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Interventions addressing risk factors of Ischemic Heart Disease in sub-Saharan Africa: a systematic review

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ABSTRACT

 Background: Ischemic Heart Disease (IHD) is currently ranked 8th among the leading causes of deaths in sub-Saharan Africa (sSA). Yet, effective population-wide preventive measures targeting risks in the region are still largely unavailable. We aimed to review population-wide and individual-level interventions addressing risk factors of Ischemic Heart Disease among adults in sSA.

Methods: A systematic search of Medline, EMBASE and Global Health was conducted to identify studies focusing on population-wide and individual-level interventions targeting risks of Ischemic Heart Disease among adults in sSA. A synthesis of basic findings of selected studies was conducted.

Results: A total of 1448 studies were identified, with only seven studies meeting our selection criteria. Three broad interventions were identified- dietary modifications, physical activity, and community-based health promotion measures on tobacco and alcohol cessation. Two studies reported significant reduction in blood pressure, and another study reported statistically significant reduction in mean total cholesterol. Other outcome measures observed ranged from mild to no reduction in blood pressure, blood glucose, body mass index and total cholesterol, respectively

Conclusion: We cannot specify with all certainty contextually feasible interventions that can be effective in modifying IHD risk factors in population groups across sSA. We recommend more research on IHD, particularly on the understanding of the burden, geared towards developing and/or strengthening preventive and treatment interventions for the disease in sSA.

Article summary

Strengths

- This study provides an insight into interventions targeting known risks of Ischemic Heart Disease (IHD) in selected African population groups.
- This study identifies substantive gaps in research and evidence for informed policy decisions on IHD in sub-Saharan Africa (SSA).
- Dietary modification, physical activity, health education and health promotion measures have been effective IHD preventive strategies in specific African population groups.

Limitations

 We still cannot generalize and recommend identified IHD interventions to many African settings, especially due varying degrees of heterogeneities within and between several African population groups.

INTRODUCTION

 The burden of cardiovascular diseases (CVDs) has consistently increased across many world regions over the last three decades.[1 2] Between 1990 and 2013, the Institute for Health Metrics and Evaluation (IHME) reported a median percentage change of CVDs at 40.8% and 89.2% for global deaths and years lived with disabilities (YLDs), respectively.[3 4] Increasing cases and deaths from CVDs, especially Ischemic Heart Disease (IHD), have also been reported among young and active adults globally.[5] Global estimates suggest about 93 million cases and 8.1 million deaths from IHD in 2013.[3 4] In Africa, IHD accounted for 361,000 deaths in 2005, and is currently ranked 8th among the top causes of deaths in the region.[6] In sub-Saharan Africa (sSA) alone, it has been estimated that mortality from IHD may rise from the current rates by about 70% and 74% among African men and women, respectively, by 2030.[7] Increasing sedentary lifestyles, tobacco smoking, alcohol consumption, and unhealthy diets, and the fast rate of urbanization and epidemiological transition across many African settings have been strongly indicated.[5 8]

The 2011 United Nations high level meeting on non-communicable diseases (NCDs) focused on developing a comprehensive policy framework for the prevention and control of NCDs globally, especially across Africa and many low- and middle-income countries (LMICs), where the burden is fast increasing.[9] Current reports from Africa show that public health response, access to health services, and availability of effective interventions and treatment options for NCDs, including IHD, are relatively poor.[10 11] Cost-effective interventions have been described in many high-income settings.[12 13] Health education, improving access to screening and detection of IHD, deploying inexpensive technologies to arrive at diagnosis, and providing

affordable medications for prevention and treatment of heart attacks, have all been practiced in many developed countries with successes.[12 14] In sSA, substantive gaps exist in terms of implementation of many of these interventions due to weak primary health care and health systems, and poor political will.[6 15] Moreover, only a few studies, reviews and randomized controlled trials (RCTs) have examined the effectiveness of some of these interventions.[6] Therefore, little evidence is available for informed policy decisions in this African sub-region.[7] A comprehensive synthesis and appraisal of the studies on interventions for IHD in sSA may be necessary towards informing better response and strengthening existing interventions. We systematically reviewed available literature on IHD in sSA to identify, synthesize and appraise population-wide and individual-level interventions addressing risk factors of IHD among adults, towards better public health policy and practice in the region.

METHODS

Search strategy

A systematic search of Medline, EMBASE and Global Health was conducted to identify relevant studies on Ischemic Heart Disease in sub-Saharan Africa, with search date set from 1980 to 2015 (**Table 1**).

#	Searches
1	cardiovascular diseases/ or myocardial ischemia/ or angina pectoris/ or coronary disease/ or coronary artery disease/ or myocardial infarction/
2	ischemic heart disease*.mp. [mp=title, abstract, original title, name of substance word subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
3	coronary heart disease*.mp. [mp=title, abstract, original title, name of substance word subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
4	ischaemic heart disease*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
5	risk/ or risk factors/
6	lifestyle intervention*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
7	population wide intervention*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
8	individual level intervention*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
9	"africa south of the sahara"/ or africa, central/ or cameroon/ or central african republic or chad/ or congo/ or "democratic republic of the congo"/ or equatorial guinea/ or gabon/ or africa, eastern/ or burundi/ or djibouti/ or eritrea/ or ethiopia/ or kenya/ or rwanda/ or somalia/ or sudan/ or tanzania/ or uganda/ or africa, southern/ or angola/ or botswana/ or lesotho/ or malawi/ or mozambique/ or namibia/ or south africa/ or swaziland/ or zambia/ or zimbabwe/ or africa, western/ or benin/ or burkina faso/ or cape verde/ or cote d'ivoire/ or gambia/ or ghana/ or guinea/ or guinea-bissau/ or liberia/ or mali/ or mauritania/ or niger/ or nigeria/ or senegal/ or sierra leone/ or togo/
10	subsaharan africa.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
11	1 or 2 or 3 or 4
12	5 or 6 or 7 or 8
13	9 or 10
14	11 and 12 and 13

Further searches were conducted on Google Scholar, and the reference lists of selected studies were further hand-searched for relevant articles. Countries in sub-Saharan Africa were as provided in the World Bank list of countries, regions and economies.[16]

Selection criteria

We included original studies (RCTs, cohort studies, and quasi-experimental studies) that described basic interventions used in modifying risk factors associated with IHD across different countries in sSA. The outcome measures assessed were changes in blood pressure, blood glucose, total cholesterol, and body mass index (BMI). We ensured participants in selected studies were adults aged 18 years and above. We excluded studies that focused on interventions in children. Reviews, commentaries, viewpoints and letters were also excluded. There were no English Language restrictions, and no attempt was made to contact authors of articles that were not selected.

Case definitions

We mainly considered studies that focused on interventions addressing known risk factors IHD, including high blood pressure, diabetes mellitus, hypercholesterolemia, overweight and obesity, and tobacco smoking.[17] Ischemic Heart Disease was defined as a group of heart and vascular events characterized by narrowing of arteries with reduced blood and oxygen supply to the heart muscle.[18] Diagnosis, when described, may be based on electrocardiographic (ECG) findings, echocardiogram or relevant imaging findings, cardiac enzymes, and/or tissue-specific cardiac biomarkers.[18 19] IHD is also often referred to as "coronary artery disease" or "coronary heart disease"; in such cases, we generally checked for any reported evidence of intervention targeting risk of ischemic myocardial necrosis to satisfy inclusion in our review.

Quality assessment

The quality of selected studies were assessed using an adaptation of Consolidated Standards of Reporting Trials (CONSORT) and Transparent Reporting of Non-randomised Designs (TREND) checklists, respectively.[20 21] Each of the studies was assessed using the appropriate quality appraisal checklist. Criteria used to assess the validity of the article included randomization, similarity between intervention and control groups, blinding, homogeneity, and follow-up after the study. Studies were graded as [++], [+] or [-], with [++] having the highest grade and [-] the lowest grade (**Supplementary file**). Generally, all studies assessed as [-] were not selected for the review.

Data extraction and synthesis

Data were double extracted from each study and stored in Microsoft Excel file format. We extracted data on overall study characteristics including study period, country, location and setting, method of participant recruitment, number and mean age of participants, intervention implemented, follow-up period, and assessment of outcome variables. We did not conduct any meta-analysis in this review due to varying heterogeneities observed within and between population groups in the selected studies. A qualitative synthesis and evidence appraisal based on relevant information obtained from selected studies was conducted (Supplementary file). A PRISMA checklist was used to assess the completeness of all stages of our review.

RESULTS

Our search returned 1448 records. Only 7 studies met our inclusion criteria and were retained for qualitative synthesis. The reasons for the excluded studies are as

highlighted in Figure 1. Individual study characteristics are shown in Table 2.

Table 2. Summary of results

Studies	Country, Location (Setting)	Study design	Type of Intervention	Results
Cappuccio <i>et al</i> . 2006 [22]	Ghana, Ejisu-Juabeng and Kumasi districts (rural & semi-urban)		Dietary modification and health promotion	Positive reduction in systolic and diastolic blood pressure, non-significant changes observed in 24 hour urinary sodium excretion
Dowse <i>et al.</i> [23]	Mauritius (semi-urban)	Cross-Sectional Survey	Health education and health promotion	Reduction in blood pressure, increased physical activity, but no effect observed on BMI. There was unusual increase in blood sugar
Forrester et al. [24]	Nigeria, Igbo-Ora and Idere (rural)	Randomised Control Trial	Dietary modification	No significant association observed between changes in salt and blood pressure
Grace <i>et al.</i> [25]	South Africa, Mpumalanga and Gauteng (rural)	Non-Randomised Trial	Physical activity and health promotion	Small reductions observed in BMI and blood pressure. No reduction observed in total serum cholesterol
Mendis <i>et al</i> . [26]	Nigeria (semi-urban)		Health education and health promotion	Positive and significant results observed in blood pressure levels
Rossouw et al. [27]	South Africa, Riversdale, Swellendam and Robertson (rural)		Health education and health promotion	Reduction in blood pressure, slight reduction in BMI for only females
Uusitalo <i>et al</i> . [28]	Mauritius (semi-urban)	Cross Sectional Survey	Dietary modification	Positive reduction observed in total serum cholesterol.

Our findings showed that population-wide and individual-level interventions conducted across selected studies included dietary modification, physical activity, health education and health promotion activities on tobacco and alcohol cessation. These interventions were primarily aimed at reducing metabolic risk factors for IHD, such as hypertension, diabetes, obesity, and hypercholesterolemia (**Table 2** & **Supplementary file**).

Dietary Modification

 Three of the retained studies employed dietary modification in addressing hypertension and hypercholesterolemia associated with IHD.[22 24 28] Two studies focused on salt intake and its relationship with blood pressure,[22 24] while the third study focused on modifying the content of a commonly used cooking oil targeted at reducing total cholesterol concentration.[28]

Cappuccio *et al.* examined the effects of not adding salt to cooking foods and limiting the consumption of preserved salted foods on urinary sodium and blood pressure among 1,013 adult participants in both rural and semi-urban settings in Ghana.[22] Although not very pronounced, significant reduction in the systolic and diastolic BP, as well as urinary sodium, was observed in the intervention group compared with control especially after 6 months of restriction of salt intake. The study concluded that BP reduction is associated with reduced salt intake in West Africa sub-region.

In a Nigerian study involving 58 participants from 2 rural communities, Forrester *et al.* also examined the effect of sodium or salt reduction on blood pressure.[24] In this study, outcome measures showed that the mean change in systolic and diastolic blood pressure for both the low salt and high salt phase differed by 4.8mm Hg and 3.2mm Hg, respectively. No significant association was observed between measured changes in salt and systolic or diastolic blood pressure (p=0.08).

In Mauritius, Uusitalo *et al.* examined the effect of modifying commonly used cooking oil (ration oil) on mean serum cholesterol concentration among 1,926 participants.[28] The main composition of the ration oil was mostly palm oil which was high in saturated and monounsaturated fatty acid. The palm oil in ration oil was

modified to entirely soya bean oil. At baseline, 86% of participants used ration oil which was still composed of mostly palm oil. During the 5 year follow-up, 53% of participants used the modified ration oil. The mean cholesterol concentration at baseline was 5.5mmol/l, and after the five years intervention programme, the mean cholesterol concentration reduced to 4.7mmol/l. There was about 0.8mmol/l reduction observed in all ethnic groups. This reduction was statistically significant for both males and females (p<0.001).

Physical activity

Only one study examined the effect of physical activity on some selected health indicators such as blood pressure, body mass index (BMI) and plasma cholesterol concentration.[25] The study was conducted among 143 male South African colliery executives. Participants were recruited from five selected collieries which spread across two South African provinces- Mpumalanga and Gauteng. Participants were exposed to a physical fitness program in the control group and a physical fitness programme combined with a health promotion intervention programme in the experimental group for 32 weeks. At 16 weeks, an improvement in BMI in the control group was observed and statistically significant. At 32 weeks, there was a reduction in BMI in the experimental group, although, this reduction was not statistically significant (p=0.067). Additionally, the study observed an improvement in both the systolic and diastolic blood pressure of participants after 16 weeks, with only the control being statistically significant. Although no statistical significance was observed in the experimental group, the values at re-assessment were better than the baseline values.

Grace et al. also examined the effect of physical activity combined with health

promotion measures on total cholesterol concentration in participants. The duration of follow-up was for 32 weeks.[25] There were no changes observed during the 16 and 32 weeks re-assessment for the experimental group as the total cholesterol concentration remained the same. In fact, a slight increase was observed in the cholesterol concentration of the control group during the 16 week re-assessment. However, no statistical significances were reported in both groups.

Health Education and Health Promotion Measures

Three studies focused primarily on health education and health promotion activities targeted at tobacco smoking and alcohol consumption towards modifying hypertension, hypercholesterolemia, diabetes and obesity.[23 26 27] Other selected studies also had some forms of health education messages along with their targeted intervention, although these were non-specific.

Dowse et al. in a study conducted in Mauritius and involving 5,162 participants, examined the effects of some health education and health promotion activities on the prevalence of IHD risk factors such as hypertension, hypercholesterolemia, diabetes and obesity over a period of five years (1987-1992).[23] The study employed the use of mass media campaigns, widespread community, school and workplace health education activities to promote increased physical activity, healthy diet, smoking cessation and reduction in alcohol consumption. While the interventions resulted in a significant reduction in the prevalence of hypertension in both male and female participants (p<0.001), no positive effects were observed with their BMI. Additionally, no statistically significant effect was observed with diabetes status.[25] In another larger South African study involving 7,188 participants, Rossouw and colleagues observed a reduction also in blood pressure in both male and female participants

 and a reduction in BMI only in the female participants after a four-year health education/promotion intervention programme.[27]

In Nigeria, Mendis *et al.* investigated the effectiveness of World Health Organization (WHO) cardiovascular disease risk management health promotion package in reducing blood pressure in primary care settings, and in improving adherence to lifestyle changes at the individual and cluster levels among 1,188 participants.[26] The intervention involved assessment and management of cardiovascular risk factors, and counselling on risk factors control such as physical activity, diet and tobacco cessation. There was a reduction in blood pressure which was more pronounced in the intervention group than the control group. In the intervention group, all participants reported quitting smoking, while 74.4% reported quitting smoking in the control group (p=0.023).

DISCUSSION

This systematic review examined population-wide and individual-level interventions that focused on modification of risk factors associated with Ischemic Heart Disease in sSA. Our findings suggests there may be effective IHD preventive strategies specific for African population groups, with dietary modification, physical activity, health education and health promotion activities being the main measures reported.

The findings from studies on effects of dietary modifications indicate that meals low in fats and salts may reduce major IHD risks, including hypertension and hypercholesterolemia.[22 24 28] However, not all studies reported statistically significant relationship, suggesting there are still uncertainties on the role of dietary salts and fats in reducing risks of IHD. Hooper and colleagues however reported that evidence obtained from large and small trials revealed that low sodium diet may help

in lowering blood pressure after withdrawing antihypertensives. Hooper further noted that a comprehensive dietary and nutritional plan addressing salt and fat consumption may be very helpful at reducing the risk of cardiovascular diseases in a population.[29]

Physical activity as a sole intervention for modifying risks of CVDs was implemented in just one study, with the authors not clearly stating how physical activity can effectively modify risk factors associated with IHD among adults.[25] However, several studies have revealed that moderate physical activity and exercise most days of the week may be associated with significant reduction in the incidence and mortality from CVDs.[30 31] In the study of 17,944 middle-aged male British civil servants, free of coronary heart disease (CHD), the age-standardized cumulative incidence of CHD was 3.1% among men observing vigorous physical activity, compared to 6.9% among those with no physical activity.[32] Although, this may not be directly compared to sSA due to several contextual differences.

From the included studies, we also noted that population-wide health education and health promotion measures can indirectly influence positive lifestyles and behavioural changes capable of reducing the risks of IHD.[23 26 27] Ford *et al.* employed a health promotion model that can relatively address common risk factors for cardiovascular diseases, with this accounting for population-wide improvements in blood pressure, cholesterol, smoking, and physical activity, and sufficient to influence a change from 44% to 76% of CHD mortality reduction.[33]

Most of the interventions reported in this review were community-based, suggesting that they may only be feasible and acceptable within contextually similar settings. The organization and sustainability of these interventions across many settings in sSA

 may be difficult due to prevailing divergent cultural and individual characteristics. Policies that allow collaboration and regular interactions between experts, community leaders, relevant stakeholders and government leaders may be helpful in instituting some of these interventions effectively on a population-wide scale in many indigenous settings in sSA.[34]

Study limitations

Our study is not without limitations. Despite a rigorous search across several electronic databases, the number of studies retained was relatively small to fully reflect the entire sub-Saharan Africa population. Moreover, only four countries were represented in this review (Ghana, Mauritius, Nigeria and South Africa), meaning that findings are more likely to reflect the conditions in these settings. There were obvious heterogeneities across the selected studies. As such, a meta-analysis, which could have provided a regional pooled estimate on the effectiveness of these interventions in sSA, was not conducted. We cannot therefore state with all certainty specific interventions for IHD that can be applied, modelled or replicated in sub-Saharan African countries. We also understand there are several interventions that have been studied in many settings outside sub-Saharan Africa, a contextual comparison of these to African countries would have been worthwhile, but discussing this would simply be beyond the aims of this study. Additionally, the WHO already provided comprehensive Package of Essential Noncommunicable (PEN) disease interventions for primary health care in less developed settings, with a focus on improving maternal nutrition, implementing tobacco prevention and cessation programmes, improving affordability of food, encouraging physical activity, and providing access to effective prevention and care of risks and diseases;[35] our review would have been more detailed if assessments of these interventions were

identified across selected studies. However, due to very low research output and a relative lack of understanding of the burden of IHD in sub-Saharan Africa, we believe our report may contribute to relevant research and policy response on IHD risk factors and interventions across countries in the region.

CONCLUSION

The rising burden of IHD in sSA without effective population-wide interventions remains a huge public health concern in the region. Hitherto, little is known on the epidemiology, treatment options and overall public health response to IHD in Africa. Our findings on dietary modifications, physical activity, and relevant health promotions measures may have been suggestive of relative improvements in reducing the risk of IHD, yet we still cannot generalize and recommend this to many African settings, especially due varying degrees of heterogeneities within and between several African population groups. We recommend more research on IHD, particularly on the understanding of the burden, geared towards developing and/or strengthening preventive and treatment options required to address the disease across several settings in sSA.

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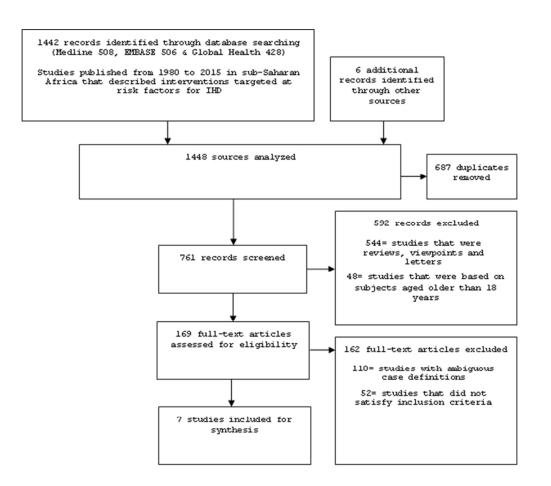
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SUPPLEMENTARY FILE

TABLE S1. EVIDENCE TABLE OF INCLUDED STUDIES

Study details	Population and setting	Description of	Outcome measures and	Results relevant to	Limitations and source of
		intervention	how they were analysed	this review	funding
Authors: Cappuccio, F.P.,	Population: Adults 18	Participants were selected	Primary outcome:	Effect of the	Limitations identified by
Kerry, S, M., Micah,	years and above located	by stratified random	Changes in systolic and	intervention on salt	authors:
F.B., Plange-Rhule, J.,	in twelve communities in	sampling method from all	diastolic blood pressure	intake: It was observed	There was a delay of about
and Eastwood, J.B.	Ejisu-Juabeng and	the villages by age and	were measured during	that smaller villages	18 months between
	Kumasi districts in	sex from the census of all	follow-up periods and	with smaller samples	household survey and the
Year: 2006	Ghana.	inhabitants in the	standardised time of	showed greater	starting of the intervention in
Citation: : A community		villages. They were	measurement was 8am	reduction in urinary	some villages.
program to reduce salt	Selected population:	randomised in blocks of	after adjusting for age, sex,	sodium excretion as	Taking of blood samples
intake and blood pressure	Adults between the ages	two to either intervention	locality and BMI.	compared to larger	from participants was a form
in Ghana, BMC Public	of 40-75 years with no	or control group. They		villages in both groups	of difficulty because there
health, 6 (13), pp. 1-11.	previous diagnosis of	were also blinded to the	Changes in 24 hour	but the net intervention	was spread of rumours in
	hypertension, stroke and	type of dietary	urinary sodium excretion	change was not	some villages that it was to
Aim of study: To	heart failure.	intervention they were	were measured at follow-	statistically significant.	be tested for HIV.
establish the feasibility of		receiving.	up periods after adjusting		The timing of data collection
reducing salt intake on	Setting: Twelve		for confounders such as	Effect of intervention on	did not suit all participants as
blood pressure reduction	communities in Ejisu-	Intervention: The	age, sex, BMI.	BP: it was observed in	some of them left for work
without targeting other	Juabeng and Kumasi	intervention was for 6		the intervention group	much earlier.
aspects of participant's	districts in Ghana. Six of	months and it involved	The method of analysis	that there was a small	The randomisation trial was
diet in twelve	these communities were	additional advice given to	between BP and urinary	reduction in systolic and	not fully managed due to
communities in Ghana	rural and the other six	participants not to add	sodium excretion was	diastolic BP which was	contamination of the two
with a high rate of	semi-urban.	salt to food when cooking	estimated by a random	more pronounced at six	arms which may have been
morbidity and mortality		and to limit the amount	effect regression model.	months and statistically	due to health workers giving
associated with stroke	Sample size: 1,013	of salts added to specific		significant for diastolic	information to control
and heart failure.	participants	meals like koobi,		BP at six months.	villages with the belief that
		momoni, kako, tilapia			all would improve the health
Study design: Cluster		(salted fish), salted pigs'		Follow-up rate in both	of all the villagers.

randomised trial		feet and salted beef and		males (80%) and	Limitation identified by
		to soak them overnight in		females (79%) at 6	reviewer: Participants lost to
Quality rating: +		water before eating them.		months was similar. The	follow up were different from
g s		The control group		impact of participants	those present during 6
		received only health		who dropped out or had	months follow-up.
		education messages on		missing data on the	
		the awareness of diabetes		study was not reported.	
		and hypertension.			Source of funding: The study
		Participants were re-		Effect of intervention	was supported by the
		examined at three months		and 95%CI on BP	Wellcome Trust
		and six months. At		reduction and urinary	(9060415/Z/00/Z).
		follow-up periods, BP,		sodium excretion at 3	
		pulse, weight, history of		and 6 months:	
		drug therapy and two 24-		SBP(mmHg)=-0.48(-	
		hour urine samples were		5.45 to -4.50) 6months=	
		measure and recorded.		-2.54(-6.54 to -1.45)	
		Blood sample was taken		DBP(mmHg) = -1.02(-	
		only during 6 month		3.95 to 1.91)	
		follow-up to measure		6months= -3.95(-7.11to	
		factors related to CVDs.		-0.78)	
				Urinary	
		The study sample was		sodium(mmol/24h)=-	
		divided into two groups:		0.5(-12.3 to 11.3)	
		Intervention (522) and		6months=6.0(-4.1 to	
A d D CK	T1: '11 1 1' A11	control (491).	TI 21 75 1	16.1)	T: '4 4' '1 4'C' 11
Authors: Dowse, G.K.,	Eligible population: All	Intervention: Health	The 2 hour 75g oral	The prevalence of	Limitations identified by authors:
Gareebo, H., Alberti,	adults between ages 25-	education activity	glucose test was measured	hypertension decreased by 19.3% in males and	1)It is not clear to what extent
K.G., Zimmet, P., Tuomilehto, J., Purran,	74 years living in ten randomly selected	promoting healthy diet, increased physical	using Yellow Spring Instruments (YSI) glucose	12.1% in females and	the changes observed
A., Fareed, D., Chitson,	population clusters in	activity, alcohol	analysers.	these changes were	represent the true
P., Collins, V.R., and	Mauritius.	reduction and smoking	Blood pressure was	significant after	intervention as it was not
Hemraj, F.	Response rate of	cessation over a 5 year	measured twice on the right	adjusting for age and	feasible to have a reference
11011114], 1.	participants was	intervention period in the	arm of seated participants	ethnic group. 95% CI	area in the small island of
Year: 1995	82.6%(5080/5892)	community, workplace	with sphygmomanometer.	for males=-2.9(-4.7 to -	Mauritius.
Citation: Changes in	Setting: Ten randomly	and schools and extensive	Physical activity was	1.1). Females=-1.5(-3.0	Limitation identified by
	1 ~			1.0(3.0	

population cholesterol concentration and other cardiovascular risk factor levels after five years of the non-communicable disease intervention programme in Mauritius, BMJ, 311: PP.1255-1259. Objective of study: To study changes in prevalence of risk factors such as diabetes, obesity, hypertension and hypercholesterolemia associated with CVDs after a 5 year intervention that involved promoting healthy lifestyle. Study design: Cross sectional cluster survey	selected population clusters plus an eleventh area purposely selected for its geographic concentration of the minority Chinese population, Mauritius. Sample size: 5,162 participants.	use of mass media. Follow-up was performed in April and May, 1992. A 2 hour 75g oral glucose tolerance test was performed on participants except diabetic patients. BP measurements, BMI and administration of a short lifestyle questionnaire.	graded on a scale of 1- 4 with 1 been the lowest grade and 4 the highest grade. Method of analysis: Data were analysed using the Statistical Package for Social Sciences (SPSS).	to 0.0). There were small non-significant increases in the prevalence of diabetes in both sexes. 95% CI for males= 1.8 (0.0 to 3.6) and females= 0.9(-0.7 to 2.5). There was an increase in moderate or heavy physical activity in males from 16.9% to 22.1% but a very low increase in females from 1.3% to 2.7%. 95% CI for males=5.2(2.9 to 7.5) and females= 1.4(0.6 to 2.2).	reviewer: Follow up frequency was done just once during the 5 year intervention program. The authors did not report if all participants were present during follow-up period. Source of funding: National Institute of Diabetes and Digestive and Kidney Diseases, grant DK-25446
Quality rating: +			10.		
Authors: Forrester, T.,	Eligible population:	Participants were	Primary outcome:	The mean net change for	Limitations identified by
Adeyemo, A., Soarres- Wynter, S., Sargent, L.,	Normotensive adults between the ages of 25-	enrolled in a 4 week run- in phase trial on a dietary	A 24-hour urine sodium excretion. This was	urinary sodium excretion during the low	authors: Due to the short period of the
Bennett, F., Wilks, R.,	55 years who were able	sodium restriction to test	measured by flame	salt and high salt phases	crossover design, the study
Luke, A., Prewitt, W.,	to give informed consent.	their compliance. After	photometry in the	after controlling for age,	could not determine the
Kramer, H., and Cooper,	Selected population:	this phase, participants	laboratory.	sex and period effects in	sustainability or acceptability
R.S.	Normotensive adults	were randomised to either	Blood pressure of	participants was	of a 70mmol reduction in
	between ages 25-55yrs	a high salt or low salt diet	participants was measured	72.2mEq/day.	sodium intake daily.
Year: 2005	who were not pregnant,	for 3 weeks, followed by	three times each with the	The average systolic	Limitation identified by
Citation: A randomised	not breastfeeding and had	a washout period for	stand mercury manometer	blood pressure for the	reviewer:
trial on sodium reduction	no history of	2weeks and a crossover	and the Omron automatic	low salt phase was	The small number of
in two developing	atherosclerotic vascular	phase for an additional 3	device and the average	109.5mmHg while the	participants and volunteer

countries, Journal of	disease, diabetes, kidney	weeks.	calculated. Participants	high salt phase was	nature of recruitments limit
human hypertension, 19:	disease and a	They were also	were seated for 5mins	114mmHg.	the study's generalizability.
pp.55-60.	BMI>40kg/m ² .	counselled and given	before BP measurements	95% CI=1.6, 7.3	The 24 hour urine sample
PFILE	Setting: Two rural	information on diets high	were taken and asked to	The average diastolic	collection by participants
Aim: To evaluate the	communities Igbo-Ora	in salts and behavioural	avoid eating, drinking	blood pressure for low	may not be accurate because
effect of low salt or high	and Idere in south west	skills that helps in	anything other than water	and high salt phase was	they were asked to record the
salt diet over the	Nigeria.	reducing salt intake.	and avoid strenuous	72mmHg and	start and end time.
crossover trial	Sample size: 58	reading surv mune.	exercise for at least 30mins	74.7mmHg respectively.	Source of funding: N/A
intervention period in	participants		before measurements.	95%CI=0.9, 4.5	Source of failuring. 1 will
order to estimate the	purciospunio		Method of Analysis:	56,061 0.5,	
mean blood pressure			continuous variables were		
response.			compared using Wilcoxon		
F			rank sum test and Wald		
Study design:			x ² test for categorical		
Randomised cross-over			variables.		
trial.			,		
W. W.					
Quality rating: +					
Authors: Mendis, S.,	Eligible population:	Participants in the	Primary outcome: It was	There was a reduction in	Limitations identified by
Johnston, S.C., Fan, W.,	Adults above 18 years of	intervention group were	absolute reduction of	mean change of systolic	authors:
Oladapo, O., Cameron,	age who were registered	counselled on the control	systolic blood pressure at	BP in both groups but it	Randomisation was done at
A., and Faramawi, M.F.	in ten pairs of randomly	of risk factors such as	12 month follow-up with	was greater in the	the regional level which
	selected primary health	diet, physical activity and	respect to baseline	intervention group	could bring about differences
Year: 2010	care facilities in Nigeria	tobacco cessation by staff	measurements. BP was	which was -11.01	in the baseline characteristics
Citation: Cardiovascular	and who were ready to	that were give a training	measured using a validated	mmHg and control -	of the intervention and
risk management and its	provide necessary	workshop on the	automatic BP monitor. Two	6.61mmHg with a p-	control groups.
impact on hypertension	information when asked.	intervention before	readings were taken with a	value of 0.0002 which	Facilities were chosen from
control in primary care in	Selected population:	participants were	5mins interval.	was statistically	only two geographical areas
low-resource settings: a	Adults between the ages	enrolled.	Secondary outcome: Rates	significant.	and they may not have been
cluster-randomised trial,	of 30-70 years with	Participants were also	of smoking cessation and	The mean changes in	representative of all primary
Bull World Health	systolic blood pressure	given follow-up cards	change in BMI compared	BMI -0.22kg/m ² for the	health care facilities in the
Organ, 88: pp.412-419.	between 140-179mmHg	that contained BP	to baseline.	intervention group and	country.
	who were not on	measurements, future	Method of analysis:	0.92kg/m ² for the	Limitations identified by
Objective of study: To	treatment for	visit dates and the back of	unvaried comparisons were	control. P < 0.0001.	reviewer:
assess the effectiveness	hypertension and no	the card contained	performed with t-tests for		1) The information on

of the WHO CVD risk	previous history of heart	summary of the	continuous variables and		smoking cessation was based
management package in	attack, stroke, transient	counselling on diet,	Fisher's exact test for		on self-report and they could
reducing blood pressure	ischaemic attack or	physical activity and	dichotomous variables.		have reported higher rates of
in primary care settings	diabetes.	tobacco cessation. This			smoking cessation.
and improving adherence	Setting: Ten pairs of	was to encourage			-
to lifestyle change	matched randomly	participants' adherence.			Future research: Future
interventions at both	selected primary care				studies should get more
individual and cluster	facilities in two regions				information and use objective
levels.	in Nigeria.				evidence on tobacco
	Sample size: 1188				cessation to ensure data
Study design: Cluster-	participants.				quality
randomised trial					Source of funding: N/A
Quality rating: ++	•				
Authors: Rossouw, J.E.,	Eligible population: All	The intervention areas	Both systolic and diastolic	Blood pressure	Limitations identified by
Jooste, P.J., Chalton,	white males and females	were divided into low	BP was assessed using a	measurements to a	author:
D.O., Jordaan, E.R.,	between the ages of 15-	intervention (LII) and	stethoscope and two sets of	greater extent in the	The participation rate was
Langenhoven, M.L.,	64 years in three rural	high intervention (HII).	ear pieces.	intervention areas and it	between 56-70% which was
Jordaan, P.C.J., Steyn,	towns in South Africa.	Both group received a	The quantity of tobacco	was statistically	lower than 80% needed to
M., Swanepoel, A.S.P.,	Setting: Three rural	structured health	consumed was assessed for	significant with	assure a representative
and Rossouw, L.J.	towns, Riversdale,	education programme on	all groups in g/day.	p<0.01.The mean net	sample.
	Swellendam and	lowering BP, reducing	BMI was also calculated in	change for SBP	There could possibly have
Year: 1993	Robertson in South	blood cholesterol and	kg/m².	observed in males for	been cross-contamination
Citation: Community-	Africa with similar age,	increasing physical	Method of Analysis: An	LII was -2.3±0.8, HII=-	between control and
Based Intervention: The	language, population size	activity and managing	unpaired t-test was used	2.7±0.9.	intervention areas because of
Coronary Risk Factor	and accessibility from	stress. In addition to this,	with a covariance	Females, LII=-2.4±0.8,	some positive effects
Study (CORIS),	cape town.	the HII received a 5-day	adjustment for age.	$HII = -3.6 \pm 0.9.$	observed in the control areas.
International Journal of	Sample size: 7,188	smoking cessation		DBP for males, LII= -	Limitation identified by
Epidemiology, 22 (3): pp.	participants	seminar, public health		3.4 ± 0.5 , HII=- 3.7 ± 0.5	reviewer:
428-438.		meetings addressed by		Females, LII=-2.5±0.5,	1) There could be a form of
		experts on each of the		HII=-3.0±0.5.	sampling bias as recruitment
Aim of study: To		risk factors and series of		There was no significant	of participants was not
examine the feasibility		2-hour diet instruction		reduction for BMI in	randomised.
and effectiveness of a		sessions under the		both intervention groups	2) Allocation of participants
community intervention		guidance of dieticians.		for both males and	to either intervention or

Authors: Uusitalo, U., Feskens, E.J.M., Tarodenly selected Tuomilehto, J., Dowse, G., Haw, U., Fareed, D., Hemraj, F., Gareebo, K., Alberti, G.M.M., and Zimmet, P. Year: 1996 Citation: Fall in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectionals survey, BMJ, 313(7064):PP. 1044-1046. Dipective: To determine the extent to which reduction in saturated fatty acid composition of colognosition of seventh content to which reduction in saturated fatty acid composition of solutions and the catent to which reduction in saturated fatty acid composition of composition of colognosition of colognosi	in reducing coronary risk factors such as high BP, high cholesterol concentration and smoking rates in three communities. Study design: Quasi-experimental design Quality rating: +	* O _*			females. LII=-0.1±0.1, HII=- 0.0±0.1 for males. Females, LII=-0.1±0.1, HII=-0.2±0.1	control group was not randomised. This could lead to selection bias Source of funding: N/A.
Tuomilehto, J., Dowse, G., Haw, U., Fareed, D., Hemraj, F., Gareebo, K., Alberti, G.M.M., and Zimmet, P. Year: 1996 Citation: Fall in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Objective: To determine the extent to which reduction in saturated fatty acid composition of fatty acid composition of eduction in saturated fatty acid composition of fatty acid composition of eduction in saturated fatty acid composition of cooking oil (ration oil) which is high in saturated fatty acid to soya bean oil. The follow up survey was done 5 years later to determine the extent to which reduction in saturated fatty acid composition of cooking oil (ration oil) which is high in saturated fatty acid to soya bean oil. The follow up survey was done 5 year intervention programme for males was 4.78mmol/l and the change observed was - 0.79mmol/l, 195% CI= - 18.9 (-21.0 to -16.8) and contentration of patricipants were available during the 5 year intervention programme for males was 4.78mmol/l and the change observed was - 0.79mmol/l, 195% CI= - 18.9 (-21.0 to -16.8) have affected the final results and conclusions drawn by the content of ration oil to soya bean oil has influenced the cholesterol concentration in participants was 4.65mmol/l, 95% CI= -17.5 (-19.2 to -15.8). There was a 14-15% reduction observed in mean cholesterol concentration in participants were available during the 5 year follow-up was 4.65mmol/l, 95% CI= -17.5 (-19.2 to -15.8). There was a 14-15% reduction of patricipants was 4.65mmol/l,	Authors: Uusitalo, U.,					_
G., Haw, U., Fareed, D., Hemraj, F., Gareebo, K., Alberti, G.M.M., and Zimmet, P. Year: 1996 Citation: Fall in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Objective: To determine the extent to which reduction in saturated fatty acid composition of composition of composition of composition of attracted fatty acid composition of large cohort of \$162 participants. was selected from a large cohort of \$162 participants. Selected population: Adults between the ages of 30-64 years stratified by age, sex and ethnic composition in the landian Ocean Sample size: 1926 Objective: To determine the extent to which reduction in saturated fatty acid composition of comp						
Alberti, G.M.M., and Zimmet, P. Participants. Selected population: Adults between the ages of 30-64 years stratified by age, sex and ethnic composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044- 1046. Alberti, G.M.M., and Zimmet, P. participants. Selected population: Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Selected population: Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Was 4.78mmol/l and the change sopserved was - 0.79mmol/l, 195% CI= - 18.9 (-21.0 to -16.8) while for females, the concentration was 4.65mmol/l and the change observed from baseline - 0.82mmol/l, 195% CI= -17.5 (-19.2 to -15.8). Sources of funding: National Institute of Diabetes and Digestive and Kidney Diseases, grant DK-25446. Digestive and kidney Diseases, grant DK-25446.				mean cholesterol	year intervention	were available during the 5
Zimmet, P. Selected population: Adults between the ages of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Selected population: Adults between the ages of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Seconpared with baseline by changes in fatty acid composition in stored serum (blood) samples in the laboratory. Method of analysis: Data analysis was done using the SPSS. Selected population: Adults between the ages of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Sample size: 1926 participants Selected population: Adults between the ages of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Sample size: 1926 participants Selected population: Adults between the ages of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Sample size: 1926 participants Selected population: Adults between the ages of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Sample size: 1926 participants Selfing: Mauritius in the Indian Ocean Sample size: 1926 participants Sample size: 1926 participants Selfing: Mauritius in the Indian Ocean Sample size: 1926 participants Sample size: 1926 participants Selfing: Mauritius in the Indian Ocean Sample size: 1926 participants Sample size: 1926 participants Selfing: Mauritius in the Indian Ocean Sample size: 1926 participants Sources of funding: National Ocean Sample size: 1926 participants Selfing: Mauritius in the Indian Ocean Sample size: 1926 participants Sources of funding: National Ocean Sample size: 1926 participants Sources of funding: National Ocean Sample size: 1926 participants Sources of funding: National Ocean Sample s					1 0	
Year: 1996 Citation: Fall in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Adults between the ages of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants Soya bean oil. The follow up survey was done 5 years later to determine whether the changes in the laboratory. Method of analysis: Data analysis was done using the SPSS. Method of analysis: Data analysis was done using the SPSS. Method of analysis: Data analysis was done using the SPSS. There was a 14-15% reduction observed in mean cholesterol concentration in adults during the intervention programme.						
Year: 1996 Citation: Fall in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Objective: To determine the extent to which reduction in saturated fatty acid composition of of composition of composition of composition of composition of composition of composition in stored by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants of 30-64 years stratified by age, sex and ethnic groups. Setting: Mauritius in the Indian Ocean Sample size: 1926 participants The content of analysis: Data analysis was done using the SPSS. There was a 14-15% reduction observed in mean cholesterol concentration in adults during the intervention programme.	Zimmet, P.					
Citation: Fall in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Discattle in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Objective: To determine the extent to which reduction in saturated fatty acid composition of	Vear: 1996					
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composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044- 1046. Objective: To determine the extent to which reduction in saturated fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044- 1046. Sample size: 1926 participants influenced the cholesterol concentration in participants. SPSS. Diseases, grant DK-25446. Objective: To determine the extent to which reduction in saturated fatty acid composition of		Setting: Mauritius in the				
oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Objective: To determine the extent to which reduction in saturated fatty acid composition of						
sectional survey, BMJ, 313(7064):PP. 1044- 1046. Objective: To determine the extent to which reduction in saturated fatty acid composition of				SPSS.		Diseases, grant DK-25446.
There was a 14-15% reduction observed in mean cholesterol Objective: To determine the extent to which reduction in saturated fatty acid composition of		participants				
1046. Objective: To determine the extent to which reduction in saturated fatty acid composition of			participants.			
Objective: To determine the extent to which reduction in saturated fatty acid composition of	· /					
the extent to which reduction in saturated fatty acid composition of					mean cholesterol	
reduction in saturated fatty acid composition of programme.						
fatty acid composition of						
					programme.	
	commonly used cooking					

oil influenced changes in cholesterol concentration in the population during a five year intervention programme. Study design: cross sectional survey					
Quality rating:+	OA				
Grace, J.M., Wilders, C.J., and Strydom, G.L. Year: 2009 Citation: The effect of a physical and combined health promotion intervention programme on some selected health indicators on south African colliery executives, South African Journal for research in sports, physical education and recreation, 131 (1). Aim of study: To go beyond focussing on physical activity as an intervention programme	Selected population: White adult male executives between the ages of 26-58 years working in five different coal mines spread across two provinces, Mpumalanga and Gauteng. Setting: Five coalmines spread across two South African provinces, Mpumalanga and Gauteng in South Africa. Sample size: 143 participants	The intervention was conducted for 32 weeks and participants were randomly allocated to either an intervention or control group. The intervention group was exposed to a physical and health promotion program while the control group only received the physical part of the intervention program. The health promotion activity included informative session on exercise, nutrition, physical stress management and awareness on health	Primary outcome: Outcome measures assessed were blood pressure which was measured with an aneroid sphygmomanometer. BMI was also measured at baseline, 16 and 32 weeks respectively. This was done by dividing the body mass (kg) by the height (m²). Total cholesterol concentration was also measured using the Accutrend GC by taking a blood specimen from a finger prick. Method of Analysis: Statistical analysis of data was done using the ANOVA repetitive testing.	The intervention group showed a statistical significance in DBP while the control group showed statistical significances in BMI and SBP. The mean DBP for was 75mmHg and 73mmHg for 16 and 32 weeks follow-up period respectively. SBP= There was a 7mmHg difference at follow up compared to baseline for control groups. BMI=-0.2kg/m² reduction for control and experimental group. The cholesterol	Limitation identified by authors: The physical part of the intervention programme was not supervised. Limitations identified by reviewer: The sample may not be generalizable to all make workers in coal mines because only executives were asked to participate in the study. The coalmines were not randomly selected hence increasing the risk of bias. The method of selecting the collieries was not randomised thereby increasing the risk of selection bias. Source of funding: N/A
but to also include other health promotion activities such as informative sessions on exercise, nutrition,		activities that reduces lifestyle habits. The control group only received the exercise intervention programme.	The turkey post-hoc tests were used to determine if certain groups were statistically significant from each other.	concentration remained the same with baseline in experimental and control group.	

physical stress	Follow up was done at 16		
	- 1 221		
management and	and 32 weeks.		
awareness on lifestyle			
habits.			
Study design: Non-			
randomised trial			
randonniscu triai			
Quality rating: +			



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION	·		
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-7
METHODS	·		
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	-
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5, 6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5, Table 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6,7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6,7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6,7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	_
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I ² for each meta-analysis http://bmjopen.bmj.com/site/about/guidelines.xhtml	-



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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6,7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	-
RESULTS	•		
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	7, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	7, 8, Table 2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	-
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	7-12
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	-
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	-
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	12-14
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	14
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	16
FUNDING			
9 Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	-

43 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. 44 doi:10.1371/journal.pmed1000097

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Interventions addressing risk factors of Ischemic Heart Disease in sub-Saharan Africa: a systematic review

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Keywords: ischemic heart disease; myocardial infarction; systematic reviews; Africa

Word count: 3235

ABSTRACT

Background: Ischemic Heart Disease (IHD) is currently ranked 8th among the leading causes of deaths in sub-Saharan Africa (sSA). Yet, effective population-wide preventive measures targeting risks in the region are still largely unavailable. We aimed to review population-wide and individual-level interventions addressing risk factors of Ischemic Heart Disease among adults in sSA.

Methods: A systematic search of Medline, EMBASE, Global Health, AJOL, and Google Scholar was conducted to identify studies focusing on population-wide and individual-level interventions targeting risks of Ischemic Heart Disease among adults in sSA. We conducted a detailed synthesis of basic findings of selected studies.

Results: A total of 2311 studies were identified, with only 9 studies meeting our selection criteria. Three broad interventions were identified— dietary modifications, physical activity, and community-based health promotion measures on tobacco and alcohol cessation. Three studies reported significant reduction in blood pressure, and another study reported statistically significant reduction in mean total cholesterol. Other outcome measures observed ranged from mild to no reduction in blood pressure, blood glucose, body mass index and total cholesterol, respectively

Conclusion: We cannot specify with all certainty contextually feasible interventions that can be effective in modifying IHD risk factors in population groups across sSA. We recommend more research on IHD, particularly on the understanding of the burden, geared towards developing and/or strengthening preventive and treatment interventions for the disease in sSA.

Article summary

Strengths

- This study provides an insight into interventions targeting known risks of Ischemic Heart Disease (IHD) in selected African population groups.
- This study identifies substantive gaps in research and evidence for informed policy decisions on IHD in sub-Saharan Africa (sSA).
- Dietary modification, physical activity, health education and health promotion measures have been effective IHD preventive strategies in specific African population groups.

Limitations

 We still cannot generalize and recommend identified IHD interventions to many African settings, especially due varying degrees of heterogeneity within and across several African population groups.

INTRODUCTION

 The burden of cardiovascular diseases (CVDs) has consistently increased across many world regions over the last three decades.[1 2] Between 1990 and 2013, the Institute for Health Metrics and Evaluation (IHME) reported a median percentage change of CVDs at 40.8% and 89.2% for global deaths and years lived with disabilities (YLDs), respectively.[3 4] Increasing cases and deaths from CVDs, especially Ischemic Heart Disease (IHD), have also been reported among young and active adults globally.[5] Global estimates suggest about 93 million cases and 8.1 million deaths from IHD in 2013.[3 4] In Africa, IHD accounted for 361,000 deaths in 2005, and is currently ranked 8th among the top causes of deaths in the region.[6] In sub-Saharan Africa (sSA) alone, it has been estimated that mortality from IHD may rise from the current rates by about 70% and 74% among African men and women, respectively, by 2030.[7] Increasing sedentary lifestyles, tobacco smoking, alcohol consumption, and unhealthy diets, and the fast rate of urbanization and epidemiological transition across many African settings have been strongly indicated.[5 8]

The 2011 United Nations high level meeting on non-communicable diseases (NCDs) focused on developing a comprehensive policy framework for the prevention and control of NCDs globally, especially across Africa and many low- and middle-income countries (LMICs), where the burden is fast increasing.[9] Current reports from Africa show that public health response, access to health services, and availability of effective interventions and treatment options for NCDs, including IHD, are relatively poor.[10 11] Cost-effective interventions have been described in many high-income settings.[12 13] Health education, improving access to screening and detection of IHD, deploying inexpensive technologies to arrive at diagnosis, and providing

affordable medications for prevention and treatment of heart attacks, have all been practiced in many developed countries with successes.[12 14] In sSA, substantive gaps exist in terms of implementation of many of these interventions due to weak primary health care and health systems, and poor political will.[6 15] Moreover, only a few studies, reviews and randomized controlled trials (RCTs) have examined the effectiveness of some of these interventions.[6] Therefore, little evidence is available for informed policy decisions in this African sub-region.[7] A comprehensive synthesis and appraisal of the studies on interventions for IHD in sSA may be necessary towards informing better response and strengthening existing interventions. We systematically reviewed available literature on IHD in sSA to identify, synthesize and appraise population-wide and individual-level interventions addressing risk factors of IHD among adults, towards better public health policy and practice in the region.

METHODS

Research question

IHD is a largely preventable NCD, with deaths estimated to rise in sSA by over 70% by the year 2030.[7] In line with the aim, this study seeks to address the question: Are there evidence-based interventional measures currently available to address known risk factors for this preventable disease in the African sub-region?

Search strategy

A systematic search of Medline, EMBASE, Global Health and African Journals Online (AJOL) was conducted in May 2016 to identify relevant studies on Ischemic Heart Disease in sub-Saharan Africa, with search date set from 1980 to 2015

(Table 1).

Table 1. Search terms

#	Searches
1	cardiovascular diseases/ or myocardial ischemia/ or angina pectoris/ or coronary disease/ or coronary artery disease/ or myocardial infarction/
2	ischemic heart disease*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
3	coronary heart disease*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
4	ischaemic heart disease*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
5	"africa south of the sahara"/ or africa, central/ or cameroon/ or central african republic/ or chad/ or congo/ or "democratic republic of the congo"/ or equatorial guinea/ or gabon/ or africa, eastern/ or comoros/ or burundi/ or djibouti/ or eritrea/ or ethiopia/ or kenya/ or rwanda/ or seychelles/ or somalia/ or south sudan/or sudan/ or tanzania/ or uganda/ or africa, southern/ or angola/ or botswana/ or lesotho/ or madagascar/ or malawi/ or mauritius/ or mozambique/ or namibia/ or sao tome and principe/ or south africa/ or swaziland/ or zambia/ or zimbabwe/ or africa, western/ or benin/ or burkina faso/ or cape verde/ or cote d'ivoire/ or gambia/ or ghana/ or guinea/ or guinea-bissau/ or liberia/ or mali/ or mauritania/ or niger/ or nigeria/ or senegal/ or sierra leone/ or togo/
6	subsaharan africa.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
7	1 or 2 or 3 or 4
8	5 or 6
9	7 and 8

Further searches were conducted on Google Scholar, and the reference lists of selected studies were further hand-searched for relevant articles. Countries in sub-Saharan Africa were as provided in the World Bank list of countries, regions and economies.[16]

Selection criteria

We included original studies (RCTs, cross-sectional or cohort studies, and quasiexperimental studies) that described basic interventions used in modifying risk

 factors associated with IHD across different countries in sSA. The outcome measures assessed were changes in blood pressure (BP), blood glucose, total cholesterol, and body mass index (BMI). We ensured participants in selected studies were adults aged 18 years and above. We excluded studies that focused on interventions in children. Reviews, commentaries, viewpoints and letters were also excluded. There were no English Language restrictions, and no attempt was made to contact authors of articles that were not selected.

Case definitions

We mainly considered studies that focused on interventions addressing known risk factors IHD, including high blood pressure, diabetes mellitus, hypercholesterolemia, overweight and obesity, and tobacco smoking.[17] Ischemic Heart Disease was defined as a group of heart and vascular events characterized by narrowing of arteries with reduced blood and oxygen supply to the heart muscle.[18] Diagnosis, when described, may be based on electrocardiographic (ECG) findings, echocardiogram or relevant imaging findings, cardiac enzymes, and/or tissue-specific cardiac biomarkers.[18 19] IHD is also often referred to as "coronary artery disease" or "coronary heart disease"; in such cases, we generally checked for any reported evidence of intervention targeting risk of ischemic myocardial necrosis to satisfy inclusion in our review.

Quality assessment

The quality of selected studies was assessed using the Jadad scale.[20] Studies were graded between 1 and 5, with 5 being the highest and 1 the lowest. Criteria employed were randomization, blinding, and accountability of all participants. Details of the grading of each study are in the **Supplementary file**.

Data extraction and synthesis

Data were double extracted from each study and stored in Microsoft Excel file format. We extracted data on overall study characteristics including study period, country, location and setting, method of participant recruitment, number and mean age of participants, intervention implemented, follow-up period, and assessment of outcome variables. We did not conduct any meta-analysis in this review due to varying heterogeneities observed within and between population groups in the selected studies. A qualitative synthesis and evidence appraisal based on relevant information obtained from selected studies was conducted (Supplementary file). A PRISMA checklist was used to assess the completeness of all stages of our review.

RESULTS

Our search returned 2311 records. Only 9 studies met our inclusion criteria and were retained for qualitative synthesis.[21-29] The reasons for the excluded studies are as highlighted in **Figure 1**. Individual study characteristics are shown in **Table 2**.

Table 2. Summary of results

Studies	Country, Location (Setting)	Study design	Type of Intervention	Results
	Nigeria, Igbo-Ora and Idere (Rural)	Feasibility Study		Reduction observed in 24- hour urinary sodium excretion, and in systolic and diastolic blood pressure
	Ghana, Ejisu-Juabeng and Kumasi districts (rural & semi-urban)		health promotion	Significant reduction in systolic and diastolic blood pressure, and changes observed in 24 hour urinary sodium excretion

Dowse <i>et al.</i> [23]	Mauritius (semi-urban)		Health education and health promotion	Reduction in blood pressure, increased physical activity, but no effect observed on BMI. There was unusual increase in blood sugar
Forrester <i>et al</i> . [24]	Nigeria, Igbo-Ora and Idere (rural)	Randomised Control Trial	Dietary modification	No significant association observed between changes in salt and blood pressure
Grace <i>et al</i> . [25]	South Africa, Mpumalanga and Gauteng (rural)	Non-Randomised Trial	Physical activity and health promotion	Minimal reductions observed in BMI and blood pressure. No reduction observed in total serum cholesterol
Mendis <i>et al</i> . [26]	Nigeria (semi-urban)		Health education and health promotion	Significant reduction observed in blood pressure levels
Mtabaji <i>et al</i> . [27]	Tanzania (semi-urban)	Randomized Control Trial	Dietary Modification	A significant reduction in arterial blood pressure among male normotensives placed on low salt diet compared to those on high salt diet.
Rossouw et al. [28]	South Africa, Riversdale, Swellendam and Robertson (rural)		Health education and health promotion	Reduction in blood pressure, slight reduction in BMI for only females
Uusitalo <i>et al</i> . [29]	Mauritius (semi-urban)	Cross Sectional Survey	Dietary modification	Positive reduction observed in total serum cholesterol.

Our findings showed that population-wide and individual-level interventions conducted across selected studies included dietary modification, physical activity, health education and health promotion activities on tobacco and alcohol cessation. These interventions were primarily aimed at reducing metabolic risk factors for IHD, such as hypertension, diabetes, obesity, and hypercholesterolemia (**Table 2** & **Supplementary file**).

Five of the retained studies employed dietary modification in addressing hypertension and hypercholesterolemia associated with IHD.[21 22 24 27 29] Four studies focused on salt intake and its relationship with blood pressure,[21 22 24 27] while the fifth study focused on modifying the content of a commonly used cooking oil targeted at reducing total cholesterol concentration.[29]

In the study by Adeyemo and colleagues, [21] the effects of reducing cooking salt among free-living normotensive individuals in two rural communities in south-western Nigeria were examined. There was at least 50 mmol reduction in 24-hour urinary sodium in 67% of the participants and 25 mmol reduction in 84% of the participants. Reductions were also observed in the systolic and diastolic BP of participants, with the mean systolic blood pressure reducing by 4.7 mm Hg and 7.0 mm Hg among men and women, respectively, after two weeks. A similar finding was reported in Tanzania by Mtabaji and colleagues, [27] with a significant reduction in arterial blood pressure among male normotensives placed on low salt diet compared to those on high salt diet. The study further reported that those on low salt diet had a urinary sodium excretion of 52 mmol/day relative to a 320 mmol/day observed among those on high salt diet. In Ghana, Cappuccio et al. also examined the effects of not adding salt while cooking and reducing the consumption of preserved salted foods on urinary sodium excretion and blood pressure among 1,013 adult participants in both rural and semi-urban settings.[22] Significant reduction in the systolic and diastolic BP, as well as urinary sodium, was observed in the intervention group compared with control, especially after six months of restriction of salt intake. The study concluded that a relative decrease in blood pressure may be observed with reduced salt intake in the West Africa sub-region. However, in a Nigerian study involving 58 participants from two rural communities, Forrester et al. reported that no significant association was observed between measured changes in dietary salt and systolic or diastolic blood pressure (p=0.08).[24] In this study, outcome measures showed that the mean change in systolic and diastolic blood pressure for both the low salt and high salt phase differed by 4.8mm Hg and 3.2mm Hg, respectively.[24]

In Mauritius, Uusitalo et al. examined the effect of modifying commonly used cooking

 oil (ration oil) on mean serum cholesterol concentration among 1,926 participants.[29] The main composition of the ration oil was mostly palm oil which was high in saturated and monounsaturated fatty acid. The ration oil was modified to entirely soya bean oil. At baseline, 86% of participants used ration oil. During the 5 year follow-up, 53% of participants used the modified ration oil. The mean cholesterol concentration at baseline was 5.5 mmol/l, with this reducing to 4.7 mmol/l at follow-up. This reduction was statistically significant for both males and females (p<0.001).

Only one study examined the effect of physical activity on some selected health measures such as blood pressure, body mass index (BMI) and plasma cholesterol concentration.[25] The study was conducted among 143 male South African colliery executives recruited across two South African provinces- Mpumalanga and Gauteng. The participants were exposed to a physical fitness program in the control group and a physical fitness programme combined with a health promotion intervention programme in the experimental group for 32 weeks. At 16 weeks, an improvement in BMI in the control group was observed and statistically significant. At 32 weeks, there was a reduction in BMI in the experimental group, although, this reduction was not statistically significant (p=0.067). The study also observed an improvement in both the systolic and diastolic blood pressure of participants after 16 weeks. Although no statistical significance was observed in the experimental group, the values at re-assessment were better than the baseline values. Moreover, effects of physical activity combined with health promotion measures on total cholesterol concentration in the participants was examined over the same 32-week period.[25] There were no changes in total cholesterol observed during the 16 and 32 weeks reassessment in the experimental group. A moderate increase was observed in the

cholesterol concentration of the control group during the 16 week re-assessment.

The third intervention identified was health education/promotion measures. Three studies were identified, and targeted essentially the effects of tobacco smoking cessation and alcohol consumption reduction on hypertension, hypercholesterolemia, diabetes and obesity.[23 26 28] Other selected studies also had some forms of health education messages along with their targeted intervention, although these were non-specific.

In Mauritius, Dowse et al. examined the effects of some health education/promotion activities on the prevalence of IHD risk factors among 5,162 subjects over a five-year period (1987-1992).[23] The study employed the use of mass media campaigns, widespread community, school and workplace health education activities to promote increased physical activity, healthy diet, smoking cessation and reduction in alcohol consumption. While the interventions resulted in a significant reduction in the prevalence of hypertension in both male and female participants (p<0.001), no positive effects were observed in BMI, and no statistically significant reduction was observed in mean fasting blood glucose.[25] In a larger South African study involving 7,188 participants, Rossouw and colleagues observed a reduction in blood pressure in both male and female participants, and a reduction in BMI only among the female participants after four-year health education/promotion intervention а programme.[28]

In Nigeria, Mendis et al. investigated the effectiveness of World Health Organization (WHO) cardiovascular disease risk management health promotion package in reducing blood pressure in primary care settings, and in improving adherence to lifestyle changes at the individual and cluster levels among 1,188 participants.[26]

 The intervention involved assessment and management of cardiovascular risk factors, and counselling on risk factors control such as physical activity, diet and tobacco cessation. There was a reduction in blood pressure which was more in the intervention group than the control group. In the intervention group, all participants reported quitting smoking, while 74.4% reported quitting smoking in the control group (p=0.023).

DISCUSSION

This systematic review examined population-wide and individual-level interventions that focused on modification of risk factors associated with Ischemic Heart Disease in sSA. Our findings suggests there may be effective IHD preventive strategies specific for African population groups, with dietary modification, physical activity, health education/promotion activities being the main measures reported.

The findings from studies on effects of dietary modifications indicate that meals low in fats and salts may reduce major IHD risks, including hypertension and hypercholesterolemia.[21 22 24 27 29] However, not all studies reported statistically significant relationship, suggesting there are still uncertainties on the role of dietary salts and fats in reducing risks of IHD. Hooper and colleagues however reported that evidence obtained from large and small trials revealed that low sodium diet may help in lowering blood pressure after withdrawing anti-hypertensives. Hooper further noted that a comprehensive dietary and nutritional plan addressing salt and fat consumption may be very helpful at reducing risks of cardiovascular diseases in a population.[30]

Physical activity as a sole intervention for modifying risks of CVDs was implemented in just one study, with the authors not clearly stating how physical activity can

 effectively modify risk factors associated with IHD among adults.[25] However, several studies have revealed that moderate physical activity and exercise most days of the week may be associated with significant reduction in the incidence and mortality from CVDs.[31 32] In the study of 17,944 middle-aged male British civil servants, free of coronary heart disease (CHD), the age-standardized cumulative incidence of CHD was 3.1% among men observing vigorous physical activity, compared to 6.9% among those with no physical activity.[33] Although, this may not be directly compared to sSA, due to several contextual differences, it still possibly suggests such measures could lead to similar outcomes in the African sub-region.

From the included studies, we also noted that population-wide health education and health promotion measures can indirectly influence healthy lifestyles and behavioural changes.[23 26 28] Ford *et al.* employed a health promotion model that can relatively address common risk factors for cardiovascular diseases, with this accounting for population-wide improvements in blood pressure, cholesterol, smoking, and physical activity, and sufficient to influence a change from 44% to 76% of CHD mortality reduction.[34]

Most of the interventions reported in this review were community-based, suggesting that they may only be feasible and acceptable within contextually similar settings. The organization and sustainability of these interventions across many settings in sSA may be difficult due to prevailing divergent social, cultural and individual issues. Hence, underlying determinants of IHD, including income distribution and educational level specific to the various population subgroups in the region, need to be identified and addressed.[35] Additionally, interventions targeting behavioral risks in the general population through a comprehensive risk assessment and designing cost-effective management protocols for the high-risk categories may need to be

 undertaken towards ensuring improved cardiovascular health in sSA.[35] Advocacies and policies that allow collaboration and regular interactions among experts in the academia, researchers, clinicians, community leaders, government and non-governmental agencies, may be helpful in instituting some of these interventions effectively on a population-wide scale in many indigenous settings in the region.[36] Such policy frameworks may need to be jointly developed by the various stakeholders to aid effective implementation, monitoring and evaluation across the sub-continent.

Our study is not without limitations. Despite a rigorous search across several electronic databases, the number of studies retained was relatively small to fully reflect the entire sub-Saharan African population. Moreover, only five countries were represented in this review (Ghana, Mauritius, Nigeria, South Africa and Tanzania), meaning that findings are more likely to reflect the conditions in these settings. There were obvious heterogeneity across the selected studies. As such, a meta-analysis, which could have provided a regional pooled estimate on the effectiveness of these interventions in sSA, was not conducted. We cannot therefore state with all certainty specific interventions for IHD that can be applied, modelled or replicated in sub-Saharan African countries. We also understand there are several interventions that have been studied in many settings outside sub-Saharan Africa, a contextual comparison of these to African countries would have been worthwhile, but discussing this would simply be beyond the aims of this study. Additionally, the WHO already provided comprehensive Package of Essential Non-communicable (PEN) disease interventions for primary health care in less developed settings, with a focus on improving maternal nutrition, implementing tobacco prevention and cessation programmes, improving affordability of food, encouraging physical activity, and

providing access to effective prevention and care of risks and diseases;[37] our review would have been more detailed if assessments of these interventions were identified across selected studies. However, due to very low research output and a relative lack of understanding of the burden of IHD in sub-Saharan Africa, we believe our report may contribute to relevant research and policy response on IHD risk factors and interventions across countries in the region.

CONCLUSION

The rising burden of IHD in sSA without effective population-wide interventions remains a huge public health concern in the region. Hitherto, little is known on the epidemiology, treatment options and overall public health response to IHD in Africa. Our findings on dietary modifications, physical activity, and relevant health promotions measures may have been suggestive of relative improvements in reducing risks of IHD, yet we still cannot generalize and recommend this to many African settings, especially due to varying degrees of heterogeneity within and across population groups. We recommend more research and active collaboration on IHD, particularly on the understanding of its epidemiological distribution and overall burden in sSA, targeted towards developing and/or strengthening population-wide preventive and treatment options across several settings in the region.

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Ethical approval: Not required.

Contributorship statement: JE conducted the literature search with oversight from DA. JE wrote the first draft of the manuscript. AVA, NO and DA contributed to the final writing of the paper and checked for important intellectual content.

Data sharing statement: No additional data available.

Conflict of interest declaration: All authors have completed the Unified Competing Interest from at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author). The authors declare no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years, and no other relationships or activities that could appear to have influenced the submitted work.

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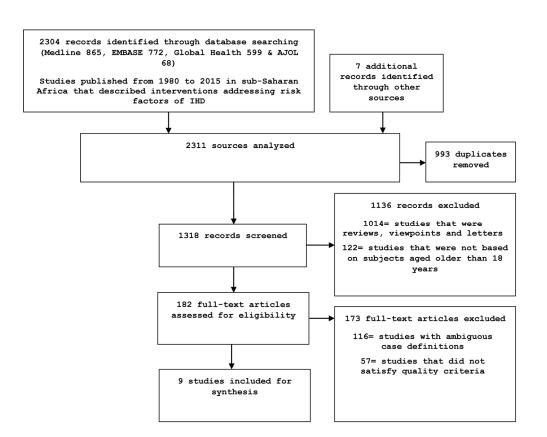


Figure 1. Flow chart of study selection 173x138mm (300 x 300 DPI)

Supplementary file: Evidence Table of Included Studies

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Supplementary					
Study details	Population and setting	Intervention	Outcome Measures	Results relevant to this review	Limitation and Sources of Funding
Authors: Adeyemo, A.A., Prewitt, T.E., Luke, A., Omotade, .O, Rotimi, C.N., Brieger, W.R., Cooper, R.S. Year:2002 Citation: The feasibility of implementing a dietary sodium reduction intervention among free- living normotensive individuals in south west Nigeria. Ethnicity & Disease, 12, pp 207-218. Design: Cross-sectional survey Quality Rating: 2	Adults aged above 25 years from a population register with no history of high BP, no concurrent illness and not on any medication. Involves two rural communities in Ibarapa district in south west Nigeria.	Cooking salt reduced by half, and stopping use of bouillon cubes and monosodium glutamate seasoning for 2 weeks.	Changes in 24 hour urinary sodium excretion were measured at follow-up. Changes in systolic and diastolic blood pressure were measured at follow-up after 30 minutes of rest.	67% of participants of achieved 50mmol reduction in urinary sodium excretion over 24 hours. 25mmol reduction was observed in 84% of the participants. Changes were observed in the systolic and diamolic blood pressure.	It was a within subject comparison study and not a randomized trial. Funding: National Heart, Lung and blood Institute (HLB 455 08)
Authors: Cappuccio, F.P., Kerry, S, M., Micah, F.B., Plange-Rhule, J., and Eastwood, J.B. Year: 2006 Citation: : A community program to reduce salt intake and blood pressure in Ghana, BMC Public health, 6 (13), pp. 1-11. Design: Cluster randomised trial	Adults aged 40-75 years with no history of hypertension, stroke and heart failure. Twelve communities in Ejisu-Juabeng and Kumasi districts in Ghana	Reducing the amount of salts added to specific meals for a period of 6 months	Changes in systolic and diastolic blood pressure were measured at follow-up. Changes in 24 hour urinary sodium excretion were also measured at follow-up.	Greater reduction in urinary sodium excretion in smaller villages of compared to larger villages. There was a small reduction in systolic and diastolic BP which was more pronounced affects months and statistically significant for diastolic BP at six months.	Blood samples collection met barriers due to rumours that it was to be tested for HIV. The randomisation trial was not fully managed due to contamination of the two arms. The timing of data collection was not suitable for many participants due to work schedules. Funding: Wellcome Trust
Quality Rating: 3				copy	(9060415/Z/00/Z).

Authors: Dowse, G.K., Garcebo, H., Alberti, K.G., Zimmet, P., Tromilehto, L., Purran, A., Fareed, D., Chitson, P., Collins, V.R., and Hemraj, F. Year: 1995 Citation: Changes in population cholesterol concentration and other cardiovascular risk factor levels after five years of the mon-communicable disease aintervention programme in Mauritius, B.MJ, 311: pp.1255-1229. Design: Cross sectional cluster survey Quality Rating: 2 Adults between ages 25-74 years in ten and entivity promoting activity, alcohol reduction and smoking cessation over a 5 year intervention period. Health education activity of promoting activity, alcohol reduction and smoking cessation over a 5 year intervention period. The 2 hour 75g oral glucose test was learly alter increased physical activity, alcohol reduction and ethnic group. 9 Small non-signification increases in the prevalence of hypergrasion after adjusting feagle and ethnic group. 9 Small non-signification of diabetes in both §xes. 9 Increase in females glucose test was learned ethnic group. 9 Small non-signification of diabetes in both §xes. 9 Increase in females glucose test was learned unity of promoting and ethnic group. 9 Small non-signification of diabetes in both §xes. 9 Increase in females glucose test was learned unity of promoting and ethnic group. 9 Small non-signification of diabetes in both §xes. 9 Increase in females glucose test was learned unity of glucose analysers. Increase in the provalence of hypergrasion after adjusting feagle and ethnic group. 9 Small non-signification of diabetes in both §xes. 9 Increase in females glucose test was learned unity of glucose analysers. Increase in the provalence of hypergrasion after adjusting feagle and ethnic group. 9 Small plus feagle feagle feagle and ethnic group. 9 Small plus feagle feag					<u>N</u>	<u> </u>
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Quality Rating: 4				16-	
Grace, J.M., Wilders, C.J.,	White adult male	Physical and health	BP was measured with	The intervention group	The physical part of the
and Strydom, G.L.	executives between the	promotion program	an aneroid	showed a statistical €	intervention programme was
	ages of 26-58 years	conducted for a period	sphygmomanometer.	significance in DBP\$\text{\text{\$\text{P}}}\text{while}	not supervised.
Year: 2009	working in five different	of 32 weeks.	BMI was also measured	the control group sh⊗wed	
Citation: The effect of a	coal mines.		at baseline, 16 and 32	statistical significances in	Funding: N/A
physical and combined			weeks respectively.	BMI and SBP. 🚊	
health promotion	Two provinces,			/ 20	
intervention programme on	Mpumalanga and		Total cholesterol	Slight reduction in He	
some selected health	Gauteng in South Africa		concentration was also	experimental and control	
indicators on south African			measured using the	group.	
colliery executives, South			Accutrend GC.	/nlc	
African Journal for research				No changes observed in	
in sports, physical education				the total cholesterol f	
and recreation, 131 (1).				participants. 중	
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Design: Non-randomised				http	
trial.)://ic	
				participants. from http://bmjop	
Quality Rating: 1					
Authors: Mendis, S.,	Adults between 30-70	Health Education on the	Absolute reduction of	Reduction in mean Change	Randomisation was done at
Johnston, S.C., Fan, W.,	years with systolic	control of risk factors of	SBP at 12 month	of SBP in both groups but	the regional level which could
Oladapo, O., Cameron, A.,	blood pressure between	CVD such as diet,	follow-up with respect	it was greater in the	bring about differences in the
and Faramawi, M.F.	140-179mmHg who	physical activity and	to baseline	intervention group.	baseline characteristics of both
	were not on treatment	tobacco cessation.	measurements.	/ 01	groups.
Year: 2010	for hypertension and no			The mean changes BMI	
Citation: Cardiovascular risk	previous history of heart		Rates of smoking	was "-0.22kg/m²" Er the	Facilities were chosen from
management and its impact	attack, stroke, transient		cessation and change in	intervention group and	only two geographical areas
on hypertension control in	ischaemic attack or		BMI compared to	0.92kg/m ² for the control.	and they may not be a
primary care in low-resource	diabetes.		baseline.	02,	representative of all primary
settings: a cluster-				4 b	health care facilities in the
randomised trial, Bull World	Ten pairs of matched			у 9	country.
Health Organ, 88: pp.412-	randomly selected			ues	
419.	primary care facilities in			st. –	Funding: N/A
	two regions in Nigeria			Pro	
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trial.) Tec	
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				jopen-2	
Authors: Mtabaji, J.P., Nara,	Normotensive male	Participants were	Differences in 24 hour	A significant reduction in	Randomization not clearly
Y., Yamori, Y. Year: 1990 Citation: The cardiac study in Tanzania: salt intake in the causation and treatment of hypertension. J Hum Hypertens. 1990	adults aged above 20 years	randomised to either a high salt or low salt diet. Daily diet were maintained on 100 g protein, 85 g fat, and 2700 kcal per day	urinary sodium excretion were measured at follow-up between subjects on high and low salt diet. Differences in arterial blood pressure were	arterial blood presser among male among male normotensives placed on low salt diet compaged to those on high salt diet. Subjects on low salk diet had a urinary sodium	explained. Funding: N/A
Apr;4(2):80-1 Study design: Randomized control trial			measured at follow-up between subjects on high and low salt diet.	excretion of 52mmol/day relative to a 320mmol/day observed among these on high salt diet	
Quality rating: 1 Authors: Rossouw, J.E.,	All white males and	Health Education on	BP was assessed using a	Statistical significant	The participation rate was
Jooste, P.J., Chalton, D.O., Jordaan, E.R., Langenhoven, M.L., Jordaan, P.C.J., Steyn, M., Swanepoel, A.S.P., and Rossouw, L.J. Year: 1993 Citation: Community-Based Intervention: The Coronary Risk Factor Study (CORIS), International Journal of Epidemiology, 22 (3): pp. 428-438. Study design: Quasi- experimental design. Quality Rating: 1	females between the ages of 15-64years. Three rural towns, Riversdale, Swellendam and Robertson in South Africa	reducing BP, cholesterol, managing stress and increases physical activity for both Low intervention (LII) and high intervention (HII) groups. In addition, HII received a 5-day smoking cessation seminar, public health meetings on each of the risk factors and series of 2-hour diet instruction sessions.	stethoscope and two sets of ear pieces. The quantity of tobacco consumed was assessed for all groups in g/day. BMI was also calculated in kg/m².	changes observed in BP measurements of both groups. No significant reduction for BMI in both intervention groups. April 10, 2024 by guest.	between 56-70% which was lower than 80% needed to assure a representative sample. There could possibly have been cross-contamination between control and intervention areas because of some positive effects observe in the control areas. Funding: N/A
Authors: Uusitalo, U., Feskens, E.J.M., Tuomilehto, J., Dowse, G., Haw, U., Fareed, D.,	Adults between 30-64 years stratified by age, sex and ethnic groups.	Dietary intervention which involved modification of palm oil in a commonly used	Reduction in the mean cholesterol concentration of participants after 5 years	There was a 14-15% reduction observed in mean cholesterol concentration in addits	Only 53% of participants we available during the 5 year follow-up period. The other 47% were lost to follow-up
Hemraj, F., Gareebo, K.,	Mauritius in the Indian Ocean.	cooking oil (ration oil) which is high in	compared with baseline by changes in fatty acid	during the intervention programme.	which would probably have affected the final results.

).1136/bmjopen-

Alberti, G.M.M., and Zimmet, P. Year: 1996 Citation: Fall in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Study design: cross sectional survey Quality Rating: 2	saturate soya be	sean oil. seri in t	mposition in stored um (blood) samples the laboratory.	016-011881 on 5 July 2016. Downloaded from http	Funding: National Institute of Diabetes and Digestive and Kidney Diseases, grant DK-25446
				1-2016-011881 on 5 July 2016. Downloaded from http://bmjopen.bmj.com/ on April 10, 2024 by guest. Protected by copyright.	
	For peer review only -	http://bmiopen.hmi.	com/site/about/quid	delines xhtml	



PRISMA 2009 Checklist

Section/topic	_#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
2 Structured summary 3 4	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-7
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	-
⁵ Eligibility criteria 6	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5, 6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5, Table 1
3 Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6,7
8 Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6,7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6,7
3 Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	-
5 Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., 1² for each meta-analysis http://bmjopen.bmj.com/site/about/guidelines.xhtml	-



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PRISMA 2009 Checklist

Page 1 of 2

		Page 1 of 2	
Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6,7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	-
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	7, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	7, 8, Table 2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	-
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	7-12
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	-
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	-
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	12-14
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	14
6 Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	16
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	-

43 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. 44 doi:10.1371/journal.pmed1000097

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BMJ Open

Interventions addressing risk factors of Ischemic Heart Disease in sub-Saharan Africa: a systematic review

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Secondary Subject Heading:	Evidence based practice, Public health, Global health
Keywords:	Ischaemic heart disease < CARDIOLOGY, Cardiac Epidemiology < CARDIOLOGY, Coronary heart disease < CARDIOLOGY

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Interventions addressing risk factors of Ischemic Heart Disease in sub-Saharan Africa: a systematic review

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Demography and Social Statistics, and the e-Health Research Cluster, Covenant University, PMB 1023, Ota, Ogun State, Nigeria bummyadeloy@gmail.com
+2348163976343

Keywords: ischemic heart disease; myocardial infarction; systematic reviews; Africa

Word count: 3218

ABSTRACT

Background: Ischemic Heart Disease (IHD) is currently ranked 8th among the leading causes of deaths in sub-Saharan Africa (sSA). Yet, effective population-wide preventive measures targeting risks in the region are still largely unavailable. We aimed to review population-wide and individual-level interventions addressing risk factors of Ischemic Heart Disease among adults in sSA.

Methods: A systematic search of Medline, EMBASE, Global Health, and AJOL was conducted to identify studies focusing on population-wide and individual-level interventions targeting risks of Ischemic Heart Disease among adults in sSA. We conducted a detailed synthesis of basic findings of selected studies.

Results: A total of 2311 studies were identified, with only 9 studies meeting our selection criteria. Three broad interventions were identified— dietary modifications, physical activity, and community-based health promotion measures on tobacco and alcohol cessation. Three studies reported significant reduction in blood pressure, and another study reported statistically significant reduction in mean total cholesterol. Other outcome measures observed ranged from mild to no reduction in blood pressure, blood glucose, body mass index and total cholesterol, respectively

Conclusion: We cannot specify with all certainty contextually feasible interventions that can be effective in modifying IHD risk factors in population groups across sSA. We recommend more research on IHD, particularly on the understanding of the burden, geared towards developing and/or strengthening preventive and treatment interventions for the disease in sSA.

Article summary

Strengths

- This study provides an insight into interventions targeting known risks of Ischemic Heart Disease (IHD) in selected African population groups.
- This study identifies substantive gaps in research and evidence for informed policy decisions on IHD in sub-Saharan Africa (sSA).
- Dietary modification, physical activity, health education and health promotion measures have been effective IHD preventive strategies in specific African population groups.

Limitations

 We still cannot generalize and recommend identified IHD interventions to many African settings, especially due to varying degrees of heterogeneity within and across several African population groups.

INTRODUCTION

 The burden of cardiovascular diseases (CVDs) has consistently increased across many world regions over the last three decades.[1 2] Between 1990 and 2013, the Institute for Health Metrics and Evaluation (IHME) reported a median percentage change of CVDs at 40.8% and 89.2% for global deaths and years lived with disabilities (YLDs), respectively.[3 4] Increasing cases and deaths from CVDs, especially Ischemic Heart Disease (IHD), have also been reported among young and active adults globally.[5] Global estimates suggest about 93 million cases and 8.1 million deaths from IHD in 2013.[3 4] In Africa, IHD accounted for 361,000 deaths in 2005, and is currently ranked 8th among the top causes of deaths in the region.[6] In sub-Saharan Africa (sSA) alone, it has been estimated that mortality from IHD may rise from the current rates by about 70% and 74% among African men and women, respectively, by 2030.[7] Increasing sedentary lifestyles, tobacco smoking, alcohol consumption, and unhealthy diets, and the fast rate of urbanization and epidemiological transition across many African settings have been strongly indicated.[5 8]

The 2011 United Nations high level meeting on non-communicable diseases (NCDs) focused on developing a comprehensive policy framework for the prevention and control of NCDs globally, especially across Africa and many low- and middle-income countries (LMICs), where the burden is fast increasing.[9] Current reports from Africa show that public health response, access to health services, and availability of effective interventions and treatment options for NCDs, including IHD, are relatively poor.[10 11] Cost-effective interventions have been described in many high-income settings.[12 13] Health education, improving access to screening and detection of IHD, deploying inexpensive technologies to arrive at diagnosis, and providing

affordable medications for prevention and treatment of heart attacks, have all been practiced in many developed countries with successes.[12 14] In sSA, substantive gaps exist in terms of implementation of many of these interventions due to weak primary health care and health systems, and poor political will.[6 15] Moreover, only a few studies, reviews and randomized controlled trials (RCTs) have examined the effectiveness of some of these interventions.[6] Therefore, little evidence is available for informed policy decisions in this African sub-region.[7] A comprehensive synthesis and appraisal of the studies on interventions for IHD in sSA may be necessary towards informing better response and strengthening existing interventions. We systematically reviewed available literature on IHD in sSA to identify, synthesize and appraise population-wide and individual-level interventions addressing risk factors of IHD among adults, towards better public health policy and practice in the region.

METHODS

Research question

IHD is a largely preventable NCD, with deaths estimated to rise in sSA by over 70% by the year 2030.[7] In line with the aim, this study seeks to address the question: Are there evidence-based interventional measures currently available to address known risk factors for this preventable disease in the African sub-region?

Search strategy

A systematic search of Medline, EMBASE, Global Health and African Journals Online (AJOL) was conducted in May 2016 to identify relevant studies on Ischemic

Table 1. Search terms on Medline

#	Searches
1	cardiovascular diseases/ or myocardial ischemia/ or angina pectoris/ or coronary disease/ or coronary artery disease/ or myocardial infarction/
2	ischemic heart disease*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
3	coronary heart disease*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
4	ischaemic heart disease*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
5	"africa south of the sahara"/ or africa, central/ or cameroon/ or central african republic/ or chad/ or congo/ or "democratic republic of the congo"/ or equatorial guinea/ or gabon/ or africa, eastern/ or comoros/ or burundi/ or djibouti/ or eritrea/ or ethiopia/ or kenya/ or rwanda/ or seychelles/ or somalia/ or south sudan/or sudan/ or tanzania/ or uganda/ or africa, southern/ or angola/ or botswana/ or lesotho/ or madagascar/ or malawi/ or mauritius/ or mozambique/ or namibia/ or sao tome and principe/ or south africa/ or swaziland/ or zambia/ or zimbabwe/ or africa, western/ or benin/ or burkina faso/ or cape verde/ or cote d'ivoire/ or gambia/ or ghana/ or guinea/ or guinea-bissau/ or liberia/ or mali/ or mauritania/ or niger/ or nigeria/ or senegal/ or sierra leone/ or togo/
6	subsaharan africa.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
7	1 or 2 or 3 or 4
8	5 or 6
9	7 and 8

Note: Searches on EMBASE, Global Health and AJOL were slightly modified

Further searches were conducted on Google Scholar, and the reference lists of selected studies were further hand-searched for relevant articles. Countries in sub-Saharan Africa were as provided in the World Bank list of countries, regions and economies.[16]

Selection criteria

We included original studies (RCTs, cross-sectional or cohort studies, and quasiexperimental studies) that described basic interventions used in modifying risk factors associated with IHD across different countries in sSA. The outcome

measures assessed were changes in blood pressure (BP), blood glucose, total cholesterol, and body mass index (BMI). We ensured participants in selected studies were adults aged 18 years and above. We excluded studies that focused on interventions in children. Reviews, commentaries, viewpoints and letters were also excluded. There were no English Language restrictions, and no attempt was made to contact authors of articles that were not selected.

Case definitions

We mainly considered studies that focused on interventions addressing known risk factors IHD, including high blood pressure, diabetes mellitus, hypercholesterolemia, overweight and obesity, and tobacco smoking.[17] Ischemic Heart Disease was defined as a group of heart and vascular events characterized by narrowing of arteries with reduced blood and oxygen supply to the heart muscle.[18] Diagnosis, when described, may be based on electrocardiographic (ECG) findings, echocardiogram or relevant imaging findings, cardiac enzymes, and/or tissue-specific cardiac biomarkers.[18 19] IHD is also often referred to as "coronary artery disease" or "coronary heart disease"; in such cases, we generally checked for any reported evidence of intervention targeting risk of ischemic myocardial necrosis to satisfy inclusion in our review.

Quality assessment

The quality of selected studies was assessed using the Jadad scale.[20] Studies were graded between 1 and 5, with 5 being the highest and 1 the lowest. Criteria employed were randomization, blinding, and accountability of all participants. Details of the grading of each study are in the **Supplementary file**.

Data extraction and synthesis

Data were double extracted from each study and stored in Microsoft Excel file format. We extracted data on overall study characteristics including study period, country, location and setting, method of participant recruitment, number and mean age of participants, intervention implemented, follow-up period, and assessment of outcome variables. We did not conduct any meta-analysis in this review due to varying heterogeneities observed within and between population groups in the selected studies. A qualitative synthesis as well as evidence appraisal based on relevant information obtained from selected studies was conducted (**Supplementary file**). A PRISMA checklist was used to assess the completeness of all stages of our review.

RESULTS

Our search returned 2311 records. Only 9 studies met our inclusion criteria and were retained for qualitative synthesis.[21-29] The reasons for the excluded studies are as highlighted in **Figure 1**. Individual study characteristics are shown in **Table 2**.

Table 2. Characteristics of included studies

Studies	Country, Location (Setting)	Study design	Type of Intervention	Results
Adeyemo <i>et al</i> . [21]	Nigeria, Igbo-Ora and Idere (Rural)	Feasibility Study		Reduction observed in 24-hour urinary sodium excretion, and in systolic and diastolic blood pressure
Cappuccio <i>et al</i> . [22]	Ghana, Ejisu-Juabeng and Kumasi districts (rural & semi-urban)	Cluster Randomised Trial		Significant reduction in systolic and diastolic blood pressure, and changes observed in 24 hour urinary sodium

Forrester <i>et al</i> .	Nigeria, Igbo-Ora and	Survey	Health education and health promotion Dietary modification	Reduction in blood pressure, increased physical activity, but no effect observed on BMI. There was an unusual increase in blood sugar No significant
[24]	Idere (rural)	Trial		association observed between changes in salt and blood pressure
Grace <i>et al</i> . [25]	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	Non-Randomised Trial	Physical activity and health promotion	Minimal reductions observed in BMI and blood pressure. No reduction observed in total serum cholesterol
Mendis <i>et al</i> . [26]	Nigeria (semi-urban)	Cluster Randomised Trial	Health education and health promotion	Significant reduction observed in blood pressure levels
Mtabaji <i>et al</i> . [27]	Tanzania (semi-urban)	Randomized Control Trial	Dietary Modification	A significant reduction in arterial blood pressure among male normotensives placed on low salt diet compared to those on
Rossouw <i>et al</i> . [28]	-	Quasi Experimental Design	Health education and health promotion	Reduction in blood pressure, slight reduction in BMI for
Uusitalo <i>et al</i> . [29]	Mauritius (semi-urban)	Cross Sectional Survey	Dietary modification	Positive reduction observed in total serum cholesterol.

Our findings showed that population-wide and individual-level interventions conducted across selected studies included dietary modification, physical activity, health education and health promotion activities on tobacco and alcohol cessation. These interventions were primarily aimed at reducing metabolic risk factors for IHD, such as hypertension, diabetes, obesity, and hypercholesterolemia (**Table 2** & **Supplementary file**).

Five of the retained studies employed dietary modification in addressing hypertension and hypercholesterolemia associated with IHD.[21 22 24 27 29] Four studies focused on salt intake and its relationship with blood pressure,[21 22 24 27]

while the fifth study focused on modifying the content of a commonly used cooking oil targeted at reducing total cholesterol concentration.[29]

In the study by Adeyemo and colleagues,[21] the effects of reducing cooking salt among free-living normotensive individuals in two rural communities in south-western Nigeria were examined. There was at least 50 mmol reduction in 24-hour urinary sodium in 67% of the participants and 25 mmol reduction in 84% of the participants. Reductions were also observed in the systolic and diastolic BP of participants, with the mean systolic blood pressure reducing by 4.7 mm Hg and 7.0 mm Hg among men and women, respectively, after two weeks. A similar finding was reported in Tanzania by Mtabaji and colleagues,[27] with a significant reduction in arterial blood pressure among male normotensives placed on low salt diet compared to those on high salt diet. The study further reported that those on low salt diet had a urinary sodium excretion of 52 mmol/day relative to a 320 mmol/day observed among those on high salt diet. In Ghana, Cappuccio et al. also examined the effects of not adding salt while cooking and reducing the consumption of preserved salted foods on urinary sodium excretion and blood pressure among 1,013 adult participants in both rural and semi-urban settings.[22] Significant reduction in the systolic and diastolic BP, as well as urinary sodium, was observed in the intervention group compared with control, especially after six months of restriction of salt intake. The study concluded that a relative decrease in blood pressure may be observed with reduced salt intake in the West Africa sub-region. However, in a Nigerian study involving 58 participants from two rural communities, Forrester et al. reported that no significant association was observed between measured changes in dietary salt and systolic or diastolic blood pressure (p=0.08).[24] In this study, outcome measures showed that

 the mean change in systolic and diastolic blood pressure for both the low salt and high salt phase differed by 4.8mm Hg and 3.2mm Hg, respectively.[24]

In Mauritius, Uusitalo *et al.* examined the effect of modifying commonly used cooking oil (ration oil) on mean serum cholesterol concentration among 1,926 participants.[29] The main composition of the ration oil was mostly palm oil which was high in saturated and monounsaturated fatty acid. The ration oil was modified to entirely soya bean oil. At baseline, 86% of participants used ration oil. During the 5 year follow-up, 53% of participants used the modified ration oil. The mean cholesterol concentration at baseline was 5.5 mmol/l, with this reducing to 4.7 mmol/l at follow-up. This reduction was statistically significant for both males and females (p<0.001).

Only one study examined the effect of physical activity on some selected health measures such as blood pressure, body mass index (BMI) and plasma cholesterol concentration.[25] The study was conducted among 143 male South African colliery executives recruited across two South African provinces- Mpumalanga and Gauteng. The participants were exposed to a physical fitness program in the control group and a physical fitness programme combined with a health promotion intervention programme in the experimental group for 32 weeks. At 32 weeks, there was a reduction in BMI in the experimental group, although, this was not statistically significant (p=0.067). The study also observed an improvement in both the systolic and diastolic blood pressure of participants after 16 weeks. Although no statistical significance was observed in the experimental group, the values at re-assessment were better than the baseline values. Moreover, effects of physical activity combined with health promotion measures on total cholesterol concentration in the participants was examined over the same 32-week period.[25] There were no changes in total

cholesterol observed during the 16 and 32 weeks re-assessment in the experimental group. A moderate increase was observed in the cholesterol concentration of the control group during the 16 week re-assessment.

The third intervention identified was health education/promotion measures. Three studies were identified, and targeted essentially the effects of tobacco smoking cessation and alcohol consumption reduction on hypertension, hypercholesterolemia, diabetes and obesity.[23 26 28] Other selected studies also had some forms of health education messages along with their targeted intervention, although these were non-specific.

In Mauritius, Dowse et al. examined the effects of some health education/promotion activities on the prevalence of IHD risk factors among 5,162 subjects over a five-year period (1987-1992).[23] The study employed the use of mass media campaigns, widespread community, school and workplace health education activities to promote increased physical activity, healthy diet, smoking cessation and reduction in alcohol consumption. While the interventions resulted in a significant reduction in the prevalence of hypertension in both male and female participants (p<0.001), no positive effects were observed in BMI, and no statistically significant reduction was observed in mean fasting blood glucose.[25] In a larger South African study involving 7,188 participants, Rossouw and colleagues observed a reduction in blood pressure in both male and female participants, and a reduction in BMI only among the female participants after health education/promotion intervention four-year programme.[28]

In Nigeria, Mendis et al. investigated the effectiveness of World Health Organization (WHO) cardiovascular disease risk management health promotion package in

reducing blood pressure in primary care settings, and in improving adherence to lifestyle changes at the individual and cluster levels among 1,188 participants.[26] The intervention involved assessment and management of cardiovascular risk factors, and counselling on risk factors control such as physical activity, diet and tobacco cessation. There was a reduction in blood pressure which was more in the intervention group than the control group. In the intervention group, all participants reported quitting smoking, while 74.4% reported quitting smoking in the control group (p=0.023).

DISCUSSION

This systematic review examined population-wide and individual-level interventions that focused on modification of risk factors associated with Ischemic Heart Disease in sSA. Our findings suggest there may be effective IHD preventive strategies specific for African population groups, with dietary modification, physical activity, health education/promotion activities being the main measures reported.

The findings from studies on effects of dietary modifications indicate that meals low in fats and salts may reduce major IHD risks, including hypertension and hypercholesterolemia.[21 22 24 27 29] However, not all studies reported statistically significant relationship, suggesting there are still uncertainties on the role of dietary salts and fats in reducing risks of IHD. Hooper and colleagues however reported that evidence obtained from large and small trials revealed that low sodium diet may help in lowering blood pressure after withdrawing anti-hypertensives. Hooper further noted that a comprehensive dietary and nutritional plan addressing salt and fat consumption may be very helpful at reducing risks of cardiovascular diseases in a population.[30]

 Physical activity as a sole intervention for modifying risks of CVDs was implemented in just one study, with the authors not clearly stating how physical activity can effectively modify risk factors associated with IHD among adults.[25] However, several studies have revealed that moderate physical activity and exercise most days of the week may be associated with significant reduction in the incidence and mortality from CVDs.[31 32] In the study of 17,944 middle-aged male British civil servants, free of coronary heart disease (CHD), the age-standardized cumulative incidence of CHD was 3.1% among men observing vigorous physical activity, compared to 6.9% among those with no physical activity.[33] Although, this may not be directly compared to sSA, due to several contextual differences, it still possibly suggests such measures could lead to similar outcomes in the African sub-region.

From the included studies, we also noted that population-wide health education and health promotion measures can indirectly influence healthy lifestyles and behavioural changes.[23 26 28] Ford *et al.* employed a health promotion model that can relatively address common risk factors for cardiovascular diseases, with this accounting for population-wide improvements in blood pressure, cholesterol, smoking, and physical activity, and sufficient to influence a change from 44% to 76% of CHD mortality reduction.[34]

Most of the interventions reported in this review were community-based, suggesting that they may only be feasible and acceptable within contextually similar settings. The organization and sustainability of these interventions across many settings in sSA may be difficult due to prevailing divergent social, cultural and individual issues. Hence, underlying determinants of IHD, including income distribution and educational level specific to the various population subgroups in the region, need to be identified and addressed.[35] Additionally, interventions targeting behavioral risks

 in the general population through a comprehensive risk assessment and designing cost-effective management protocols for the high-risk categories may need to be undertaken towards ensuring improved cardiovascular health in sSA.[35] Advocacies and policies that allow collaboration and regular interactions among experts in the academia, researchers, clinicians, community leaders, government and non-governmental agencies, may be helpful in instituting some of these interventions effectively on a population-wide scale in many indigenous settings in the region.[36] Such policy frameworks may need to be jointly developed by the various stakeholders to aid effective implementation, monitoring and evaluation across the sub-continent.

Our study is not without limitations. Despite a rigorous search across several electronic databases, the number of studies retained was relatively small to fully reflect the entire sub-Saharan African population. Moreover, only five countries were represented in this review (Ghana, Mauritius, Nigeria, South Africa and Tanzania), meaning that findings are more likely to reflect the conditions in these settings. There were obvious heterogeneity across the selected studies. As such, a meta-analysis, which could have provided a regional pooled estimate on the effectiveness of these interventions in sSA, was not conducted. We cannot therefore state with all certainty specific interventions for IHD that can be applied, modelled or replicated in sub-Saharan Africa. We also understand there are several interventions that have been studied in many settings outside sub-Saharan Africa; a contextual comparison of these to African countries would have been worthwhile, but discussing this would simply be beyond the aims of this study. Additionally, the WHO already provided comprehensive Package of Essential Non-communicable (PEN) disease interventions for primary health care in less developed settings, with a focus on

improving maternal nutrition, implementing tobacco prevention and cessation programmes, improving affordability of food, encouraging physical activity, and providing access to effective prevention and care of risks and diseases;[37] our review would have been more detailed if assessments of these interventions were identified across selected studies. However, due to very low research output and a relative lack of understanding of the burden of IHD in sub-Saharan Africa, we believe our report may contribute to relevant research and policy response on IHD risk factors and interventions across countries in the region.

CONCLUSION

The rising burden of IHD in sSA without effective population-wide interventions remains a huge public health concern in the region. Hitherto, little is known on the epidemiology, treatment options and overall public health response to IHD in Africa. Our findings on dietary modifications, physical activity, and relevant health promotion measures may have been suggestive of relative improvements in reducing risks of IHD, yet we still cannot generalize and recommend this to many African settings, especially due to varying degrees of heterogeneity within and across population groups. We recommend more research and active collaboration on IHD, particularly on the understanding of its epidemiological distribution and overall burden in sSA, targeted towards developing and/or strengthening population-wide preventive and treatment options across several settings in the region.

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Data sharing statement: No additional data available.

Conflict of interest declaration: All authors have completed the Unified Competing Interest from at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author). The authors declare no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years, and no other relationships or activities that could appear to have influenced the submitted work.

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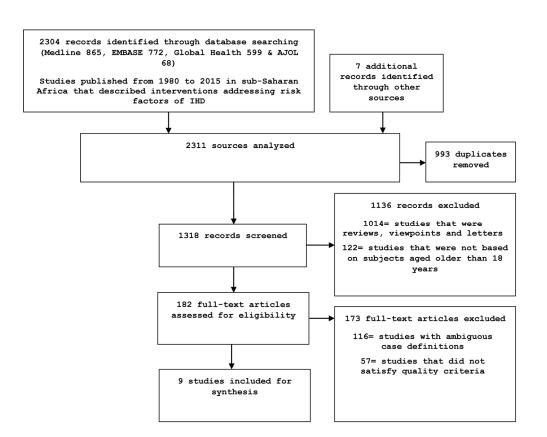


Figure 1. Flow chart of study selection 173x138mm (300 x 300 DPI)

Supplementary file: Evidence Table of Included Studies

		ВМЈ С)pen	0.1136/bmjopen-2016-011	Page 22 of
Supplementary		T			
Study details	Population and setting	Intervention	Outcome Measures	Results relevant to this review	Limitation and Sources of Funding
Authors: Adeyemo, A.A., Prewitt, T.E., Luke, A., Omotade, .O, Rotimi, C.N., Brieger, W.R., Cooper, R.S. Year:2002 Citation: The feasibility of implementing a dietary sodium reduction intervention among free- living normotensive individuals in south west Nigeria. Ethnicity & Disease, 12, pp 207-218. Design: Cross-sectional survey Quality Rating: 2	Adults aged above 25 years from a population register with no history of high BP, no concurrent illness and not on any medication. Involves two rural communities in Ibarapa district in south west Nigeria.	Cooking salt reduced by half, and stopping use of bouillon cubes and monosodium glutamate seasoning for 2 weeks.	Changes in 24 hour urinary sodium excretion were measured at follow-up. Changes in systolic and diastolic blood pressure were measured at follow-up after 30 minutes of rest.	67% of participants of achieved 50mmol control in urinary sodium excretion over 24 hours. 25mmol reduction was observed in 84% of the participants. Changes were observed in the systolic and diagolic blood pressure.	It was a within subject comparison study and not a randomized trial. Funding: National Heart, Lung and blood Institute (HLB 455 08)
Authors: Cappuccio, F.P., Kerry, S, M., Micah, F.B., Plange-Rhule, J., and Eastwood, J.B. Year: 2006 Citation: : A community program to reduce salt intake and blood pressure in Ghana, BMC Public health, 6 (13), pp. 1-11. Design: Cluster randomised trial	Adults aged 40-75 years with no history of hypertension, stroke and heart failure. Twelve communities in Ejisu-Juabeng and Kumasi districts in Ghana	Reducing the amount of salts added to specific meals for a period of 6 months	Changes in systolic and diastolic blood pressure were measured at follow-up. Changes in 24 hour urinary sodium excretion were also measured at follow-up.	Greater reduction in urinary sodium excretion in smaller villages of compared to larger villages. There was a small reduction in systolic and diastolic BP which was more pronounced affects months and statistically significant for diastolic BP at six months.	Blood samples collection met barriers due to rumours that it was to be tested for HIV. The randomisation trial was not fully managed due to contamination of the two arms. The timing of data collection was not suitable for many participants due to work schedules. Funding: Wellcome Trust
Quality Rating: 3				соруг	(9060415/Z/00/Z).

Authors: Dowse, G.K., Garcebo, H., Alberti, K.G., Zimmet, P., Thomilehto, J., Purran, A., Fareed, D., Chitson, P., Collins, V.R., and Hemarj, F. Year: 1995 Citation: Changes in population chosterol econcentration and other candiovascular risk factor levels after five years of the mon-communicable diseases intervention programme in Mauritus, BMJ, 311: pp.1255-1259. Design: Cross sectional clusters survey Quality Rating: 2 Adults between ages 25-74 years in ten The 2 hour 75g oral glucose test was benefit was being cassation over a 5 year intervention period. The 2 hour 75g oral glucose test was benefit was being cassation over a 5 year intervention period. The 2 hour 75g oral glucose test was being discovered physical activity, alcohol reduction and setting group. Small non-significagil increases in the prevalence of hypergasion after adjusting of after adjusting for after adjusting of after adjusting for af						
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Quality Rating: 4				16-	
Grace, J.M., Wilders, C.J.,	White adult male	Physical and health	BP was measured with	The intervention group	The physical part of the
and Strydom, G.L.	executives between the	promotion program	an aneroid	showed a statistical ₹	intervention programme was
	ages of 26-58 years	conducted for a period	sphygmomanometer.	significance in DBP while	not supervised.
Year: 2009	working in five different	of 32 weeks.	BMI was also measured	the control group shewed	
Citation: The effect of a	coal mines.		at baseline, 16 and 32	statistical significances in	Funding: N/A
physical and combined			weeks respectively.	BMI and SBP. 🚊	
health promotion	Two provinces,			' 20	
intervention programme on	Mpumalanga and		Total cholesterol	Slight reduction in the	
some selected health	Gauteng in South Africa		concentration was also	experimental and control	
indicators on south African			measured using the	group.	
colliery executives, South			Accutrend GC.	'nlc	
African Journal for research				No changes observed in	
in sports, physical education				the total cholesterol of	
and recreation, 131 (1).				participants. 중	
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Design: Non-randomised				a#tr	
trial.				o://A	
				participants. from http://bmjop	
Quality Rating: 1					
Authors: Mendis, S.,	Adults between 30-70	Health Education on the	Absolute reduction of	Reduction in mean Change	Randomisation was done at
Johnston, S.C., Fan, W.,	years with systolic	control of risk factors of	SBP at 12 month	of SBP in both grougs but	the regional level which could
Oladapo, O., Cameron, A.,	blood pressure between	CVD such as diet,	follow-up with respect	it was greater in the	bring about differences in the
and Faramawi, M.F.	140-179mmHg who	physical activity and	to baseline	intervention group.	baseline characteristics of both
	were not on treatment	tobacco cessation.	measurements.	/ 01	groups.
Year: 2010	for hypertension and no			The mean changes in BMI	
Citation: Cardiovascular risk	previous history of heart		Rates of smoking	was "-0.22kg/m²" Er the	Facilities were chosen from
management and its impact	attack, stroke, transient		cessation and change in	intervention group and	only two geographical areas
on hypertension control in	ischaemic attack or		BMI compared to	0.92kg/m ² for the control.	and they may not be a
primary care in low-resource	diabetes.		baseline.	024	representative of all primary
settings: a cluster-				44 5	health care facilities in the
randomised trial, Bull World	Ten pairs of matched			у 9	country.
Health Organ, 88: pp.412-	randomly selected			ues	
419.	primary care facilities in			tt. –	Funding: N/A
	two regions in Nigeria			oor o	
Design: Cluster-randomised				tec	
trial.				:tec	
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Quality Rating: 3				/ 0	

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Authors: Mtabaji, J.P., Nara,	Normotensive male	Participants were	Differences in 24 hour	A significant reduction in	Randomization not clearly
Y., Yamori, Y. Year: 1990 Citation: The cardiac study in Tanzania: salt intake in the causation and treatment of hypertension. J Hum Hypertens. 1990	adults aged above 20 years	randomised to either a high salt or low salt diet. Daily diet were maintained on 100 g protein, 85 g fat, and 2700 kcal per day	urinary sodium excretion were measured at follow-up between subjects on high and low salt diet. Differences in arterial blood pressure were	arterial blood presser e among male & & & & & & & & & & & & & & & & & & &	explained. Funding: N/A
Apr;4(2):80-1 Study design: Randomized control trial	0,		measured at follow-up between subjects on high and low salt diet.	excretion of 52mmol/day relative to a 320mmol/day observed among these on high salt diet	
Quality rating: 1 Authors: Rossouw, J.E.,	All white males and	Health Education on	RP was assessed using a	Statistical significant	The participation rate was
Jooste, P.J., Chalton, D.O., Jordaan, E.R., Langenhoven, M.L., Jordaan, P.C.J., Steyn, M., Swanepoel, A.S.P., and Rossouw, L.J. Year: 1993 Citation: Community-Based Intervention: The Coronary Risk Factor Study (CORIS), International Journal of Epidemiology, 22 (3): pp. 428-438. Study design: Quasi- experimental design. Quality Rating: 1	females between the ages of 15-64years. Three rural towns, Riversdale, Swellendam and Robertson in South Africa	reducing BP, cholesterol, managing stress and increases physical activity for both Low intervention (LII) and high intervention (HII) groups. In addition, HII received a 5-day smoking cessation seminar, public health meetings on each of the risk factors and series of 2-hour diet instruction sessions.	BP was assessed using a stethoscope and two sets of ear pieces. The quantity of tobacco consumed was assessed for all groups in g/day. BMI was also calculated in kg/m².	changes observed in BP measurements of both groups. No significant reduction for BMI in both intervention groups. April 10, 2024 by guest.	between 56-70% which was lower than 80% needed to assure a representative sample. There could possibly have been cross-contamination between control and intervention areas because of some positive effects observe in the control areas. Funding: N/A
Authors: Uusitalo, U., Feskens, E.J.M., Tuomilehto, J., Dowse, G., Haw, U., Fareed, D.,	Adults between 30-64 years stratified by age, sex and ethnic groups. Mauritius in the Indian	Dietary intervention which involved modification of palm oil in a commonly used	Reduction in the mean cholesterol concentration of participants after 5 years	There was a 14-15% reduction observed in mean cholesterol concentration in adults during the intervention	Only 53% of participants we available during the 5 year follow-up period. The other 47% were lost to follow-up which would probably house.
Hemraj, F., Gareebo, K.,	Ocean.	cooking oil (ration oil) which is high in	compared with baseline by changes in fatty acid	programme.	which would probably have affected the final results.

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Alberti, G.M.M., and Zimmet, P. Year: 1996 Citation: Fall in cholesterol over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey, BMJ, 313(7064):PP. 1044-1046. Study design: cross sectional survey Quality Rating: 2		urated fatty acid to va bean oil.	composition in stored serum (blood) samples in the laboratory.	016-011881 on 5 July 2016. Downloaded from http	Funding: National Institute of Diabetes and Digestive and Kidney Diseases, grant DK- 25446
				-2016-011881 on 5 July 2016. Downloaded from http://bmjopen.bmj.com/ on April 10, 2024 by guest. Protected by copyright	
	For peer review on	ly - http://bmiopen.h	omi.com/site/about/quid	delines.xhtml	



PRISMA 2009 Checklist

Section/topic	_#	Checklist item	Reported on page #
TITLE			1 0
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
2 Structured summary 3 4	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-7
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	-
⁵ Eligibility criteria 6	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5, 6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5, Table 1
3 Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6,7
8 Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6,7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6,7
3 Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	-
5 Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., 12 for each meta-analysis http://bmjopen.bmj.com/site/about/guidelines.xhtml	-



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PRISMA 2009 Checklist

Page 1 of 2

		Page 1 of 2	
Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6,7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	-
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	7, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	7, 8, Table 2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	-
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	7-12
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	-
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	-
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	12-14
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	14
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	16
FUNDING			
Funding)	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	-

43 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. 44 doi:10.1371/journal.pmed1000097

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