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Assessment of the association of plant-based diets with cardiovascular disease risk profile in Africa: a systematic review and meta-analysis protocol

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ABSTRACT

Introduction Cardiovascular disease (CVD) is currently the leading cause of death worldwide. In Africa where infectious diseases are still the leading cause of death, the contribution of non-communicable diseases led by CVDs has significantly increased in recent years. The rise of CVDs in Africa is attributed at least in part to the adoption of sedentary behaviours and unhealthy eating habits, which are linked with urbanisation and westernisation of cultures. Dietary attributes associated with CVD risk have been less investigated in Africa. However, evidence from developed nations has reported a protective effect of healthy dietary patterns such as plant-based diets (PBDs) on cardiometabolic health. The current protocol is for a review aiming to assess existing evidence on the association of PBDs with CVD risk profile in African populations.

Methods and analysis This protocol was developed following the 2015 guidelines of the Preferred Reporting Items for Systematic Review and Meta-analysis Protocols. We will conduct a comprehensive search of the literature for published studies on PBDs in relation to CVD risk profile in African populations. Observational studies published between January 1990 and December 2019 will be screened. A search strategy using keywords and medical subject headings terms will be applied across multiple scientific databases including PubMed-Medline, Scopus and EBSCOhost and the African Journals Online platform. Manual searches of reference lists from relevant articles will be performed. Citations will be traced using the ISI Web of Science to further identify eligible studies. Grey literature will also be screened for relevant abstracts from conference proceedings, and experts in the field will be contacted where appropriate. Two investigators will independently screen all the titles and abstracts to determine which records are eligible for full-text review. Subsequently, two investigators will review the eligible full text using the selection criteria. A third investigator will be consulted to resolve any discrepancies. Data will be extracted from studies that are eligible for the review. Meta-analysis will be performed for studies with similar or comparable methods and reported outcome measures. This will be performed overall, and by major study-level characteristics. Heterogeneity in the estimates across studies will be assessed and quantified with the use of Cochrane Q and I^2 statistics, respectively. Publication biases will be investigated through funnel plots and Egger test of bias. Relevant sensitivity analyses will be performed to confirm the robustness of the findings.

Ethics and dissemination The review will analyse data from published studies; therefore, it does not require ethical approval. The findings of the review will be submitted as part of a PhD thesis at Stellenbosch University, South Africa. Additionally, the findings will be presented at conferences and published in a peer-reviewed journal.

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Strengths and limitations of this study

- ► To our knowledge this will be the first systematic review and meta-analysis to investigate the associations of plant-based diets (PBDs) with cardiovascular disease (CVD) risk profile in Africa.
- ► Studies previously conducted in Africa may be limited (not published) and could have used varying methods to assess adherence to a PBD and accurately measure its association with CVD risk in African populations.
- ► A considerable degree of heterogeneity may be present by including studies with small sample sizes in the meta-analysis.
- ► Appropriate statistical techniques will be used to ensure that this review compiles accurate findings.

INTRODUCTION

According to WHO, cardiovascular disease (CVD) is currently the leading cause of deaths globally. In 2016, CVD was accountable for 44%[1] of non-communicable disease (NCD) deaths worldwide and 10% in Africa.[2] The prevalence estimates of major CVD risk factors among adult populations from Africa are reported to be 30% for high blood pressure,[3] 3.4%–8.9% for diabetes mellitus,[4] 20% or higher for dyslipidaemia across Africa.[5] In South Africa,[6] overweight/obesity is 31% in men and 68% in women, with women being more susceptible to obesity in most African

countries.[7–10] These high prevalence rates in Africa are a cause for concern. In comparison to high-income countries, the demographic of individuals affected by cardiometabolic risk factors in Africa is slightly different to the global population. African individuals most susceptible to CVD are younger, female and have a low socioeconomic status.[11]

The CVD burden in Africa and worldwide is influenced by several modifiable risk factors and lifestyle choices. Currently, approximately 6 million people die annually as a result of tobacco use.[12] There appears to be a rapid increase in the number of smokers residing in sub-Saharan Africa.[13 14] The prevalence of smoking across Africa in 2015 was quite varied; with rates ranging from 9% in East Africa and up to 60% in West Africa.[15] Physical inactivity is also a major lifestyle contributor to the rise in CVDs. The global burden of sedentary behaviour, that is, physical inactivity is responsible for 3.2 million deaths per year.[1] A survey conducted between 2003 and 2009 across 22 countries in Africa reported that more than 90% of the individuals residing in East Africa met the WHO recommended physical activity levels (moderate activity for at least 150 min per week). In comparison, only 40%–50% met the recommended physical activity levels in West Africa.[16] These statistics may not seem very alarming; however, it should be taken into consideration that a possible decline in physical activity could pose a major risk to individuals.[16 17]

The rapid increase in urbanisation and adoption of western lifestyle behaviours is most likely driving the burden of CVD in Africa. In urbanised areas, physical activity is reduced,[18] and traditional low-fat and high-fibre diets, which are usually consumed in rural areas, are replaced with high-fat and low-fibre diets.[19 20] The westernised diet is an unhealthy dietary pattern, which is characterised by the consumption of processed and energy-dense foods with a high content of saturated fat and refined sugar[21] such as fast foods and soft drinks. People who consume westernised diets are at a greater risk of developing diet-related diseases. The frequent consumption of poor-quality foods that are sugary, fatty and processed has been associated with diabetes mellitus, being overweight or obese and CVD.[22]

The term ‘plant-based’ has rapidly gained popularity within the scientific, commercial and public communities. Previous studies have described the health benefits associated with vegetarian diets, which predominantly consist of plant foods.[23–26] Although plant-based diets (PBDs) have been defined in various ways, the emphasis on the consumption of plant foods such as fruits, vegetables, whole grains, legumes, nuts and seeds remains constant in its definition. Satija and colleagues recently created three PBD indices (ie, overall, healthy and unhealthy) to assess adherence to a PBD. These indices were created using relative scoring based on consumption quintiles of various food groups; with either positive or reverse scoring for plant foods, and reverse scoring for animal foods. For the overall PBD index, higher intakes of plant foods, irrespective of the nutritional value, were scored higher. To distinguish between healthy and less healthy plant foods, for the healthy PBD index higher intakes of fruits, vegetables, whole grains, nuts, seeds, legumes, vegetable oils, coffee and tea were scored higher. Whereas, for the unhealthy PBD index higher intakes of fruit juices, other sugar-sweetened beverages, refined grains, potatoes or potato fries, sweets and desserts were scored higher.[27] These PBD indices have been used to assess the associations with CVD risk factors (ie, hypertension), CVD incident, CVD-related deaths and all-cause mortality, in cohorts residing in the USA.[28 29]

Several studies have reported on the cardiometabolic health benefits of PBDs. PBDs have been associated with the prevention of diabetes mellitus and related complications. McMacken and Shah reviewed PBD as a prevention and treatment option in patients with type 2 diabetes (T2D). Their findings showed that following a PBD is protective against T2D; specifically, consuming plant proteins, fats that are unsaturated and unrefined carbohydrates.[30] In support of this, PBD is also reported to be associated with a lower body mass index in vegans,[31] promotes a healthy body weight and reduces insulin resistance by minimising meat consumption.[32 33] PBDs may also prevent heart failure due to its beneficial health properties. Evidence has shown that because of PBDs having a high content of antioxidants and low content of unhealthy fats (ie, certain saturated or trans fatty acids), it reduces the severity of heart failure. Consuming diets rich in healthy plant-based foods has been associated with a lower cardiometabolic risk in comparison to consuming less healthy plant foods. In addition to this, there is evidence of PBDs providing a beneficial effect on glycaemic control, blood pressure and lipid profile.[27] Future studies are needed to expand on the existing evidence of the health benefits associated with PBDs in preventing CVDs.[34]

Rationale

Unhealthy dietary habits are a shared risk factor of CVDs and other NCDs. In every population, an individual’s lifestyle, including dietary habits, plays an influential role in determining their overall health.[35] Studies from high-income countries have highlighted the benefits of healthy dietary habits. PBDs have been associated with lower risk of T2D[30–32] and CVD.[34] Evidence on the health effects of PBDs in low-to-middle income countries, including those in Africa, is limited. Therefore, knowledge of the association of dietary habits among other lifestyle factors to the growing CVD burden in Africa is needed to develop locally appropriate prevention and control strategies.

Objective

This protocol is for a systematic review (and meta-analysis if possible) to investigate the association of PBDs with CVD risk in Africa.

Review questions

This systematic review will primarily address the following research question:

1. What is the association between PBDs and CVD risk factors in African populations?

The secondary outcomes will be to address:

1. What are the factors modifying the associations (if any) of PBDs with cardiometabolic risk profile across African populations?
2. How consistent has a PBD been defined across studies investigating its relationship with cardiometabolic risk profile in African populations?

METHODS

Patient and public involvement

Patients or members of the public were not involved in developing this protocol. Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Eligibility criteria

Inclusion criteria

We will use our research questions to identify key concepts and determine the Population, Exposure, Comparator for the exposure and desired Outcome (PECO). These components will be used to determine which studies meet the selection criteria.

The following is an outline of the inclusion criteria using the PECO concept:

- Study design: Observational study designs reporting associations, for example, cross-sectional, case–control and cohort studies will be deemed eligible. Studies published from January 1990 to December 2019 will be included in the review.
- Population: Adult populations residing in Africa who are 18 years or older.
- Exposure: Healthy dietary patterns will be the exposure assessed using predefined and/or posterior dietary analysis. PBDs emphasising the consumption of healthy plant foods (ie, fruit, vegetables and whole grains) and limiting animal foods (low-fat dairy products, poultry and fish)[36] will be regarded as healthy diets. Examples will include vegan, vegetarian, predefined Mediterranean or Dietary Approaches to Stop Hypertension (DASH) Scores and components of a PBD, for example, consumption of healthy plant food groups associated with health benefits.[27]
- Comparator: Unhealthy dietary patterns will be the comparator assessed and will primarily consist of diets that emphasise the consumption of less healthy plant foods namely refined grains, sweets and desserts.[27] In addition to other dietary patterns which do not exclude animal foods such as red meat, high-fat dairy products and eggs (eg, lacto-ovo vegetarian), processed foods (ie, fast food intake) depicting a westernised diet[21] or the consumption of animal-derived foods.
- Outcome: CVD and/or cardiometabolic risk factors: hypertension, dysglycaemia and diabetes mellitus, dyslipidaemia, overweight/obesity and metabolic syndrome.

Exclusion criteria

Studies that do not meet the following criteria will not be included in the review:

- Study designs not measuring association (eg, not reporting measures of association such as odds ratios (ORs) or relative risks (RRs)).
- Studies conducted in non-African study populations.
- Studies that were performed on animal models.

Information sources

Electronic databases

Searches will be performed in electronic databases including PubMed-Medline, Scopus and EBSCOhost to identify eligible articles. The databases will be searched for studies on PBDs and CVD risk in Africa published up to December 2019. Manual searches will be conducted using the reference lists of the relevant studies to identify other articles of interest. Citations will be searched for in ISI Web of Science to trace the full text.

Other sources

The African Journals Online platform will also be searched to obtain studies published in relevant local journals. Grey literature will be searched for conference proceedings in the fields of public health and nutrition, using the ISI Web of Science Conference Proceedings Citation Index (CPCI). Conference abstracts related to the association between PBD and CVD risk in Africa will be screened, using CPCI to check whether full text has been published, and subsequently retrieved from the relevant websites. Authors or experts in the relevant fields will be contacted (if necessary) for missing data or unpublished studies, respectively.

Search strategy

Comprehensive literature searches will be conducted to identify eligible studies from the African continent. A search strategy was developed after consultation with the faculty librarian at the Faculty of Medicine and Health Sciences at Stellenbosch University. The same search strategy will be used in all electronic databases. We will use free texts and medical subject headings terms (where applicable) in combination with the African filter[37] to search for relevant studies. A summary of the search terms that will be used in PubMed-Medline is provided in table 1 and will be adapted as needed for each database.

Study records

Records management

We will use a citation management software to identify duplicate records from the articles that will be screened for eligibility. Prior to screening the identified studies duplicates will be removed. Articles presenting findings from the same study will be excluded and the most recent

Table 1 PubMed-Medline search terms and strategy

Search	Terms
#1 - POPULATION	Africa* OR Algeria OR Angola OR Benin OR Botswana OR Burkina Faso OR Burundi OR Cameroon OR Cameroun OR Cape Verde OR Central African Republic OR République Centre Afrique OR RCA OR CAR OR Chad OR chad OR Comoros Islands OR Comoros OR Congo Or Democratic Republic of Congo OR DRC OR République Démocratique du Congo OR RDC OR Djibouti OR Egypt OR Equatorial Guinea OR Eritrea OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea Bissau OR Ivory Coast OR Cote d'Ivoire OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Sao Tome OR Sao Tome & Principe OR Rwanda OR Senegal OR Seychelles OR Sierra Leone OR Somalia OR Somali Land OR South Africa* OR South Sudan OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR Western Sahara* OR Zambia OR Zimbabwe OR Central Africa* OR West Africa* OR Western Africa* OR East Africa* OR Eastern Africa* OR North Africa* OR Northern Africa* OR Southern Africa* OR sub Saharan Africa* OR sub-Saharan Africa* OR Africa South of Sahara* OR African descent OR African ancestry OR Africans
#2 – EXPOSURE	Healthy dietary patterns OR Plant-based diet OR Healthy diet OR Traditional diet OR Vegetarian diet OR Vegan diet OR Mediterranean diet OR Dietary approaches to stop hypertension OR DASH diet OR nutrition OR diet, vegetarian [MeSH Terms] OR diet, vegan [MeSH Terms] OR diets, vegetarian [MeSH Terms] OR dietary habits [MeSH Terms] OR behaviors, eating [MeSH Terms]
#3 – COMPARATOR	Unhealthy plant dietary patterns OR Westernised diet OR Animal-based OR Fast foods OR Processed foods
#4 – OUTCOMES	Cardiovascular disease OR Metabolic syndrome OR Hypertension OR Diabetes mellitus OR Insulin resistance OR Hyperglycaemia OR Dysglycaemia OR Prediabetes OR Dyslipidaemia OR Hypercholesterolaemia OR Hypertriglyceridaemia OR Obesity OR Overweight
#5	#1 AND #2 AND #3 AND #4

and comprehensive publication will be used. Data will be compiled using Excel Workbooks for systematic reviews (VonVille, Helena M. Primary Excel Workbook for Systematic Reviews, http://libguides.sph.uth.tmc.edu/excel_SR_workbook).

Screening

Two investigators will independently screen the titles and abstracts of the articles identified from the literature search. The Preferred Reporting Items for Systematic Reviewsand Meta-Analyses (PRISMA) for abstracts checklist will be used as a guideline, to apply the inclusion criteria of the review. Full text of eligible abstracts will be reviewed using the standardised PRISMA 2009 checklist. The full text of the remaining studies will be retrieved and reviewed independently by two investigators. A non-biased third investigator will be consulted if the two investigators are unable to reach a consensus on the inclusion of studies. Non-eligible studies will be documented and reasons for the exclusion will be reported.

Data extraction and data items

Data extraction will be performed independently by two investigators. An Excel spreadsheet will be used to record the following data extracted from eligible studies; the first author's name, year of publication, country name, study design, sample size, study population characteristics (eg, age and gender), dietary exposure and/or comparator assessed, reported measures of CVD risks (eg, blood pressure measurements and fasting biomarkers such as glucose, insulin, lipogram and so on) and outcome measures of association between PBD and CVD risk (eg, ORs and RR).

Quality assessment and risk of bias in individual studies

Eligible studies will be critically appraised by two investigators to assess the quality and the risk of bias of the studies included in the review. The Strengthening the Reporting of Observational Studies in Epidemiology checklist will be used as a guide to assess the reporting methodology of each observational study. The National Heart, Lung, and Blood Institute Quality Assessment Tool for Observational Studies (https://www.nhlbi.nih.gov.health-topics/study-quality-assessment-tools) will be used to determine the study quality. A quality score ranging from 0 to 14 will be calculated to assess the potential risk of bias of each study.

Data synthesis, analysis and assessment of heterogeneity

If there are significant differences in the study designs and methodologies, we will provide a narrative summary of the findings. Quantitative data will be summarised for studies with comparable methodologies and presented in tables and forest plots reporting weighted summary statistics. Findings will be reported overall and by region, study setting and population (rural vs urban populations), exposure and comparator (dietary patterns), outcome measures assessed (cardiometabolic risk profile biomarkers and measurements) and significant findings (measures of association). Appropriate meta-analytic techniques will be applied to combine results from eligible studies. We will report a summary measure of the

individual studies using a random effects model to obtain a pooled estimates of the OR for cross-sectional or case–control studies and RRs for cohort studies. Weighted summary statistic of the outcomes of interest (ie, ORs or RRs with 95% CIs) will be reported for each study included in the review.

Heterogeneity across the included studies will be investigated and quantified. The Cochrane Q statistic will be used to assess heterogeneity across studies included in meta-analysis. The inconsistency index (I^2) will be used as quantified measure of heterogeneity, with values equivalent to 25% representing low heterogeneity, 50% indicating medium heterogeneity and 75% as high heterogeneity.[38] To investigate publication bias, we will use graphical and statistical assessment. A funnel plot to assess publication bias among studies that will be included in meta-analyses. Furthermore, funnel plot asymmetry will be statistically tested using Egger's test.[39 40]

Sensitivity analysis

Sensitivity analysis will be implemented using the leave-one-out method to assess and confirm the robustness of the findings. Where significant publication bias is apparent, the Tweedie and Duval trim and fill methods[41] will be used to impute the missing studies and examine the plausibility of the imputed studies. The 'meta' package of the statistical software R (The R Foundation for Statistical Computing, Vienna, Austria) will be used to perform the data analysis.

Potential amendments

Any amendments to the protocol will be reported and published as corrigendum to maintain transparency and adhere to the 2015 PRISMA-P guidelines.[42]

Ethics and dissemination

Ethics approval is not a prerequisite for this study because it has a systematic review and meta-analysis design, which will assess published data. This review will form part of a PhD thesis that will be submitted as a doctoral study by publication at Stellenbosch University. The results will be published in peer-reviewed journals. In addition to this, findings will be presented at research meetings and conferences pertaining to public health, nutrition and pathology. Furthermore, significant findings will be submitted to relevant health and policy authorities to lessen the burden of CVDs in Africa.

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Competing interests None declared.

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