for cardiovascular risk factors control, one of the most challenging purposes of cardiac rehabilitation. Whenever necessary, it is recommended that the nutrition intervention includes models of behavioural change and adherence strategies. During the cardiac rehabilitation programme, cooking classes for patients and family members can be used (when possible) to provide tools in practice for healthy eating. Practitioners must be encouraged to adopt a flexible dietary approach, mindful of patient beliefs and preferences. Moreover, it should be acknowledged that other comorbidities may necessitate deviations from established advice, with dietitians actively guiding the multi-professional team[27].

Regarding weight loss, the patient should be informed about the benefit of weight loss, targets to achieve and proposed interventions. Adherence of the patient to the prescribed eating plan and/or food education is fundamental to obtain meaningful results. Interventions should combine eating, exercise, and behavioural programs to reduce total energy intake, aiming for an energetic deficit (500-1000 kcal/day) to attain the desired weight, especially in patients with BMI>25 kg/m^2 and/or abdominal circumference >102cm in men and 88cm in women. Targets for weight loss could be >10% in some individuals, aiming for 0.5-1 kg/week for more than six months[25,34].

Table 2 provides essential aims and objectives of healthcare professionals involved in nutritional counselling of patients in cardiac rehabilitation programmes.

3.3. Knowledge gaps

Up to this day there are no studies evaluating and comparing the effectiveness of the different methods used in cardiac rehabilitation (cooking classes, individual consultations, group sessions) on adherence and maintenance of healthy dietary habits. As such, there is currently no guideline-recommended approach and future studies are needed to assess the most impactful intervention. The long-term effect of behavioural interventions also remains unclear as there is a lack of evidence for these.

Table 2. Key messages for the promotion of effective nutritional counselling in cardiac rehabilitation

Healthcare practitioners, as part of the multi-disciplinary team, should aim to:
Undertake a detailed assessment of the patient's dietary habits • Evaluate daily energy intake and preferred food sources of nutrients • Assess number of meals, snacks and, when applicable, cooking habits • Explore alcohol consumption; where increased, explore psychosocial factors that may have an impact
Encourage and support behavioural changes that will enable healthy eating habits in the long run • Educate the patient (and, where appropriate, their carers) on the importance of healthy nutrition for cardiovascular risk factor control, with an emphasis on their co-morbidities • Provide individualised support tailored to the patient's beliefs and preferences • When possible, cooking classes for patients and their next of kin can be provided

Liaise effectively with other members of the team • Physicians, nurse practitioners, dietitians and clinical psychologists should collaborate to support the patient's needs and tackle issues that may occur • Generate individualised nutritional plans that can be adopted in the patient's daily life

4. Nutritional care in sports medicine

4.1. Rationale

Healthy nutrition and exercise have been recognised as strategic lifestyle components since Hippocrates. They act synergistically to enhance physical performance, reduce recovery time and boost mental health[23]. Nutrition focuses on energy availability to provide substrate stores to meet the metabolic demand during exercise and recovery. In contrast, exercise training aims to increase metabolic efficiency and athletic skills. Although nutrition and exercise have been studied separately too often, their interaction is incompletely understood.

In sports medicine, nutrition has a central role in an athlete's life as it is crucial for repeated cycles of high-quality training, optimal performance as well as adequate and fast recovery from exercise. Previous studies have shown that athletes who followed nutritional plans by sports nutritionists performed significantly better compared to those who followed a self-chosen nutritional strategy[35,36]. Furthermore, systemic and local inflammation that follows excessive muscle damage may be ameliorated by a healthy nutritional status[37].

Importantly however, insufficient energy intake may have detrimental effects both for recreational and for competitive athletes. Relative energy deficiency in sport (RED-S) is a condition which reflects a significant impairment of physiological functioning and results in a multifaceted deleterious impact on the athlete's psychological, cardiovascular, endocrine, gastrointestinal, and haematological systems[38–40]. In affected female athletes, amenorrhoea and hypoestrogenism are some of the features of RED-S that are linked with early atherosclerosis, endothelial dysfunction and disruption of the renin-angiotensin-aldosterone axis[41,42]. In the more severe form of the syndrome, anorexia nervosa may cause arrhythmias, pericardial effusion, and valvular abnormalities[43].

The International Olympic Committee, with the clearly stated goal to "*protect the health of the athlete*", has generated a Consensus Statement in which clinical recommendations are provided for the management of the affected individuals[38]. It is of paramount importance that all healthcare providers are aware of the negative impact chronic or severe energy deficiency can have on recreational or competitive athletes' health. More significantly, healthcare providers should be able to provide guidance for the prevention of this disease that can have a traumatic impact on athlete's life.

4.2. Nutritional counselling for athletes

Education of athletes and, where appropriate their next of kin, is paramount in maintaining an adequate nutritional plan and sufficient energy intake in the long run. Nutrition education interventions have been proved to be effective methods of improving the athletes' sports nutrition knowledge both in individual and team sports[44,45]. These can be provided by sports medicine experts or sports nutritionists and may be in the form of short classroom-based sessions, group activities or interactive workshops[44,46]. Participation in such activities has been shown to be an effective way of improving athletes' eating habits, which in turn have positive impact on performance[47,48].

Both for recreational and for competitive athletes, tailored sport-specific requirements, athlete's characteristics, periodisation of training and competitions, and nutritional goals are essential for selecting the best the nutritional strategy[49]. Therefore, in practice nutritional plans can be individualised, considering the specific sport, the performance goals, body composition, nutrient intake timing, competition planning, and food preferences, as "one size does not fit all".

The nutritional recommendations endorse a "food first" approach with sufficient calories. This comprises macronutrients, mainly carbohydrates and proteins[50,51], scaled to (lean) body mass, with vitamins, minerals, and other micronutrients primarily obtained from fresh vegetables and fruits[49,52]. Restoring muscular glycogen is a critical factor in post-exercise recovery. Appropriate hydration and fresh fruits appear as effective as sugar sports beverages during recovery[53]. Recurrent injuries should prompt investigation into the appropriateness of or the adherence to the nutritional plan chosen.

Many superfoods, nutritional products, supplements, and nutraceuticals have been proposed on the market. Some have been tested in research studies to prove their efficacy; others are believed to be crucial, even without evidence-based data. However, the primary outcomes of studies, such as a lower degree of inflammation, oxidative stress reduction, or a faster metabolic recovery[27,29] may not be perceived as essential benefits, nor as performance or recovery enhancers by the athletes and coaches. The debate is still ongoing if elite-level athletes need formulated supplementation and healthy nutrition to overcome the strenuous exercise workloads and reduce oxidative stress. This is because polyphenol-rich nutrition seems as effective as supplements[29,30]. Table 3 summarises important elements of the nutritional counselling for athletes.

4.3. Knowledge gaps

The effect of nutraceuticals, supplements, and probiotics added to a healthy and correct nutrition on exercise performance or metabolic recovery has not been established.

One of the most significant challenges in sports nutrition studies is to consider differences in genetics, absorption, metabolism, and excretion, coupled with a high-quality methodology[54]. Nutrigenomics and nutrigenetics are rapidly growing experimental approaches that use the "OMICs"

technologies (metabolomics, lipidomics, proteomics) together with genetic sequencing to analyse the individual athlete's response to nutrition and supplementation[55]. It is likely that implementation of both approaches will lead to a profound advance in sports nutrition, however no firm evidence is available yet to confirm this.

Table 3. Important considerations for the nutritional counselling for athletes

Healthcare practitioners should aim to:
Endorse a "food first" approach with sufficient calories • Assess athlete's body composition, specific sport, training plan and performance goals • Follow-up athletes regularly (weekly weight measurements) to ensure there is an energy balance state and prevent significant changes in body composition / weight • Ongoing communication with the athlete, coach and next of kin is essential for maintenance of appropriate energy intake
Underpin the importance of appropriate nutritional strategy • Educate the athlete and, when applicable the next of kin, on the significance of a healthy and tailored nutritional approach that covers their needs in energy demands • Provide individualised support according to athlete's metabolic demands and dietary preferences
Identify and manage appropriately signs and symptoms of energy deficiency • Recurrent injuries or illnesses should prompt investigation into the appropriateness of the chosen nutritional plan or adherence to it • Seek appropriate expertise (sports medicine expert and sports nutritionist) for athletes with or at high risk of developing relative energy deficiency (RED-S)

5. Nutritional care in children with cardiovascular disease

5.1. Rationale

Healthy eating in childhood and adolescence with an appropriate supply of energy and nutrients ensures daily performance and enables growth processes and healthy development. Dietary recommendations for children often focus on obesity. However, healthy nutrition also plays an essential role in children with other chronic diseases. A high-quality diet with healthy eating habits in childhood and adolescence is of paramount importance in the prevention of cardiovascular diseases and elimination of cardiovascular risk factors[56].

Children with established cardiovascular disease, such as congenital heart defects, are particularly prone to malnutrition, a serious issue that may result not only in failure to thrive but also other complications such as heart failure symptoms, anaemia and recurrent episodes of illnesses[57]. Ideally, the nutritional care of children and adolescents with cardiovascular disease should engage multiple members of the multi-disciplinary team including paediatricians, cardiologists, specialist nurses, paediatric dietitians and pharmacists[58]. It is imperative that all physicians can identify these patients

with cardiovascular disease and refer them early to a paediatric cardiology centre that will provide the appropriate support and nutritional counselling.

5.2. Nutritional counselling for children with familial hypercholesterolaemia

Familial hypercholesterolaemia is a common genetic disorder characterised by lifelong highly elevated low-density lipoprotein cholesterol levels. These changes are already present at birth leading to early atherosclerotic lesions and premature coronary heart disease. Therefore, screening and therapy should start early, including dietary advice from certified paediatric dietitians or nutritionists[59].

Through individualised counselling, children and families should be supported in consuming less food and beverages with high cholesterol, saturated fat, and *trans*-fat content. Intake of fruit and vegetables, whole grains, fish, or lean meats according to the Mediterranean or heart-healthy diet and maintaining a healthy body weight should be encouraged[60]. All nutrition advice should be age-adapted to ensure the healthy growth of children[61], in addition to any necessary pharmacotherapy.

There is no information about special alternative diets which might be contraindicated in these children. All dietary strategies should be assessed regularly to ensure all requirements for healthy growth are met[61].

5.3. Nutritional counselling for children with congenital heart disease

Congenital heart disease is a common birth defect, which often requires surgical interventions in early childhood. Children with congenital heart disease have a high risk for malnutrition or undernutrition, leading to growth restriction, delays in cardiac surgery, increased preoperative morbidity, and postoperative complications[62].

Parents often reported feeding difficulties, including refusal, poor appetite, longer feeding times, and frequent feeding. In addition, structural anomalies of the gastrointestinal tract, gastroesophageal reflux, or neurological problems have additional adverse effects on feeding[62,63].

Human breast milk by breastfeeding, bottle, or feeding tubes is recommended for neonates[62,63] and considered the “gold standard” independently of the method delivered, in preference to formula milk. Perioperative nutrition, including enteral and parenteral nutrition, is vital for reaching sufficient energy intake and improving postoperative recovery[62]. After successful cardiac surgery, weight and growth improve immediately in many children. Children with multiple cardiac surgeries or early feeding disorders are at risk for long-term feeding disorders[64].

Table 4 summarises the most important messages for nutritional counselling for children and adolescents with cardiovascular disease.

Table 4. Summary of key points essential for the nutritional counselling of children and adolescents with cardiovascular disease

Healthcare practitioners should aim to:
Acknowledge the importance of nutritional counselling in children with cardiovascular disease • Provide nutritional advice that is tailored to the patient's age, body habitus, risk factors and underlying disease • Assess patients regularly to ensure all requirements for healthy growth and development are met
Ensure appropriate nutritional counselling is provided • Refer patients early to a paediatric cardiology centre that will provide the appropriate support and nutritional counselling under the care of a specialist multi-disciplinary team • When appropriate, liaise with certified paediatric dietitians or nutritionists for the selection of the most appropriate nutritional plan for the individual

5.4. Knowledge gaps

Optimal nutrition in children with congenital heart disease is essential to reduce mortality and to improve normal growth. However, there is a lack of large studies identifying the best nutrition strategies[63].

6. Nutrition and public health in Europe

6.1. Nutritional counselling at the population level

In the current European policy landscape, most countries use information and education to improve dietary behaviours, such as curriculum and community-based nutrition education, developing cooking skills, training of cooking skills, training food service providers and teachers, and nutrition counselling in healthcare settings. Nutritional policies aim to result in a healthier dietary intake, with impact on a large spectrum of disease including cardiovascular disease and obesity across all socioeconomic strata.

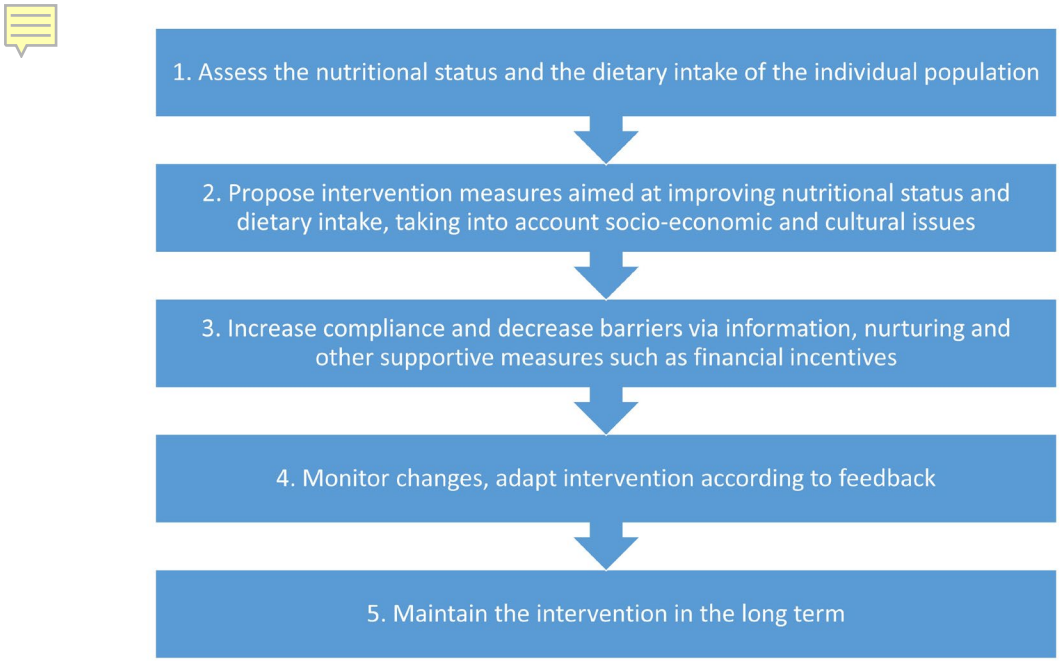
The most commonly used nutrition policies are information-based policies providing nutrition information such as food-based dietary guidelines (in 23 European countries[65,66]) and mass media and informational campaigns (e.g., the worldwide 5-A-Day campaign). However, while these can improve population health, they are likely to be failing the socially disadvantaged groups and, in doing so, widening inequalities in diet[67,68].

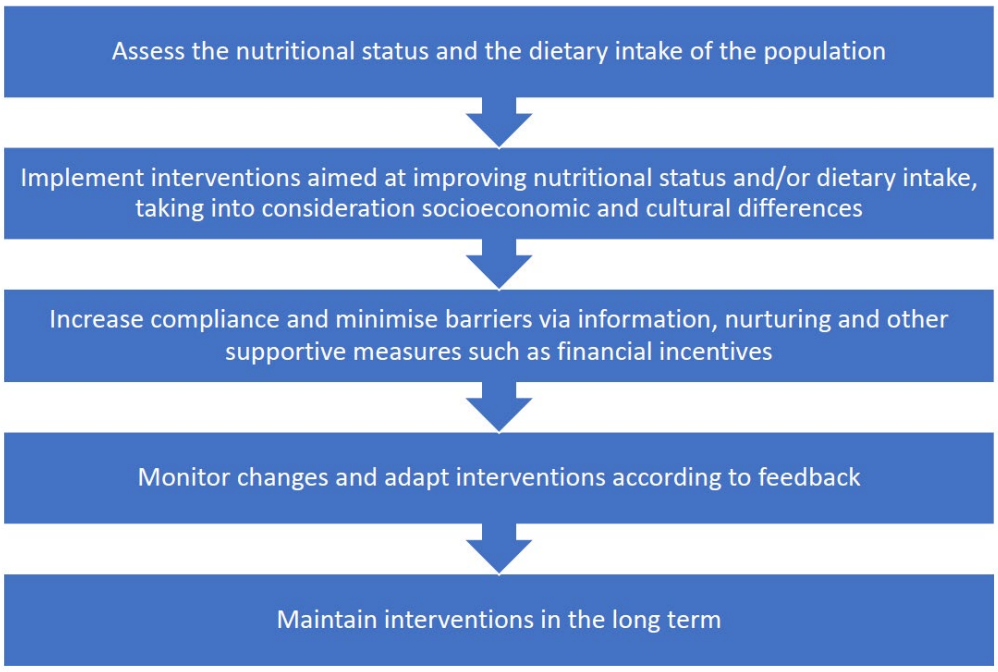
Tackling the food environment can result in more significant and equitable improvements in diet and health. Current popular actions - implemented in 32 European countries[66] - are regulations on food health claims, mandatory nutrient lists on packaged food, and easy-to-understand labelling. A concrete example is France, Belgium, and Spain adopting the NutriScore label, classifying foods and drinks according to five categories of nutritional quality. However, these policies rely on consumer knowledge and behaviour, and might result in widening dietary and social inequalities[68]. Food advertising and marketing restrictions exist in 11 European countries[66]. Portugal restricts the advertising of products high in energy, salt, sugar, saturated fat, and *trans*-fats before, during, and after children's programmes. United Kingdom (UK) bans TV advertising of these products before 9 pm.

Another approach developed in 17 European countries[66] is to improve the nutritional quality of the whole food supply through reformulation (reduction of salt, saturated fat, and sugar). The UK Food Standards Agency Salt reformulation programme was a success story, substantially decreasing salt content and intake over a decade. However, after England replaced it with the Public Health Responsibility Deal in 2011, a less demanding scheme for targeting and monitoring the salt content of food, annual declines in salt intake slowed significantly[69]. Estimates suggest that this lack of robust target setting, monitoring, and enforcement might have resulted in 9900 additional cases of cardiovascular disease by 2018[69]. Other policies aim to offer a healthier environment, especially in schools, through the distribution of fruit, vegetables, and milk products in the EU[70] , bans on vending machines in France, offering healthy food options as default in food service outlets in Norway, and voluntary commitments to reduce portion sizes in Portugal, Spain, and the UK.

Finally, more countries are using fiscal tools to modify consumer food behaviours with health-related food taxes implemented in 12 European countries[66], mainly targeting sugary drinks. These policies are not simply designed to reduce consumption but also to induce reformulation of food and drink products, as recently evidenced by the UK Soft Drinks industry levy[71]. European nutrition policies show great diversity and governments' political will to tackle poor diets. However, most policies are information-based, relying on personal nutrition literacy, thus risking widening inequalities. More attention should be given to developing and implementing low-agency population policies, which are admittedly politically challenging[68,72]. Combining agency and low-agency policies as an integrated system approach will likely improve diets and narrow inequalities, as proposed by the European Food and Nutrition Action Plan 2015-2020[73]. A flowchart summarizing the steps for promoting a healthy nutrition at the population level is provided in **Figure 2**. However, significant challenges remain to build an integrated food policy framework towards a healthy and sustainable food system[74].

Figure 2: Key steps for the promotion of healthy nutrition





6.2. Nutritional counselling at the workplace and at schools

Workplace-based dietary interventions are large-scale strategies to reach as many individuals as possible for prolonged periods[75,76]. As for nutrition policies, they aim at providing a healthy food environment at the workplace and not to specifically tackle cardiovascular diseases. A limited number of trials of workplace-based interventions seem to be effective in modifying some dietary habits, behaviour, and health outcomes[75,76]. However, reviews have typically reported that workplace interventions targeting dietary behaviour yield modest improvements and are often poorly implemented,

limiting their impact[75]. In Europe, most countries like the Netherlands, Norway, Germany, and Portugal have dietary guidelines for the workplace based on voluntary action[66]. For example, in the Netherlands, policies include putting the "healthier" choices in the most visible places on the displayed range[66]. Furthermore, some European countries have mandatory standards influencing the food available in specific workplaces like Finland, Germany, Portugal and UK[66]. Schools are a unique powerful tool through which nutrition education can be promoted in society. According to a recent guideline published by the World Health Organization, provision of health education about nutrition is an essential intervention and component of school health services worldwide, as its influence for students can lead to meaningful and sustainable healthy behaviours[77]. Healthy dietary habits endorsed by a young individual can not only reduce their risk of illness but also contribute to their emotional well-being and productivity[78]. A South Korean cross-sectional survey that included more than 65,000 school-going adolescents, demonstrated that healthy dietary habits were associated with lower mental distress and higher psychological wellbeing, revealing in this way the important link between nutrition and welfare[79]. This, in turn, can also lead to important long-term cost-effective advantages for the wider society. It is therefore imperative for nutritional counselling to be incorporated in primary and secondary education as its impact and benefits can be tremendous for all children and adolescents and, consequently, the society as a whole.

6.3. Knowledge gaps

Policymaking is a nonlinear process and simply providing scientific evidence is not enough for implementation. Methods to engage with stakeholders and bring the voice of the public to understand the political, legal, and technical feasibility alongside public acceptance need to be further developed[80], and health practitioners should also engage in advocate for population level changes[81].

7. Nutritional counselling: is it cost-effective?

Knowledge of the cost-effectiveness of nutritional interventions could prioritise health policy decision-making[82]. Due to the scarce financial resources, policymakers must choose their investments wisely, focusing on the best value for money. It is well known that preventive interventions score rather well on their cost-effectiveness outcomes[83,84]. Several studies focussing on the cost-effectiveness of nutritional interventions have been conducted. These often consider obesity or diabetes as intermediate outcomes in developing other chronic diseases such as cardiovascular disease [55-58].

Previous studies focussed mainly on community-based, school-based, or workplace-based programmes, often showing conflicting results. For example, according to a review, only 5 out of 23 strategies promoting fruit and vegetable intake in healthy adults were cost-effective[85]. Context and setting seem to be essential drivers in the cost-effectiveness outcome. A recent study focused on

nutrition education and system-level dietary modification in a workplace setting. It resulted in a cost-effective outcome[86]. Importantly, most interventions are offered as comprehensive programmes focusing on healthy eating and physical activity, making it difficult to assess the attributable impact of nutrition-related actions.

Recently, increased focus has been on the cost-effectiveness of food labelling (front-of-pack labelling), fiscal taxes, price reductions, and industry agreements with very favourable outcomes. Outstanding outcomes are seen in salt reduction strategies, with taxes and salt reduction by manufacturers and food labelling being cost-effective or even cost-saving[87,88]. These results are confirmed for other nutrients, such as eliminating industrial *trans*-fats or using a fruit and vegetable subsidy, saturated fat, sugar and salt taxes, and junk food taxes[89–91]. The magnitude of the tax seems critical here; taxes and subsidies should be used together with the increased total food price being similar to the healthy food subsidy. Whilst the taxation level is expected to vary between countries, as well as the proposed plans of how this income is going to be used to aid healthier nutrition, it is anticipated that this should be in the region of 10-20%[90,92].

7.1. Knowledge gaps

Context and setting seem to be essential drivers in the cost-effectiveness outcome. Further research is needed into the prerequisites of cost-effective interventions and how to establish these boundary conditions in practice.

8. Conclusion

Dietary prevention of cardiovascular disease should be targeted from cradle to the grave, in the presence or absence of disease, and from individual to population level. Dietary recommendations and policies need to be well communicated and aimed to make the healthy choice the easy choice. There are no "magic" foods, yet one should aspire to a diversified fresh diet, rich in season fruit and vegetables, low in fat meat products, and reduced in salty, sugary, fatty, or ultra-processed foods. Nevertheless, a healthy, environmentally sustainable, cost-effective diet is achievable provided patients, health professionals, food industries, and policymakers join efforts, enabling a reduction in cardiovascular adverse events. The provision of healthy foods and education, starting early in life, has the potential to create good eating habits which can be maintained and passed to the next generations.

9. Conflict of interest

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11. References

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