

Nutritional Management of Dyslipidemia with Co-Existing Morbidities in Pakistan: A Systematic Review Based on Guidelines and Literature Review

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Abstract

Objective: Dyslipidemia and atherosclerotic cardiovascular events are highly prevalent in Pakistan, which could be attributed to lack of education, poverty, unhealthy dietary habits, and most importantly absence of local guidelines. Our main goal was to develop a comprehensive comparison of the existing international guidelines for the management of dyslipidemia. Based on the lifestyle modifications suggested by these, the secondary objective was to develop dietary recommendations for dyslipidemia coexistent with other morbidities.

Methods: We conducted a systematic review on three databases; PUBMED, SCOPUS, and International Guidelines Library to acquire guidelines for management of dyslipidemia. The guidelines fulfilling the criteria of the Clinical Practice Guidelines developed by Institute of Medicine in 2011 were selected for data extraction and their quality was assessed by the Mini-Checklist (MiChe) tool. Dietary recommendations for dyslipidemia and other co-morbid conditions were developed based on the review of guidelines and data from randomized control trials. Using the input from clinical nutritionists, these suggestions were modified according to local sources and presented as MyPlates.

Results: Twenty-three guidelines selected according to inclusion/exclusion criteria were compared based on various aspects like atherosclerotic cardiovascular events risk calculator, risk categories, and lifestyle modifications. All the guidelines proposed a similar management approach for dyslipidemia. The major difference was observed in the dietary recommendations were due to the availability and cost-effectiveness of nutritional sources. This also served as our basis when developing nutritional recommendations for dyslipidemia with other conditions.

Conclusion: Dietary modification is the cornerstone of managing dyslipidemia. Due to Pakistan's unique dietary patterns and the economic condition, a multidisciplinary approach with physicians and dietitians is required to develop easily applicable dietary regimes for dyslipidemia.

Keywords: Dyslipidemia, Management, Guidelines, Diet, Nutrition

Introduction

According to the World Health Organization (WHO), 74% of the total global deaths in 2019 were from non-communicable diseases of which ischemic heart disease and stroke were the leading causes.¹ Such cardiovascular events have a multifactorial origin, consisting of both modifiable and non-modifiable risk factors.² To lower CVD mortality, aggressive and comprehensive management of its risk factors, including dyslipidemia, hypertension, diabetes mellitus, and smoking, are crucial.

Dyslipidemia plays a central role as the deranged levels of serum lipids leads to atherosclerotic changes in vessels, increasing the chances of a cardiovascular event.³ Dyslipidemias are collectively among the most commonly detected and treated chronic conditions. They are classically characterized by abnormal serum levels of cholesterol, triglycerides, or both, involving abnormal levels of related lipoprotein species.

The developed countries have managed to reduce the burden of dyslipidemia significantly through raising awareness, rigorous lipid testing, improving availability of lipid-lowering medications and developing regularly updated guidelines with regular updates.³ However, an opposite trend has been observed in the South-East Asian countries particularly Pakistan as indicated by the increased number of deaths (in thousands) due to ASCVD (ischemic heart disease and stroke) attributable to dyslipidemia from 1990 to 2019. According to Liu T, the number of deaths due to the aforementioned events in North America decreased from approximately 200,000 in 1990 to approximately 100,000 in 2019.³ In comparison, the number of deaths due to the same events in Southeast Asia increased from approximately 50,000 in 1990 to approximately 100,000 in 2019.^{3,4} South East Asians (SEA) are reported to be more prone to develop CVD at an earlier age even in the absence of traditional risk. Dyslipidemia pattern in Western populations is mainly characterized by predominantly as increased levels of LDL-C in comparison to Asian populations specifically SEA having a mixed dyslipidemia pattern with a significant low HDL-C and high TG levels.

To our knowledge, one of the most important reasons is the lack of any evidence-based guidelines for the management of dyslipidemia, developed specifically for the population of Pakistan. Adopting the guidelines of other countries for managing dyslipidemia in Pakistan is inappropriate due to the great difference in our dietary patterns and nutritional constituents. Hence, the main rationale behind this study was to determine local food sources beneficial in certain coexistent diseases bearing in mind the poor economic status of the major population.

We aimed to conduct a systematic review of the current local and international guidelines for the management of dyslipidemia to develop a detailed and extensive comparison of these recommendations. Based on this systematic review, the secondary objective is to establish basic dietary suggestions regarding clinical nutrition of the Pakistani population for dyslipidemia along with other co-morbid conditions. By using the dietary suggestions acquired from selected guidelines, our clinical dietitians suggested various foods and their nutrient composition beneficial in combating dyslipidemia alone and dyslipidemia with comorbid. From the comparative analysis of various guidelines for dyslipidemia and extensive literature review and data from randomized controlled trials, the outcome of the secondary objective was to develop MyPlates according to the food resources available in Pakistan.

Methods

This systematic review employed the criteria included in the Preferred Reporting Items for Systematic Review (PRISMA). The protocol for this review was published in the International Prospective Register of Systematic Reviews, PROSPERO (CRD42023414885).

The inclusion criteria are based on definition of clinical practice guidelines provided by Institute of Medicine's 2011 definition⁵:

"Clinical Practice Guidelines are statements that include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options."

Hence, only those guidelines that had evidence-based statements meant for application in clinical practice as a standard of care for dyslipidemia, augmented management of dyslipidemia through risk stratification, screening and diagnosis and suggesting treatment option(s) for dyslipidemia and/or compare their advantages and disadvantages were included.

The guidelines written in languages other than English, represented older versions, gender specific or focused on pediatric population, specifically focused on management of a single disease were excluded.

This systematic review was conducted with search results from the databases of PUBMED, SCOPUS, and the International Guidelines Library. The search results acquired from these databases were combined in Microsoft Office 365 Excel. First, the duplicates were removed followed by the screening of titles, abstracts, and full-text articles independently by two reviewers. Finally, the screening of the two reviewers was compared and any conflict was resolved by the judgment of a third reviewer.

The guidelines were analyzed and compared based on various clinically important parameters of dyslipidemia including risk factors for ASCVD, 10-year risk calculation, screening, risk stratification, non-pharmacological and pharmacological management with treatment goals.

To assess the quality and utility of the guidelines, the Mini-Checklist (MiChe, 2014) tool was used by two authors independently.⁶ This tool assesses the quality of the guidelines through eight different points including the manner of presentation, background and objectives, evidence review methodology, details of treatment approaches etc on a 3-level scale (yes, to some extent, no). The assessed 8 criteria were then converted into an overall quality score on a 7-level scale in which guidelines with a score of 1-3 were labeled as high overall risk of bias while those with a score of 5-7 were labeled as low overall risk of bias. The formula used to calculate the risk of bias was⁷:

$$\text{Overall quality rating} = \frac{3}{4}(n_{\text{yes}}) + \frac{3}{8}(n_{\text{To some extent}}) + 1$$

The USDA Center for Nutrition Policy and Promotion (CNPP) has developed MyPlate to facilitate the public in organizing their dietary intake.⁷ It provides information regarding the five major groups of food required to maintain and promote a healthy lifestyle. We developed a different version of the MyPlate by modifications including re-labelling the categories of food groups (proteins, vegetables, fruits, fats, water and other fluids and substances to avoid with the starches included in fruits and vegetables) and incorporating recommended percentage intake of each macro and micronutrient as shown in Figure 1. Supplementary figures 1 to 9 show the dietary recommendations for dyslipidemia (developed on the basis of guideline analysis) and dietary recommendations for dyslipidemia with other co-morbid conditions (developed on the basis of literature review of randomized controlled trials). The keywords used to search the literature for RCTs reporting a beneficial effect of certain nutrients in co-morbids with dyslipidemia are provided in the Supplementary Table 4. The indigenous alternatives were suggested by local expert clinical nutritionists.

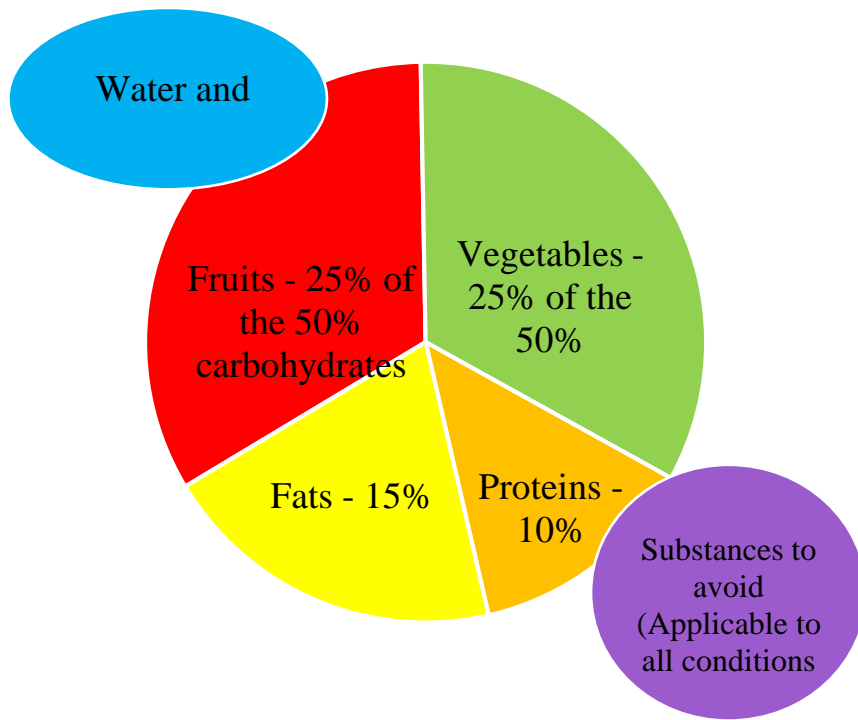


Figure 1: Modified MyPlate.

Results

The search results of the PUBMED, Google scholar databases and the International Guidelines Library are given in Figure 2.

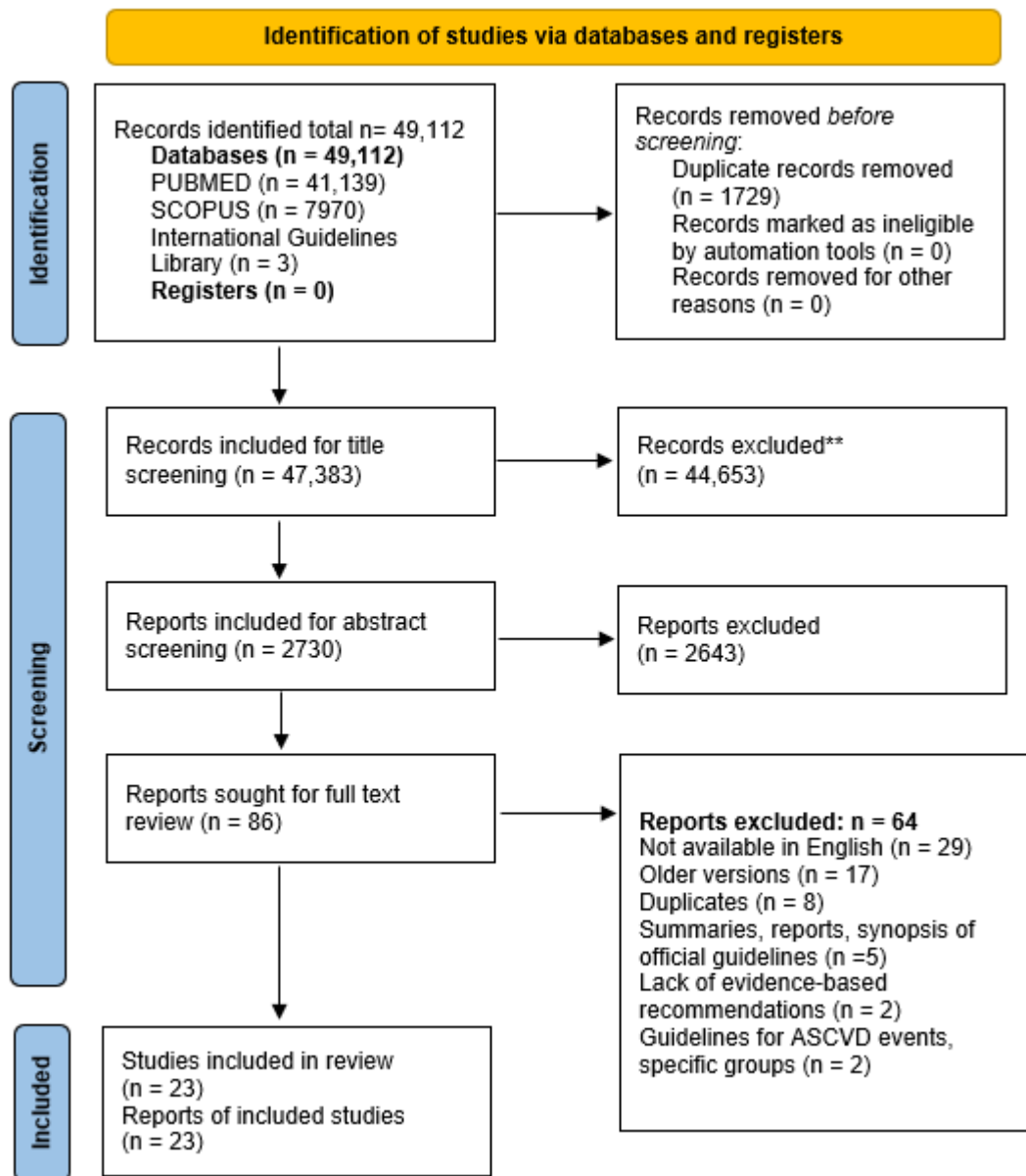


Figure 2: Flowchart Diagram for Systematic Review on Local and International Guidelines for Dyslipidemia.

Each guideline was studied in detail and upon comparison, it was observed that the recommendations of all the guidelines were different in the aspect of nutritional management only, which is discussed in Table 1.

Table 1: Comparison of recommended dietary patterns.

Diet	Regions following dietary pattern	Description	Summary
Mediterranean-style dietary pattern ⁸⁻¹³	United States of America, Canada, India, Europe	<ul style="list-style-type: none"> -Reduce fat dairy products. -Consume fish, lean meats, and skinless poultry. -Reduce salt intake. -Consume soluble fiber and sources of insoluble fiber (such as whole wheat). 	<p>Lipids</p> <ul style="list-style-type: none"> -Reduce intake of trans fats and saturated fats -Increase intake of MUFAs and PUFAs -Avoid high fat products like fried foods, bakery items etc. -Increase intake of extra virgin olive oil.

Dietary approaches to stop Hypertension (DASH) dietary pattern ^{9,12,13}	India, United States of America, Canada, Europe	<ul style="list-style-type: none"> -Reduce total fat intake to 25% - 35% of calories -Consume a high unsaturated fat/saturated fat ratio -Consume plant-based foods (fruits, vegetables, nuts, legumes, and grains) -Consume extra virgin olive oil -Consume higher amounts of fruit, non-starchy vegetables, nuts, legumes, fish, vegetable oils, yoghurt, and wholegrains. -Reduce intake of red and processed meats, foods higher in refined carbohydrates, and salt. 	<p>Carbohydrates</p> <ul style="list-style-type: none"> -Increase intake of fruits, nuts, grains, legumes and vegetables. -Avoid products with high glycemic index like bakery products, foods with artificial sweeteners and refined carbohydrates, beverages, fruits juices etc. <p>Proteins</p> <ul style="list-style-type: none"> -Consume fish, lean meats, proteins from plant sources (lentils, whole grains) -Avoid processed meats and fatty meats. -Reduce intake of salt -Reduce intake of alcohol -Increase intake of plant sterols and dietary fibre
Ketogenic dietary pattern ¹³	India	<ul style="list-style-type: none"> -Consume higher amounts of fat and protein. -Reduce carbohydrate consumption to as low as 20-50 g daily. 	
Macronutrient-targeted dietary pattern ^{14,15}	China, Japan	<ul style="list-style-type: none"> -Consume amount of carbohydrates that is 50%–65% of total energy -Reduce lipid intake to be < 20%–30% of total energy 	
The American Heart Association dietary pattern ¹⁶	United States of America	<ul style="list-style-type: none"> -Consume a diet based on vegetables, fruits, legumes, nuts, whole grains, and fish -Replace saturated fat with dietary monounsaturated and polyunsaturated fats -Reduce amounts of cholesterol, sodium, processed meats, refined carbohydrates, sweetened beverages, trans fat. 	
Taiwanese dietary pattern ¹⁷	Taiwan	<ul style="list-style-type: none"> -Reduce fried foods, sweets and sweetened beverages, high fat and sugar-containing pastry, fatty and organ meats -Consume rich plant-based foods including whole grains, vegetables, fresh fruits, nuts and seeds, tea, and unsaturated fatty acid-rich non-tropical plant oils (e.g., soybean oil, sunflower oil, olive oil); sources of omega-3 fatty acids (e.g., fish, nuts, legumes); good protein foods (low degree processed soy 	

Dietary pattern based on Dietary Guidelines for Australian Adults ¹⁸	Australia	<p>product, fish, egg, and lean animal protein); low in trans-fats, fried foods, fatty meat, processed meats or fish products</p> <ul style="list-style-type: none"> -Consume a varied diet rich in vegetables, fruits, wholegrain cereals, lean meat, poultry, fish, eggs, nuts and seeds, legumes and beans, and low-fat dairy product -Reduce foods containing saturated and trans fats -Reduce salt to <6g/day (approximately 2300 mg sodium)
High-carbohydrate low-fat dietary pattern ¹⁹	Korea	<ul style="list-style-type: none"> -Consume whole grains instead of refined rice -Consume balanced diet including adequate amounts of fish, beans, and fresh vegetables -Consume fresh fruits and milk -Reduce fruit concentrates and sweetened milk
International atherosclerosis society dietary pattern ^{9,16,20}	Middle East, Global, Europe	<ul style="list-style-type: none"> -Reduce intake of saturated fatty acids to 7% of total calories -Consume a relatively high intake of fruits, vegetables, and fiber. -Consume monounsaturated/polyunsaturated fatty acids. -Consume some fish rich in omega-3 fatty acids. -Consume foods low in sodium and high in potassium -Reduce processed meats and sugar-sweetened beverages, sweets, grain-based desserts and bakery foods. -Consume plant sterols/stanols (2 g/day) as a dietary adjunct along with soluble/viscous fiber (10–25 g/ day).
Indo-Mediterranean Diet ¹³	India	<ul style="list-style-type: none"> -Consume fruits, vegetables, whole grains like unpolished rice, whole wheat and millets; fatty fish for non-vegetarians and fenugreek seeds, mustard seeds, flax seeds, soya bean oil, mustard oil for vegetarians (as sources of omega-3 fatty acids), nuts.

Intermittent fasting ¹³	India	<ul style="list-style-type: none"> -Consume extra-virgin olive oil (an unrefined oil) for cooking, baking, dipping bread, dressing, dips, cold dishes. -Alternating periods of normal food intake with periods of little to no caloric intake. -A popular weekly regimen is 5 days of normal eating with 2 days of restricted eating (about 400 calories per day).
Plant based dietary pattern ²¹	Poland	<ul style="list-style-type: none"> -Consume saturated fatty acids < 10% of energy supply -Consume 200 g of fruit daily. -Consume 200 g of vegetables daily. -Consume fish at least once or twice per week.

For the assessment of the risk of bias, each guideline was rated according to the MiniChecklist tool. Of the twenty-three guidelines, 18 had a score of seven, three had a score of six and only one guideline had a score of five. Supplementary Table 1 describes the definitions of MiChe ratings and the scoring for each guideline is available in Supplementary table 3.

Despite the different burden of cholesterol in various countries, the treatment approaches do not have many differences. However, each guideline showcases significant variability in dietary patterns recommended for dyslipidemia. Most of the regions have strategies for primary and secondary prevention.^{8-10,16,18,19,22,23} Primary prevention is followed by individuals that have documented dyslipidemia but with no history of any atherosclerotic cardiovascular event like myocardial infarction, stroke, etc. while secondary prevention is employed for the group with documented dyslipidemia and previous history of an atherosclerotic cardiovascular event. A brief regional comparison of the management approaches for dyslipidemia according to the guidelines is provided in Table 1. Apart from dietary interventions, all the guidelines recommend reducing weight by physical activity, avoiding smoking, adequate amount of sleep, and appropriate management of stress and mental health disorders.

After analysis of the guidelines and an extensive review of the literature, general dietary recommendations for not only dyslipidemia but other conditions coexisting with dyslipidemia have been developed. On the basis of their nutritional composition, local alternatives available in Pakistan have also been suggested in Table 2.

Table 2: General dietary recommendations and their local alternatives for dyslipidemia management.

Conditions	General Recommendations with Local Alternatives				
	Fluids and Salt	Fats	Fruits	Vegetables	Proteins
Dyslipidemia*	<ul style="list-style-type: none"> -Increase water intake -Remove salt shakers from table. -Avoid raw salt in salad, egg or at the 	<ul style="list-style-type: none"> -Avoid trans-fat and saturated fats (Vanaspati ghee, bakery shortening, hard margarine, fat spreads, butter, ghee, suet, coconut oil, palm oil) -Consume MUFAs and PUFAs (seeds, olive oil, canola oil) 	<ul style="list-style-type: none"> -Consume high fibre fruits (apple, guava, banana, strawberry) 	<ul style="list-style-type: none"> -Consume sterol rich vegetable (peas, beans, whole tomato, wheat) -Consume high fibre vegetables (Non starchy vegetables like bell peppers, tomato, 	<ul style="list-style-type: none"> -Increase plant based proteins such as Pulses (lentils& beans) and, nuts in diet. -Avoid processed and red meat -Consume fish and whole grains

	table on the cooked food.	-Consume low-fat dairy products (cottage cheese, skim milk, yogurt) -Consume extra virgin olive oil if affordable		cucumbers, radish, carrot, lettuce)	
Dyslipidemia and Diabetes Mellitus	-Increase water intake -Remove salt shakers from table. -Avoid raw salt in salad, egg or at the table on the cooked food.	-Consume n3-rich fatty acids (fish like salmon and rohu, vegetable oil, rapeseed oil, seeds like flaxseeds and chia seeds, walnuts) -Consume vitamin B and B6 rich foods (cottage cheese, yogurt, skim milk)	-Consume low glycemic index fruits (Apple, pears, citrus fruits, guava) -Consume vitamin-C rich fruits (citrus fruits like oranges and lemon)	-Consume vitamin-B rich vegetables (leafy green vegetables like cabbage, spinach) -Consume vitamin-B6 rich vegetables (vegetables like potatoes, peas, and corn) -Consume vitamin-C rich vegetables (cruciferous vegetables like cabbage, turnip)	-Consume low glycemic index nuts (peanuts, almonds, walnuts) -Consume vitamin-D rich foods (beef liver, fatty fish like pomfret fish) -Consume vitamin-E rich foods (peanuts, sunflower seeds, almonds) -Consume coenzyme Q rich foods (red meat fishes like sardines and tuna, organ meats like beef liver)
Dyslipidemia and Hypertension	-Increase water intake -Remove salt shakers from table. -Avoid raw salt in salad, egg or at the table on the cooked food. -Consume green tea	-Avoid trans-fat and saturated fats (Vanaspati ghee, bakery shortening, hard margarine, fat spreads, butter, ghee, suet, coconut oil, palm oil) -Consume MUFAs and PUFAs (seeds, olive oil, canola oil) -Consume low-fat dairy products (cottage cheese, skim milk, yogurt) -Consume extra virgin olive oil if affordable	-Consume flavanol-rich sources of food like chocolate.	-Consume polysulfide rich foods like garlic or aged garlic extracts	
Dyslipidemia and Chronic Kidney Disease	-Increase water intake -Remove salt shakers from table. -Avoid raw salt in salad, egg or at the table on the cooked food.	-Consume omega 3 fatty acids rich foods (sunflower oil, sesame oil)	-High-fibre fruits (apple, guava, strawberries) -Avoid potassium-rich fruits (bananas, apricots)	-High-fibre vegetables (non-starchy vegetables like lettuce, cucumbers, cauliflower) -Avoid potassium-rich vegetables (potatoes, tomatoes, spinach)	-Consume omega 3 fatty acids rich foods (walnuts, sunflowers seeds, salmon)

Dyslipidemia and steatotic liver disease (MASLD/NAFLD)	<ul style="list-style-type: none"> -Increase water intake -Remove salt shakers from table. -Avoid raw salt in salad, egg or at the table on the cooked food. 	<ul style="list-style-type: none"> -Consume omega 3 fatty acids (like flax seed oils) 	<ul style="list-style-type: none"> -Consume high-fibre fruits (apple, guava, strawberries) -Consume antioxidant-rich fruits (citrus fruits like lemon and oranges, plum, pomegranate) 	<ul style="list-style-type: none"> -Consume high-fibre vegetables (non-starchy vegetables like lettuce, cucumbers, cauliflower) -Consume antioxidant-rich vegetables (spinach, beetroot, carrots) 	<ul style="list-style-type: none"> -Consume omega 3 fatty acids (fishes like sardines, salmon, chia seeds, flax seeds)
Dyslipidemia and metabolic syndrome	<ul style="list-style-type: none"> -Increase water intake -Remove salt shakers from table. -Avoid raw salt in salad, egg or at the table on the cooked food -Consume calcium rich drinks (milk, yogurt, cheese) 	<ul style="list-style-type: none"> -Consume fermented dairy products (yogurt, cheese) 	<ul style="list-style-type: none"> -Consume polyphenols rich foods (strawberry, grapes, cherries) -Consume lycopene rich foods (apricot, papaya, melon) -Consume carotenoids rich foods (watermelon, mango, oranges) -Consume flavonoids rich foods (berries, cherries) -Consume folate rich foods (banana, strawberry, mango) -Consume vitamin C rich foods (citrus fruits like lemon and oranges) -Consume resveratrol rich foods (grapes, plums, apple) 	<ul style="list-style-type: none"> -Consume calcium and vitamin B rich foods (leafy green vegetables like cabbage and spinach) -Consume vitamin C rich foods (cruciferous vegetables like cauliflower and spinach) -Consume organosulfur compounds rich foods (cauliflower, garlic, onion) 	<ul style="list-style-type: none"> -Consume magnesium-rich foods (almonds, cashews) -Consume selenium and zinc rich foods (eggs, sunflower seeds, sardines, whole grains) -Consume vitamin B rich foods (beef liver) -Consume vitamin D rich foods (beef liver and fatty fish) -Consume vitamin E rich foods (almonds, peanuts, sunflower seeds)
Dyslipidemia and pancreatitis	<ul style="list-style-type: none"> -Increase water intake -Remove salt shakers from table. -Avoid raw salt in salad, egg 	<ul style="list-style-type: none"> -Avoid trans-fat and saturated fats (Vanaspati ghee, bakery shortening, hard margarine, fat spreads, butter, ghee, suet, coconut oil, palm oil) 	<ul style="list-style-type: none"> -Consume low-fiber rich fruits (watermelon, melon, plums, papaya, peaches) 	<ul style="list-style-type: none"> -Consume calcium rich foods (vegetables like lettuce, and zucchini) -Consume vitamin K rich foods (vegetables like lettuce, zucchini, carrots) 	<ul style="list-style-type: none"> -Consume magnesium rich foods (almonds, cashews) -Consume vitamin A rich foods (liver, fish like salmon) -Consume vitamins B1, B2,

or at the table on the cooked food
 -Consume MUFAs and PUFAs (seeds, olive oil, canola oil)
 -Consume low-fat dairy products (cottage cheese, skim milk, yogurt)
 -Consume extra virgin olive oil if affordable

B3, and B12 rich foods (cereal grains, red meat, and fish)
 -Consume vitamin D rich foods (beef liver and fatty fish)
 -Consume vitamin E rich foods (almonds, peanuts, sunflower seeds)

-Increase water intake
 -Remove salt shakers from table.
 -Avoid raw salt in salad, egg or at the table on the cooked food.

-Avoid trans-fat and saturated fats (Vanaspati ghee, bakery shortening, hard margarine, fat spreads, butter, ghee, suet, coconut oil, palm oil)
 -Consume MUFAs and PUFAs (seeds, olive oil, canola oil)
 -Consume low-fat dairy products (cottage cheese, skim milk, yogurt)
 -Consume extra virgin olive oil if affordable

-Consume iron rich foods (prunes, apricot, raisins)
 -Consume potassium rich foods (apricots, banana, pomegranate)
 -Consume vitamin C rich foods (citrus fruits like lemon and oranges)
 -Consume phenol-rich fruits (apple, mango, pomegranate)
 -Consume resveratrol rich foods (grapes, berries, apple)

-Consume vitamin B rich foods (vegetables like cabbage and spinach, cauliflower)

-Consume iodine (beef liver, eggs, and fish like salmon)
 -Consumeelenium and zinc rich foods (eggs, sunflower seeds, sardines, whole grains)
 -Consume copper rich foods (organ meats, whole grain)
 -Consume magnesium rich foods (almonds, cashews)
 -Consume vitamin-A rich foods (liver, fish)
 -Consume vitamin-B rich foods (beef liver)
 -Consume vitamin D rich foods (beef liver and fatty fish)
 -Consume prebiotics (almonds, chickpeas) and probiotics (yogurt)
 -Consume inositol rich foods (whole grains and legumes)
 -Consume carnitine rich foods (legumes,

Dyslipidemia
 and thyroid disease

					eggs, seafood, lean meats) -Consume melatonin rich foods (eggs, fish like salmon and sardines)
Dyslipidemia and heart failure	-Avoid excessive intake of water. -Remove salt shakers from table. -Avoid raw salt in salad, egg or at the table on the cooked food.	-Consume omega 3 fatty acids (flaxseed oil)	-Consume iron rich foods (prunes, apricot, raisins) -Consume vitamin C rich fruits like lemon and oranges)	-Consume sterol rich vegetable (peas, beans, tomato, whole wheat) -Consume high-fibre vegetables (Non starchy vegetables like bell peppers, tomato, cucumbers, radish, carrot, lettuce)	-Consume vitamin D rich foods (beef liver and fatty fish) -Consume vitamin E rich foods (almonds, peanuts, sunflower seeds) -Consume thiamine rich foods (cereal, beans, lentils, bread, sunflower seeds) -Consume coenzyme Q rich foods (red meat fishes like sardines and tuna, organ meats like beef liver)

Table 3: Academy of Nutrition and Dietetics 2023 Evidence-based Nutrition Practice Guideline for Saturated Fat Intake.

Saturated fat	Benefits
Amount of Saturated Fat Intake	Reduced saturated fat intake was associated with decreased total cholesterol and low density lipoprotein-cholesterol (LDL-C) and cardiovascular disease events
Replacement of Saturated Fat Intake	Replacement of dietary saturated fat with polyunsaturated fat promotes healthy eating patterns and reduces total cholesterol and coronary heart disease events
Sources of Saturated Fat Intake	Certainty of evidence demonstrates that a variety of dairy products are not associated with an increased risk of cardiovascular disease; however, reduction of red meat and processed meat is associated with reduced cardiovascular disease risk.

Discussion

The analysis of the guidelines for dyslipidemia management from various regions covered by this systematic review shed light on two important features. First, while risk calculators for ASCVD risk may have some limitations, risk stratification remains important for guiding interventions. Second, the cornerstone of management of any type of dyslipidemia relies heavily on non-pharmacological interventions which include healthy dietary patterns, adequate physical activity, maintaining a healthy weight and avoidance of detrimental habits like smoking, stress etc. Almost all the guidelines acknowledge the benefits of adopting a Mediterranean diet/DASH diet/Plant-based diet but emphasize the need for regional food adaptations.^{8,9,11-13}

A comparison of major dyslipidaemia guidelines, including the 2018 AHA/ACC/Multisociety Blood Cholesterol Management Guideline, the 2021 ESC Prevention of CV Disease Guidelines, and the 2021 Canadian Cardiovascular Society's Management of Dyslipidemia, revealed a consistent approach.²⁴ While our study encompassed a larger number of guidelines, little variation was observed in the aspects analyzed compared to other studies.²⁴ Risk stratification relies on population-specific calculators, with LDL-C as the primary goal and other lipid measurements like non-HDL-C, ApoB, and Lp(a) used in certain conditions. Lifestyle modifications, particularly dietary changes like the Mediterranean and plant-based diets, are recommended across most guidelines, aligning with previous studies.^{24,25}

According to the 2019 Pakistan Dietary Guidelines for Better Nutrition, food availability measured by kg/capita/year has been reported to be steady. This is indicated by the nationwide accessibility of major food sources like wheat, rice, maize, fats and oils, meat, milk, vegetables, fruits, and pulses for the growing population of Pakistan.²⁶ Despite the sufficient supply of various food sources, the common man is unable to acquire different nutrients due to insufficient household income. This paves the way for numerous macro and micronutrient deficiencies further promoting a detrimental effect on the work habits of the populace. Pakistani cuisine is renowned for its rich flavors and diverse culinary traditions. Rice cooked as Biryani and Pulao are popular dishes often prepared with meat, spices, and aromatic herbs. Snacks and street foods such as Pakoras and samosas are deep-fried snacks commonly consumed in Pakistan. Nihari is a flavorful slow-cooked stew made from tender meat, bone marrow, and a variety of spices. Halwa Puri is a popular breakfast combination in Pakistan, consisting of a semolina-based sweet dish (halwa) and deep-fried bread (puri). Furthermore, urbanization also plays a significant role in increasing trend towards fatty food consumption. The consumption of energy-dense foods, such as sweets, bakery products, fried foods has increased significantly. Furthermore, the food practices also vary significantly according to region. The sajji method of roasting whole lambs in a deep pit is a distinctive regional practice unique to Balochi cuisine. Khyber Pakhtunkhwa (KPK) residents are heavy meat eaters and tea drinkers, mainly green tea. The Punjabi cuisine includes large amounts of ghee (clarified butter), rice, and spices (masala). The Punjabi people are known for their roti and sophisticated cooking preparations. Muhajirs (a major community occupying Sindh) have clung to the traditional habits and tastes of the regions they migrated from, and it is possible to find distinctly Indian culinary practices kept alive in the migrant Muhajir communities.

According to the 2019 Pakistan Dietary Guidelines for Better Nutrition, the consumption patterns of the Pakistani population are very high in detrimental fats, sugars, and salt with decreased intake of fruits and vegetables.²⁶ Moreover, the portion sizes do not correspond with the caloric requirement resulting in obesity. The traditional foods of Pakistan are calorie-dense but this is further aggravated by urbanization which has significantly increased the amount of processed food and fast food intake. To combat the epidemic of dyslipidemia and other conditions observed in Pakistan, healthcare providers specifically local dietitians must focus on modifying the dietary regime of each patient according to the 2019 Pakistan Dietary Guidelines for Better Nutrition. Some beneficial strategies include the development of pamphlets containing dietary recommendations for a specific condition coexistent with dyslipidemia. Furthermore, they should be available in the local language of the patient and should also highlight local food sources as substitutes to increase compliance. To increase conformity with the guidelines, it is also imperative to increase the diffusion of nutritionists amongst the populace so that the obstacles of the language barrier and regional sources of food can be overcome.

Body mass index (BMI) is an indicator of the nutritional status assessed by taking the weight of adults in kilograms divided by height in meters square. According to the World Health Organization, the categories for the Asian population have been defined as:

1. 18.5–22.9 kg/m² (increasing but acceptable risk)

2. 23–27.4 kg/m² (increased risk)

3. 27.5 kg/m² or higher (high risk of developing chronic health conditions)

To maintain an ideal BMI, the amount of nutrients recommended for dyslipidemia and other conditions must be according to the 2019 Pakistan Dietary Guidelines for Better Nutrition.

For the overall population in Pakistan, cereal grains are the main staple in Pakistani food, providing 62% of total energy in the diet.²⁷ The consumption of fruits and vegetables, fish, and meat is low either due to widespread poverty or seasonal availability which can lead to micronutrient deficiencies such as zinc, iodine, and iron, frequently observed in Pakistan. In Pakistan, majority of the physicians recommend lifestyle modification along with statins and ezetimibe as a preferred treatment regimen.²⁸ However, tailored dietary plans are challenging particularly in a low-income country context. Educating the population of Pakistan of cost-effective nutritional alternatives along with importance of physical activity is vital to combat dyslipidemia for which the role of dietitians is undeniable.

Due to cultural and economic differences between the communities of Pakistan and foreign countries, it is essential to use international guidelines as a base for developing suitable dietary recommendations. To promote the effective implementation of beneficial dietary practices conforming to Pakistani culture, the following tips can be used for practical application of dyslipidemia guidelines in Pakistan.²⁹ However, they are meant to be tailored based on individual preferences and health goals.

- Be mindful of portions for foods that are higher in fat, sugar, or salt, like *samosas*, *pakoras*, and other fried appetizers; curries made with a lot of oil, *ghee*, or coconut milk; and desserts.
- Fill half of a 10-inch plate (the size of a regular dinner or paper plate) with colorful, non-starchy vegetables, such as spinach, eggplant, okra, carrots, green beans, bitter melon, tomatoes, or green salad.
- Prepare or choose mostly salad or vegetable dishes made with only a little oil. Use vinegar and lemon for a salad dressing.
- Choose a small taste of deep-fried vegetables, and those made with cream or a lot of oil.
- Try yogurt *raita*, mint or coriander chutney, and *kachumber* (chopped salad), instead of salty preserved pickle or chutney, or only take a small amount.
- Take only as much grain or starchy vegetables, such as rice, bread, potatoes, or green peas, to fill ¼ of your plate.
- Choose high-fiber grains like brown rice, cracked wheat, and whole grain breads like chapati or roti.
- Prepare or choose plain steamed or boiled rice or grains and baked breads without ghee or butter.
- Try to stay away from or take a tiny serving of fried potatoes, rice dishes, breads (such as *puris* or *parathas*), or snacks (like *samosas*, *pakoras*, or *chaats*).
- Eat 2 to 3 ounces of protein (lean meat, fish, dal, or tofu), enough to fill ¼ of the plate.
- Pick dishes with baked or grilled lean meat or poultry (like chicken without the skin or beef or goat with the fat cut off), fish, or shrimp.
- Prepare or choose bean, lentil, or dal dishes that are made with just a little oil or ghee.

- Take just a taste of high-fat foods like meat or vegetable curries cooked with coconut milk, cream, ghee, or a lot of oil.
- Choose fresh fruits such as oranges, apples, or strawberries for dessert.
- Try not to eat (or have only a small serving of) desserts that are high in sugar and fat, like cookies, cakes, *kulfi*, *halwa*, *kheer*, *rasmalai*, *gulab jamun*, *raasgulas*, *barfis*, or other desserts in sugar syrup or made with cream or *ghee*.

It has been recommended that less than 10% of the total dietary fat should be acquired from saturated fats.²⁶ It is advisable for the dietitians of Pakistan should employ Saturated Fat 2023 Evidence-Based Nutrition Practice Guideline shown in the table 3.³⁰

Dyslipidemia: The recommendations presented in supplementary figure 1 are supported by most of the guidelines. Restriction of salt, trans fat and saturated fats prevents the development of atherosclerotic plaques in vessels while the opposite role is played by monounsaturated and polyunsaturated fatty acids.^{9,12,13,16} Phytosterols and fibre are recommended due to their property of decreasing the amount of cholesterol absorbed from diet, thereby decreasing its absorption in blood hence fibre rich fruits and vegetables are an essential part of a hypolipidemic diet (Table 2).^{8,9,13,15,16}

Dyslipidemia and Diabetes Mellitus (DM): A high risk of malnutrition is present in individuals suffering simultaneously from two chronic conditions, especially if dietary pattern is involved in the pathophysiology. Hence, supplementation with vitamins B, B6, C, and D is beneficial.³¹⁻³³ Similarly, n-3 polyunsaturated fatty acids are beneficial due to their anti-inflammatory properties and can be effective to combat pro-inflammatory conditions, particularly dyslipidemia despite having no benefit in DM.³⁴ While many guidelines for dyslipidemia support the increased intake of nuts and fruits, patients with both dyslipidemia and diabetes should focus on low-glycemic index nuts and fruits, particularly apples and guavas due to their high fibre content (Table 2, Supplementary figure 2).³⁵

Dyslipidemia and Hypertension: Green tea, rich in polyphenols, has antioxidant features that provide protection against cardiovascular events.³⁶ A randomized controlled trial conducted by Heiss et al. (2015) observed that the intake of cocoa due to its high content of flavanols improved the systolic blood pressure and endothelial function, thereby highlighting its beneficial role in dyslipidemia and hypertension.³⁷ Garlic has long been reported to have hypolipidemic and hypotensive effects at the level of vascular endothelium (Table 2, Supplementary figure 3).³⁸

Dyslipidemia and Chronic Kidney Disease (CKD): A diet rich in fibre and low in protein content is recommended for individuals with both dyslipidemia and CKD. These dietary patterns not only decrease LDL-C, but they also improve anemia and delay the decline in glomerular filtration rate (GFR). A restriction in the intake of potassium and phosphorus is beneficial in chronic kidney disease.^{9,39} However, fruits and vegetables, which are generally recommended for both conditions, are highly rich in these minerals. Hence, each patient should be provided with a diet plan bearing in mind these restrictions (Table 2, Supplementary figure 4).

Dyslipidemia and Steatotic Liver Disease: Steatotic liver disease (MASLD/NAFLD) is a pro-inflammatory condition, so incorporating various antioxidants, omega-3 fatty acids and fibre in the diet can have a dual benefit of ameliorating dyslipidemia and steatotic liver disease.⁴⁰ Similarly, a low glycemic index diet has been observed to reduce the hepatic fat stores (Table 2, Supplementary figure 5).⁴¹

Dyslipidemia and Pancreatitis: In patients with dyslipidemia and acute/chronic pancreatitis, there is a high risk of deficiency of vitamins and minerals, hence supplementation with vitamins A, D, E, K and minerals like calcium and magnesium is important.⁴² A dietary regime low in fibre should be adopted in chronic pancreatitis as it aggravates steatorrhea.⁴² In inherited hyperlipidemic conditions like familial chylomicronemia syndrome, daily fat intake is restricted to 20g.⁴³ Therefore, optimal fat intake is important depending on the type of pancreatitis. For mild acute pancreatitis, a low-fat diet is generally preferred.⁴² In chronic pancreatitis, a well-balanced diet is recommended with upto 30% to 33% of the total energy coming from fats (Table 2, Supplementary figure 6).⁴²

Dyslipidemia and Metabolic Syndrome: Metabolic syndrome consists of multiple pathologies existing together with low-grade inflammation. An adequate intake of various antioxidants including vitamin E, polyphenols, lycopenes, carotenoids, and resveratrol are recommended to be beneficial.^{44,45} Similarly, organosulfur compound rich substances like garlic are recommended due to their profound hypotensive and hypolipidemic effects which can be used to control the dyslipidemia and hypertension seen in metabolic syndrome (Table 2, Supplementary figure 7).³⁸

Dyslipidemia and Hyperthyroidism: Certain nutrients like carnitine and inositol are beneficial in thyroid disease due to their various effects in the functioning of thyroid hormone.⁴⁶ The intake of dietary iodine should be regulated in hyperthyroidism, especially in individuals on anti-thyroid drugs (Table 2, Supplementary figure 8).⁴⁷

Dyslipidemia and Heart Failure: Heart failure is a chronic condition with progressively increasing inflammatory burden as the disease worsens. Salt restriction is recommended as it is beneficial to combat both dyslipidemia and heart failure.¹² Nutrients like coenzyme Q1 and thiamine are also recommended due to their antioxidant activity and improvement of cardiac functions.^{48,49} Due to dietary restrictions in both conditions, there is a high risk of developing malnutrition which can be overcome by amino acid supplementation in a high protein diet mainly from plant sources (Table 2, Supplementary Figure 9).²¹

Precision nutrition is an advanced approach to the treatment of various acute and chronic conditions by involving dietary plans. It determines the knowledge of an individual's genetic build, microbiome, and metabolic response to specific foods. Based on this evidence, a far more effective dietary approach can be maintained for the prevention and treatment of various diseases. The main obstacle to the introduction and application of precision nutrition in Pakistan is the unavailability of proper funding and resources. However, a specific approach towards the management of dyslipidemia through dietary intake will prove to be extremely beneficial considering the burden of dyslipidemia and other conditions observed in our country.

The nutritional demands of various genders and age groups are different, owing to their diverse physical activity levels and metabolic rates. While this study outlines the various food sources that are beneficial in specific conditions coexistent with dyslipidemia, it is to be noted that the amount of these nutrients should be tailored while bearing these differences in mind. Moreover, the study provides an overview of recommended local dietary supplementation derived from international guidelines and could be used as a basis for developing guidelines for Pakistan.

Conclusion

Pakistan is a developing country that faces the problems of overpopulation and illiteracy. Our daily lifestyles and dietary patterns are not healthy. All these factors combined play a major causative role in the epidemic of dyslipidemia seen in Pakistan. To combat this problem, approaches should be developed that cater to our issues of poverty while simultaneously reducing the burden of high cholesterol in our population. Hence, it is important to develop dietary regimes according to our economy and resources.

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Supplementary Figure 1: Dyslipidemia MyPlate.



Supplementary Figure 2: Dyslipidemia and Diabetes Miletus MyPlate.



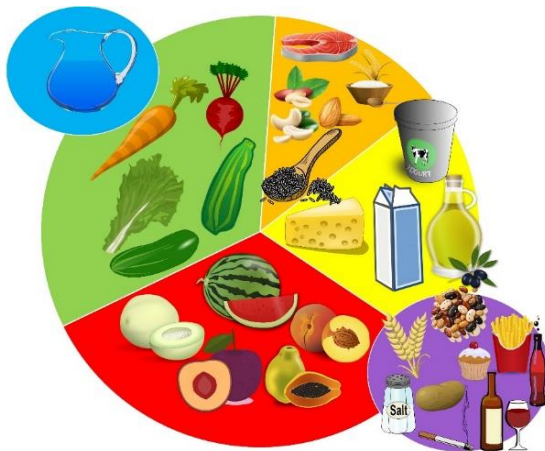
Supplementary Figure 3: Dyslipidemia and Hypertension MyPlate.



Supplementary Figure 4: Dyslipidemia and Chronic Kidney Disease MyPlate.



Supplementary Figure 5: Dyslipidemia and metabolic dysfunction-associated steatotic liver disease MyPlate.



Supplementary Figure 6: Dyslipidemia and Pancreatitis MyPlate.



Supplementary Figure 7: Dyslipidemia and Metabolic Syndrome MyPlate.



Supplementary Figure 8: Dyslipidemia and Thyroid Disease MyPlate.



Supplementary Figure 9: Dyslipidemia and Heart Failure MyPlate.

Supplementary Table 1: Definition of MiChe-ratings.

Protocol	1. The guideline has been written in a generally comprehensible manner and its key recommendations are easy to identify.	2. The guideline's target audiences and scope of application were specified.	3. The background, the objectives of the guideline, and the patients for whom the guideline is relevant were clearly described.	4. The persons that developed the guideline are named, and their financial independence and any conflicts of interest are clearly documented.	5. The search for evidence was systematic and the criteria used to select evidence were described.	6. The guideline recommendations are unambiguous and the evidence they are based on is clearly presented.	7. Different treatment options are presented and take account of pharmacological benefits, side effects and risks.
Yes	All key recommendations highlighted	Target audience and scope mentioned together clearly	All three points addressed	More than one author and conflict of interest stated	1. Only systematic search for evidence OR 2. All recommendations based on other guidelines with systemic review of evidence OR 3. Some recommendations based on non-systematic search for evidence (e.g. original studies, discussions in meetings, expert opinions)	1. Highlighted key recommendations are linked to evidence or cited in the references OR 2. Evidence for all recommendations is given in other guidelines	Non-pharmacological treatment options described with advantages and disadvantages of each
Partly	Some key recommendations highlighted	Described by stating for dyslipidemia with no characteristics defined	Either one or two of the total three points not addressed	More than one author or conflict of interest stated	All recommendations based on non-systematic search for evidence (e.g. original studies, discussions in meetings, expert opinions)	Evidence for some recommendations is given in other guidelines	Non-pharmacological treatment options described with advantages and disadvantages of each
No	No key recommendation highlighted	None mentioned	None of the three points addressed	One author (or no author given) and no conflict of interest statement	No search of evidence done OR all recommendations based on very weak evidence	No recommendation is linked to evidence	No treatment options given. OR Only one treatment option given

Supplementary Table 2: MiChe-ratings of included studies for risk of bias assessment, ordered historically.

<i>Guidelines</i>	The guideline has been written in a generally comprehensible manner and its key recommendations are easy to identify.	The guideline's target audiences and scope of application were specified.	The background, the objectives of the guideline and the patients for whom the guideline is relevant were clearly described.	The persons that developed the guideline are named, and their financial independence and any conflicts of interest are clearly documented.	The search for evidence was systematic and the criteria used to select evidence was described.	The guideline recommendations are unambiguous and the evidence they are based on is clearly presented.	Different treatment options are presented that take into account potential benefits, side effects, and risks.	Clear information is provided up-to-date guidelines for how the guideline is expected to be implemented.
<i>1) Third Report of National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment on High Blood Cholesterol in Adults (Adult Treatment Panel III) – Final Report (2002)</i>	Yes	Yes	Yes	To some extent (Authors stated but no disclosure of conflict of interest)	Yes (Systematic search for evidence and some recommendations are based on non-systematic review of evidence)	Yes (Highlighted key recommendations are linked to evidence or the evidence is cited in the references)	Yes	To some extent (Mentioned previous guidelines on which based on expected completion of newer versions)
<i>2) Guidelines for the management of Absolute cardiovascular disease risk-An initiative of the National Vascular Disease Prevention Alliance (2012)</i>	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and some recommendations are based on non-systematic review of evidence)	Yes (Highlighted key recommendations are linked to evidence or the evidence is cited in the references)	Yes	To some extent (Mentioned previous guidelines on which based on expected completion of newer versions)
<i>3) South African dyslipidaemia guideline consensus statement (2012)</i>	To some extent (Some key recommendations highlighted by writing in points)	To some extent (Guidelines for management of	To some extent (Explains the background, the objectives but not the relevant patients)	To some extent (More than one author named but no disclosure of conflict of interest)	Yes (All recommendations are based on another guideline in which	Yes (Evidence for all recommendations is given in another guideline)	Yes	To some extent (Mentioned previous guidelines on which based on

		dyslipidemia by health care professionals with no specific population)			systematic review of evidence was performed)			expected completion (newer version any)
4) <i>An International Atherosclerosis Society Position Paper: Global recommendations for the management of dyslipidemia—Full report (2013)</i>	Yes	To some extent (Guidelines for management of dyslipidemia with no specific population)	To some extent (Explains the background, the objectives but not the relevant patients)	Yes	To some extent (All recommendations based on non-systematic search for evidence (e.g. original studies, discussions in meetings, expert opinions)	Yes (Highlighted key recommendations are linked to evidence or the evidence is cited in the references)	Yes	No information previous or any version mentioned
5) <i>National Institute for Health and Care Excellence-Cardiovascular disease: risk assessment and reduction, including lipid modification (Clinical Guideline 181) (2014)</i>	Yes	Yes	Yes	Yes	Yes (Only systematic search for evidence)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some extent (Mention previous on which based mention expected completion newer version any)
6) <i>National Lipid Association Recommendations for Patient-Centered Management of Dyslipidemia: Part 1—Full Report (2015)</i>	Yes	Yes	Yes	Yes	To some extent (All recommendations based on non-systematic search for evidence (e.g. original studies, discussions in meetings, expert opinions)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some extent (Mention previous on which based a mentions newer version no expected of completion been mentioned)
7) <i>2016 Chinese guidelines for the management of</i>	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and	Yes (Highlighted key recommendations	Yes	To some extent (Mention previous

<i>dyslipidemia in adults (2016)</i>						some recommendations are based on non-systematic review of evidence)	are linked to evidence or cited in the references)		on which based mention expected completion newer version any)
8) <i>Consensus clinical recommendations for the management of plasma lipid disorders in the Middle East (2021)</i>	Yes	Yes	Yes	Yes	Yes	(Recommendedations based on systematic review of evidence in other guidelines and non-systematic review of evidence e.g. regional expert opinion)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some (Mention previous on which based mention expected completion newer version any)
9) <i>Polish Forum for Prevention Guidelines on Dyslipidaemia: update 2016 (2016)</i>	Yes	Yes	Yes	Yes	Yes	(All recommendations based on another guideline with systemic review of evidence)	Yes (Evidence for all recommendations is given in another guideline)	Yes	To some (Mention previous on which based mention expected completion newer version any)
10) <i>Japan Atherosclerosis Society (JAS) Guidelines for Prevention of Atherosclerotic Cardiovascular Diseases 2017 (2017)</i>	Yes	Yes	Yes	Yes	Yes	(Systematic search for evidence and some recommendations are based on non-systematic review of evidence)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some (Mention previous on which based mention expected completion newer version any)

<p>11) 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol - A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines (2018)</p>	Yes	Yes	Yes	Yes	Yes (Only systematic search for evidence)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some (Mention previous on which based mention expected completion newer version any)
<p>12) Korean Society of Lipid and Atherosclerosis - 2018 Guidelines for the management of dyslipidemia (2018)</p>	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and some recommendations are based on non-systematic review of evidence)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some (Mention previous on which based mention expected completion newer version any)
<p>13) Updated Cardiovascular Prevention Guideline of the Brazilian Society of Cardiology – 2019 (2019)</p>	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and some recommendations are based on non-systematic review of evidence)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some (Mention previous on which based mention expected completion newer version any)
<p>14) 2019 ESC/EAS Guidelines for the management of</p>	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and	Yes (Highlighted key recommendations	Yes	To some (Mention previous

*dyslipidaemias:
lipid modification to
reduce
cardiovascular risk
(2019)*

some are linked to
recommendations are based on evidence or cited in
non-systematic the references)
review of
evidence)

on which
based
mention
expected
completion
newer version
(any)

15) *Consensus
statement by the
American
Association of
Clinical
Endocrinologists
and American
College of
Endocrinology on
the management of
Dyslipidemia and
prevention of
Cardiovascular
disease algorithm -
2020 executive
summary (2020)*

Yes Yes Yes Yes

Yes (Systematic
search for
evidence, some
recommendations
based on other
guidelines with
systemic review
of evidence, some
recommendations
based on non-
systematic
search for
evidence (e.g.
original studies,
discussions in
meetings, expert
opinions)

Yes (Evidence of
highlighted key
recommendations
are cited in the
references,
Evidence for some
recommendations is
given in another
guideline.)

Yes

To some
(Mention
previous
on which
based
mention
expected
completion
newer version
(any)

16) *Lipid
Association of India
Expert Consensus
Statement on
Management of
Dyslipidemia in
Indians 2020: Part
III (2020)*

Yes Yes Yes Yes

Yes (Systematic
search for
evidence and
some
recommendations
are based on
non-systematic
review of
evidence)

Yes (Evidence of
highlighted key
recommendations
are cited in the
references)

Yes

To some
(Mention
previous
on which
based
mention
expected
completion
newer version
(any)

17) *Executive
Summary of the
2020 Clinical
Practice Guidelines
for the Management
of Dyslipidemia in*

Yes Yes Yes Yes

Yes (Systematic
search for
evidence and
some
recommendations
are based on

Yes (Highlighted
key
recommendations
are linked to
evidence or cited in
the references)

Yes

To some
(Mention
previous
on which
based
mention

<i>the Philippines (2020)</i>						non-systematic review of evidence)			expected completion newer version any)
18) VA/DoD Clinical Practice Guideline for the Management of Dyslipidemia for Cardiovascular Risk Reduction (2020)	Yes	Yes	Yes	Yes	Yes	Yes (Only systematic search for evidence)	Yes(Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some (Mention previous on which based mention expected completion newer version any)
19) Asian Pacific Society of Cardiology Consensus Recommendations on Dyslipidaemia (2021)	Yes	Yes	Yes	Yes	Yes	Yes(Systematic search for evidence and some recommendation s are based on non-systematic review of evidence)	Yes(Highlighted key recommendations are linked to evidence or cited in the references)	Yes	No information previous or any version mentioned
20) 2021 Canadian Cardiovascular Society Guidelines for the Management of Dyslipidemia for the Prevention of Cardiovascular Disease in Adults (2021)	Yes	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and some recommendation s are based on non-systematic review of evidence)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some (Mention previous on which based mention expected completion newer version any)
21) Management of dyslipidemia in Poland: Interdisciplinary Expert Position Statement endorsed by the Polish Cardiac Society	Yes	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and some recommendation s are based on non-systematic	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes	To some (Mention previous on which based mention expected completion

<i>Working Group on Cardiovascular Pharmacotherapy. The Fourth Declaration of Sopot (2021)</i>					review of evidence)				newer ve any)
22) <i>PoLA/CFPiP/PCS/PSLD/PSD/PSH guidelines on diagnosis and therapy of lipid disorders in Poland 2021 (2021)</i>	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and some recommendations are based on non-systematic review of evidence)	Yes (Highlighted key recommendations are linked to evidence or cited in the references)	Yes		To som (Mention previous on which based mention expected completio newer ve any)
23) <i>2022 Taiwan lipid guidelines for primary prevention (2022)</i>	Yes	Yes	Yes	Yes	Yes (Systematic search for evidence and some recommendations are based on non-systematic review of evidence)	Yes(Highlighted key recommendations are linked to evidence or cited in the references)	Yes		To som (Mention previous on which based mention expected completio newer ve any)

Supplementary Table 3: Keywords used for literature review regarding dietary management of co-morbid conditions.

CONDITION	KEYWORDS
Dyslipidemia + Diabetes	Antioxidants, dietary supplements, diabetes mellitus, type 2, oxidative stress, vitamin D, ascorbic acid, vitamin b12, blood cholesterol, blood lipoprotein, vitamin E, glycemic index, blood glucose, omega 3 fatty acids, Eicosapentaenoic Acid, Docosahexaenoic Acids
Dyslipidemia + Hypertension	Blood pressure, hypertension, tea, diet therapy, blood cholestrol, coenzymes, dietary supplements, garlic, blood lipids, hypercholestrolemia, cacao
Dyslipidemia + Chronic Kidney Disease	Chronic Kidney Disease, dietary fibre, protein restricted diet, dietary protein, diet therapy, glomerular filtration rate, chronic renal insufficiency, dietary potassium, phosphorus

Dyslipidemia + Steatotic Liver Disease	Antioxidants, dietary supplements, Non-Alcoholic fatty liver disease, diet therapy, dietary fibre, cholesterol, omega 3 fatty acids, Eicosanoids, docosahexaenoic acids, glycemic index
Dyslipidemia + Pancreatitis	Pancreatitis, malnutrition, nutritional support, acute pancreatitis, chronic pancreatitis, dietary fibre, diet therapy, dietary supplements
Dyslipidemia + Metabolic Syndrome	Dietary supplements, diet therapy, metabolic syndrome, carotenoids, lycopenes, vitamin E, blood lipids, dyslipidemia, vitamin D, Calcium, cheese, milk, yogurt, fermented foods, resveratrol, selenium, zinc, magnesium
Dyslipidemia + Thyroid Disease	Dietary supplements, diet therapy, dyslipidemia, carnitine, hypothyroidism, hyperthyroidism, resveratrol, inositol, melatonin, cardiovascular disease, selenium, zinc, iodine, vitamin A, magnesium, oxidative stress
Dyslipidemia + Heart Failure	Dietary supplements, diet therapy, dyslipidemia, heart failure, sodium restricted diet, high protein diet, coenzyme q, thiamine