Curr Treat Options Cardio Med (2019) 21: 24
DOI 10.1007/s11936-019-0725-4

Prevention (K Aragam, Section Editor)

Interventions to Reduce Ethnic and Racial Disparities in Dyslipidemia Management

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Published online: 7 May 2019

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This article is part of the Topical Collection on *Prevention*

Keywords Health disparities · Dyslipidemia · Statins · Community health · Risk factor modification · Racial/ethnic differences in health care

Abstract

Purpose of review Race and ethnicity are associated with disparities in risk assessment, screening, patient awareness, treatment, and control of dyslipidemia and can contribute to worsened cardiovascular outcomes. This review summarizes these gaps in care and highlights recent interventions aimed at reducing them.
Recent findings Disparities in dyslipidemia diagnosis and treatment are well documented among certain racial and ethnic minority groups. Less is known about dyslipidemia among Hispanics, Asians, and Native Americans/Pacific Islanders, who have significant heterogeneity in cardiovascular risk and outcomes. Programs to reduce inequalities have focused on targeted risk assessment, improved screening practices, statin adherence-enhancing policies, culturally inclusive risk factor modification campaigns, and multidisciplinary treatment teams, with variable success.
Summary Interventions to reduce racial/ethnic disparities in dyslipidemia are important at all phases of care. Nevertheless, initiatives concentrating on single elements of the lipid treatment cascade were generally less effective at improving clinical endpoints than those that comprehensively addressed multiple phases. Moreover, there was a disproportionately greater number of published studies analyzing patient-facing lifestyle-based risk factor modifications than other types

of interventions. Future investigations should focus on understudied populations such as disaggregated Hispanic, Asian, and Native American populations. Additionally, innovative strategies utilizing information technology and provider-facing programs are needed.

Introduction

Dyslipidemia, defined as low levels of high-density lipoprotein (HDL) cholesterol or elevated total cholesterol (TC), low-density lipoprotein (LDL) cholesterol (LDL-C), or triglyceride (TG) levels, is one of the best-established risk factors for cardiovascular disease (CVD) [1]. CVD, which includes coronary artery disease (CAD), myocardial infarction (MI), congestive heart failure (CHF), peripheral artery disease, and stroke, remains the leading cause of death in the USA and much of the world [2–4]. Unfortunately, disparities in dyslipidemia management by race and ethnicity have been described at every level of the lipid treatment cascade, from risk factor assessment to screening, drug prescription, and medication adherence [5••, 6]. This review briefly overviews the literature on these gaps, then summarizes selected recently published interventions (within the past 5 years) that address them at each step of the cascade.

Background

Although race and ethnicity are complex, often imprecise social constructs, they can serve as convenient, widely used proxies for more individualized risk factor profiles, especially when addressing the needs of vulnerable populations that are at increased risk of CVD.

In general, racial/ethnic minority groups in the USA tend to have higher rates of poor cardiovascular health (which include high cholesterol, hypertension, diabetes, smoking, obesity, physical inactivity, and diets low in fruits and vegetables) when compared to non-Hispanic whites (NHWs) [7]. The only conventionally classified racial/ethnic group with a lower risk profile than NHWs is Asian Americans/Pacific Islanders (AAPI), but this itself is a heterogeneous category including subgroups with widely varying CVD risks, such as South Asians, who may have higher CVD risk than NHWs, and East Asians, with relatively lower CVD risk than NHWs [7, 8••, 9, 10]. These differences translate into adverse cardiovascular outcomes for minorities. For example, African Americans have shorter life expectancy than NHWs in the USA, and it is estimated that CVD explains up to 43% of this difference [5••]. When compared with NHWs, African Americans have higher rates of stroke, sudden cardiac death, peripheral arterial disease, early onset heart failure, and fatal CAD [5••]. These disparities are likely further magnified by socioeconomic status, which is an important independent indicator for vulnerability to CVD, and may act as an effect modifier for those belonging to certain racial/ethnic groups [5••, 7, 11, 12]. Minority groups with substantial immigrant populations also face the challenges of limited English language proficiency, variable time spent in the USA, and result in varying individual degrees of disease susceptibility [13–15].

Focusing specifically on dyslipidemia, non-white Americans shoulder a disproportionate burden of risk. Hispanics have higher rates of dyslipidemia than NHWs [12, 16–18], while South Asians—people with origins in India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, and the Maldives—have both higher rates of dyslipidemia and atherosclerotic disease than NHWs [8••, 19]. Even when the overall prevalence of dyslipidemia appears lower in certain racial/ethnic groups compared to NHWs, the epidemiology may be misleading. African Americans, who have an overall 5–8% lower rate of documented dyslipidemia as compared with NHWs, actually have a higher incidence of dyslipidemia in individuals over the age of 45 [5••, 20, 21]. Part of this finding may be due to the African American "triglyceride paradox" where African Americans with insulin resistance, type 2 diabetes, and CVD (which are usually associated with hypertriglyceridemia) often have normal TG levels [22]. It has also been hypothesized that African Americans' higher risk of early CVD mortality could explain why the prevalence of lipid disorders appears lower than in NHWs—higher CVD mortality rates in African Americans reduces the denominator of those living with dyslipidemia [5••]. Additionally, cohorts focusing on African Americans such as the Jackson

Heart Study have revealed a higher prevalence of dyslipidemia than previously thought [23].

There are several sources of racial/ethnic disparities throughout the lipid treatment cascade that deserve attention as described below.

Screening, diagnosis, and risk stratification

Racial/ethnic minorities, particularly African Americans and Hispanics, are less likely to undergo laboratory-based screening and diagnosis of dyslipidemia than NHWs [16, 18, 24–27]. Recent analyses suggest that rates of dyslipidemia screening remain substantially higher for NHWs (41.6%) than for African Americans (29.9%) [25]. Hispanics are also 15% less likely than NHWs to receive regular lipid testing by their primary care teams [24, 27, 28].

Poor granularity in classification of racial/ethnic groups may also contribute to the observed disparity. Hispanics, for example, represent a heterogeneous group, with Cubans and Puerto Ricans at particularly high risk of dyslipidemia, while Dominicans (who have the highest rate of African ancestry) are at lower risk [29, 30••]. Studies including Asian ethnicity often combine East and South Asian subgroups, who have highly divergent comorbid CVD risk factors and outcomes [7, 8••, 9, 10]. Even among East Asian populations, the perception that this group has a more favorable lipid profile compared to NHWs applies to Chinese- and Japanese-Americans rather than Filipino- and Vietnamese-Americans, who actually have higher levels of LDL-C than NHWs [10]. Native Hawaiians and Pacific Islanders are further understudied and often classified with other racial/ethnic groups, which remains problematic as they have higher rates of dyslipidemia than other East Asian subgroups [31].

Even when at-risk populations are identified, current risk stratification algorithms remain imperfect at determining appropriate thresholds for statin therapy and intensity among certain minorities. The most commonly used pooled cohort equation risk calculator for atherosclerotic cardiovascular disease (ASCVD) designed by the American College of Cardiology (ACC) and American Heart Association (AHA) was developed only in NHW and African American populations. Hispanics and Asians—two of the largest minority groups in the USA—are notably missing from these equations. Therefore, there is concern that our current risk prediction model fails to accurately capture risk in these heterogeneous populations [9, 32]. Similarly, it is likely that these calculators underestimate risk in South Asians who were not represented in derivation cohorts [32]. Other countries with significant racial/ethnic diversity, such as the United Kingdom, have validated algorithms estimating risk for over nine specific racial/ethnic subpopulations (http://qrisk.org/) [33]. Genome-wide association studies (GWAS) have further demonstrated promise in identifying patients at higher CVD risk and therefore most likely to benefit from primary and secondary prevention with statins and other lipid-lowering therapies [34–36]. Similarly to the pooled cohort equations, however, the populations in these studies are overwhelmingly of white European ancestry, with underrepresentation of racial/ethnic minorities [37]. Ultimately, the lack of precise risk prediction may impact appropriate decision-making for statin initiation in increasingly diverse patient populations.

Patient awareness of disease and self-management

Awareness of dyslipidemia as a disease, its risk factors, and healthy living behaviors is lower in racial/ethnic minority groups compared with NHWs. The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) found that nearly half of Hispanics with dyslipidemia were unaware of their diagnosis [18]. Even among those with suspected coronary artery disease, Hispanics were more than twice as likely as NHWs to have misperceptions about hyperlipidemia [20]. Much of this may be due to poor health care counseling and patient education. Hispanics and African-Americans were statistically less likely than NHWs to receive diet, nutrition, and exercise counseling at primary care visits [24]. This is likely exacerbated by language and cultural barriers, where Hispanics, like other minority groups with large immigrant populations, may have difficulty understanding complex explanations and instructions from medical providers and find it challenging to navigate the health care system [11].

Treatment with cholesterol-lowering medications

Multiple studies have shown that statin use, the cornerstone of dyslipidemia treatment, is significantly lower among African Americans relative to NHWs, even after controlling for health care utilization. African Americans have a 5–15% lower crude treatment rate with statins than NHWs [12, 16, 17]. Hispanics have similarly decreased rates of cholesterol-lowering medication prescriptions compared to NHWs [16, 28]. These findings are unfortunately consistent in high-risk minority populations such as African American diabetics [26]. In fact, an increased number of patient vulnerabilities—older

age, African American race, female sex, high area-level poverty, and lack of health insurance—decreases the likelihood of statin use, even after controlling for health care utilization [12].

Even among minority groups prescribed lipid-lowering agents, adequate control of dyslipidemia remains suboptimal. For example, in the HCHS/SOL, only 30% of patients were treated with pharmacotherapy, and only 64% of those on treatment were at goal [18]. Other studies have documented that African Americans were significantly less likely than NHWs to have their cholesterol-lowering drug dosages altered or to receive a statin at guideline-recommended intensity [16, 30••].

Among some East Asian populations, studies have suggested reduced statin metabolism relative to NHWs, leading to an increase in blood serum concentrations of statins and an increase in serious adverse events (i.e., myopathy and rhabdomyolysis) [38–41]. Because of this, current recommendations caution against higher doses of rosuvastatin in Asians [42]. Studies of statins in South Asian subgroups, however, have demonstrated similar efficacy and safety as found in NHWs at the same dose [43]. Furthermore, the assumption of similar reductions in lipid levels and CVD risk at lower statin doses in East Asians than expected in NHWs is based on studies performed in East Asians living in East Asia [9]. This makes it difficult to discern whether the finding is from genetic differences in statin metabolism or lifestyle factors, potentially limiting applicability to diverse Asian-Americans.

Disease control and medication adherence

Low rates of statin adherence are widely documented among racial/ethnic minority populations, even for secondary prevention following adverse CVD such as stroke [44]. While investigating potential health care-system related factors for this finding, one study found that African Americans were more likely to underestimate the benefits and safety of statins and have lower trust in their physicians as compared to NHWs [30••]. Interestingly, these differences were no longer present after controlling for patients' clinical characteristics, socioeconomic status, patient beliefs, and clinician characteristics, but no single confounding factor or sets of factors could be identified as the cause of the racial/ethnic differences.

Interventions to address racial/ethnic disparities in dyslipidemia

Several contemporary studies have highlighted interventions to address the above treatment cascade element disparities at each step (Fig. 1 and Table 1). These include:

Screening, diagnosis, and risk stratification

Recent interventions have creatively sought minority patients in non-clinic settings, tapping into the strength of cultural centers and events, often as part of broader CVD risk factor screening initiatives [46, 59–61]. A recent example includes the *Jazzin' Healthy* program (2017), which provided primary care screening, including lipid screening, to a predominantly African American population at a jazz festival, finding high levels of dyslipidemia among participants [46]. Point-of-care cholesterol testing, as performed at black churches, showed small improvements in LDL-C levels over time when paired with point-of-care counseling and referral to disease education and exercise programs [60]. Indeed, cultural centers of gathering may constitute an important source of lipid diagnoses, as a 2016 study found that over 60% of African-American churchgoers in the Kansas City metro region reported having received a cholesterol screen within the prior 12 months at a place of worship [61].

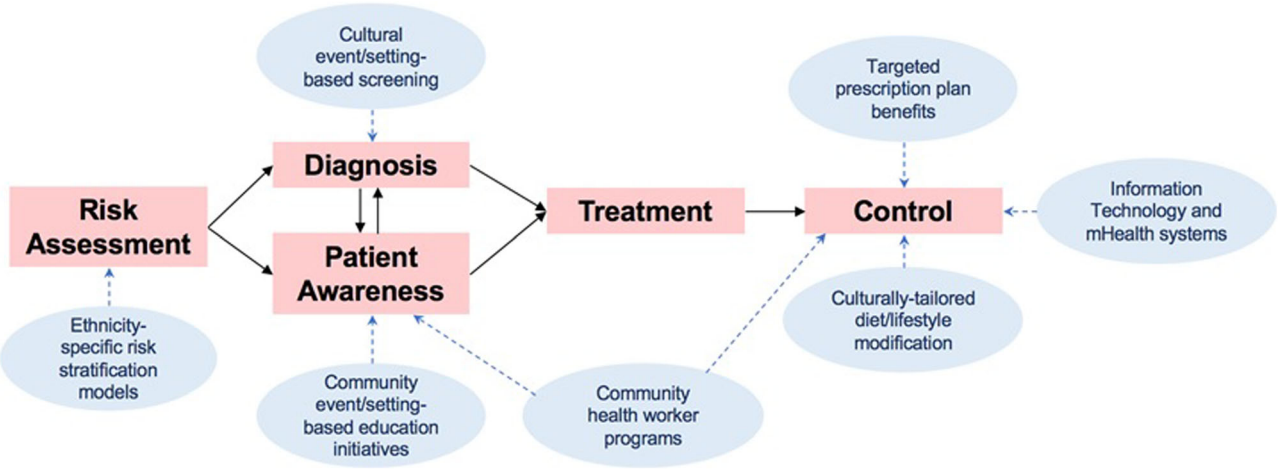

Fig. 1. Schematic of dyslipidemia treatment cascade elements resulting in health disparities and strategies to improve them. Provides a schematic of the dyslipidemia treatment cascade (square boxes), with recently published interventions described in this article in ellipses.

Enhancements of ASCVD risk stratification algorithms that improve risk assessment in racial/ethnic minorities may also have profound impacts on lipid-lowering drug prescriptions. Simply revising the 2013 pooled cohort equation with more contemporary data corrected extreme misestimations of CVD risk in African Americans in one analysis, which could allow for better tailored statin therapy for this population [62••]. These equations can further be improved for underrepresented racial/ethnic groups via increased granularity. Though not yet explored in US populations, a group in the United Kingdom developed the *QRISK* series of calculators whose updates have incorporated data from a cohort including a substantial number of South Asians, black Africans, black Caribbeans, Chinese, and other East Asians [33, 51]. The *QRISK2* ethnicity category includes "Indian, Pakistani, Bangladeshi, other Asian, black Caribbean, black African, Chinese, and other ethnic group" as options, which have implications for tailored treatment and appropriate statin dosages [33].

Patient awareness of disease and self-management

Multiple interventions have focused on patient education and awareness campaigns, representing both event-based and individual-directed programs [46, 49, 57, 60, 63, 64]. The aforementioned *Jazzin' Healthy* project also included a dyslipidemia education program, after which 76% of participants reported planning to change health behaviors within 1 month [46]. Bilingual, culturally appropriate education/empowerment curricula for Latina and African American women showed modest but statistically significant improvements in the adoption of low-fat diets and triglyceride levels and LDL-C levels, respectively, in a pair of pilot studies [63, 64].

Understandably, many awareness programs with lipid profile-improving behaviors were included within interventions targeting high-risk subgroups, particularly diabetics. The *DECIDE* (*Decision-making Education for Choices in Diabetes Everyday*) study (2016) found that small improvements in LDL-C control among African American diabetics could be achieved using group, individual, or self-study educational programs, though differences were not

Table 1. Select recent interventions targeting racial/ethnic disparities in dyslipidemia screening and management

Author, year	Population	Category	Study design	Intervention/setting	Control	Sample size	Outcome on dyslipidemia
Brewer (2017) [45]	African Americans in Minnesota	Diet/lifestyle education	Cohort	Screening and education at churches	None	37	Not significant
Isaacs (2017) [46]	African Americans in Chicago	Diet/lifestyle education	Cross-sectional	Screening and education at jazz festivals	None	285	76% intention to change behavior
Kandula (2015) [47]	South Asians in Chicago	Diet/lifestyle education	Randomized controlled trial	Six interactive lifestyle/ diet classes in community centers	Printed education material	63	Not significant
Jiang (2013) [48]	Prediabetic American Indians, Alaskan Natives across USA	Diet/lifestyle education	Cohort	Culturally sensitive diet/lifestyle curriculum and home diary over 1–3 years in community health centers	None	2553	2.9–4.9% reduction in LDL-C, 7.3% increase in those at LDL-C goal
Fitzpatrick (2016) [49]	Diabetic African Americans in Baltimore	Diet/lifestyle education	Randomized controlled trial	Randomized participants to self-study, individual, or group versions of diabetes/CVD education programs in community centers	Enhanced usual care	182	Increase in LDL-C control in all groups but no significant intervention effect
Xu (2018) [50]	African Americans in Atlanta	Risk stratification	Cohort	Risk stratification model developed; high-risk patients enrolled in multidisciplinary program	None	5364	Evaluation pending
Hippisley-Cox (2008) [33], (2017) [51]	Diverse population of UK	Risk stratification	Observational	ASCVD risk stratification algorithm incorporating multiple races/ ethnicities of UK	None	2.2 million	Not applicable

Table 1. (Continued)

Author, year	Population	Category	Study design	Intervention/setting	Control	Sample size	Outcome on dyslipidemia
Lewey (2015) [52•]	African Americans covered by large national employer	Medication adherence	Retrospective cohort	Copays for statins were eliminated for members of large national employer	Comparable patients with copay	1961	Statin adherence improved in African American zip codes
Lyles (2016) [53•]	African Americans, Hispanics, Asian, Filipino, NHW	Medication adherence	Cohort	Internet-based patient portal with online prescription referral of statins	Baseline values	17,760	Decrease in time without statins for minority users
Jones (2013) [54]	South Asians in Calgary	Multimodal intervention	Cohort	Screening, education, referral in religious centers	None	100	18% decrease in TC/HDL ratio
James (2017) [55]	NHWs, African Americans, and Hispanics in Boston	Multimodal intervention	Randomized controlled trial	Information technology (IT) and population health managers at primary care centers	IT alone	12,555 (607 African Americans, 591 Hispanics)	Nonsignificant trends toward improved LDL-C control, limited by sample size
Allen (2014) [56]	African Americans in Baltimore	Multimodal intervention	Randomized controlled trial	Nurse practitioners and community health workers at primary care centers	Enhanced usual care	525	21.6% vs 5.7% reduction in LDL-C
Spencer (2018) [57]	Diabetic Hispanics in Detroit	Multimodal intervention	Randomized controlled trial	Community health workers ± peer led sessions vs usual care in community health centers	Enhanced usual care	222	No significant intervention effect
Krantz (2017) [58•]	Low-income urban Hispanics in Colorado	Multimodal intervention	Prospective single group	Community health worker education program with provider referral capability	Baseline values	768	Significant decrease in LDL-C (– 14 mg/dL)

LDL-C low-density lipoprotein cholesterol, CVD cardiovascular disease, UK United Kingdom, ASCVD atherosclerotic cardiovascular disease, NHWs non-Hispanic whites

statistically significant when compared to enhancement of usual care [49]. Other modalities to augment community health worker (CHW) guided self-management programs included the addition of peer-led group sessions in diabetic Hispanics, which demonstrated significant intragroup improvement in LDL-C at 18 months, but no statistical significance compared to the control arm [57].

Lifestyle and behavioral modification

Given the patient-facing nature of behavioral modifications, many studies in minority populations have focused on non-pharmacologic treatments such as diet improvement, weight loss, and exercise [45, 48, 58•, 63–67]. A recent trial of a weight loss program coupled with community-based strategies to support healthy lifestyles in 409 rural African American women found decreases in both weight and triglycerides, regardless of the extent of community-based strategies [67]. Physical activity interventions tailored to leverage existing community bonds include guided walking groups in predominantly African American and Hispanic neighborhoods, such as the *Walk Your Heart to Health* study [66]. This analysis of 695 participants found sustained increases in physical activity and lower odds of high cholesterol, with improvements in HDL particularly pronounced among African American members of the cohort.

The *SAHELI* (*South Asian Heart Lifestyle Intervention*) pilot clinical trial targeted underserved South Asian immigrants in Chicago using interactive classes to improve physical activity, lose weight, and adopt diets low in saturated fat intake [47]. While it found significant improvements in weight loss, lipid control was no different between the study and control groups.

A 2013 cohort study using CHW-led intensive CVD-reduction curriculum in 2553 prediabetic American Indians and Alaskan Natives across the USA found both significant improvement in primary outcomes of weight loss and diabetes as well as a 2.9–4.9% reduction in LDL-C and a 7.3% increase in those meeting LDL-C goal levels [48]. The absence of a control arm and high dropout rate were noted, however.

Disease control and medication adherence

A less explored step of interventions in the dyslipidemia treatment cascade remains maintenance of appropriate therapy and statin adherence. Nevertheless, several recent studies emphasize the use of original approaches using service and technology innovations.

A 2014 study analyzed the efficacy and cost-effectiveness of nurse practitioners (NPs) and CHWs in addition to usual primary care at achieving better LDL-C control in a cohort of 525 predominantly African American Baltimore-area women with uncontrolled lipids, blood pressure, and blood sugar levels [56]. The intervention group received reinforcement of medication counseling, lifestyle counseling, and addressing of other barriers to disease control. At study conclusion, the NP/CHW group achieved statistically significant improvements in control of all measured risk factors, including LDL-C (21.6% vs 5.7% reduction). The mean cost per participant in the NP/CHW group per year was $2825, significantly higher than the $2198 in the usual care group. Interestingly, this was driven by an increased frequency of visits and lab tests, as medication prescriptions did not differ between the groups. The authors

concluded that the marginal cost of $40 per 1% improved LDL-C control demonstrated in the intervention group was a cost-effective measure to improve CVD risk factor control in underserved populations.

In 2015, a large self-insured employer sought to improve medication adherence by eliminating copays for statins for all employees [52•]. Though data on employee race was not available, zip code as a proxy for NHW or African American race was used. Participants were compared to a control group of patients covered by the largest insurer in New Jersey, which still required statin copays. The study found that prior to eliminating copays, those living in African American zip codes had higher rates of statin non-adherence. After the copay elimination was implemented, statin adherence significantly increased by 6% for intervention patients living in areas with the top tertile of African American residents. This association persisted even after controlling for income. The authors concluded that eliminating copay disproportionally improved statin adherence among African Americans, and that similar interventions might be beneficial for reducing other disparities by race.

An internet-based patient portal with online prescription refill functions was highlighted in a 2015 Kaiser Permanente study examining its impact on statin adherence across racial/ethnic groups [53•]. Difference-in-difference models showed substantial decreases in time without statins among diabetics of all races who used the intervention. Notably, these decreases were more marked among exclusive users of African American, Latino, Asian, and Filipino descent than NHW users, suggesting the potential of this technology to reduce racial/ethnic disparities in statin adherence.

The rise of mobile information technology devices such as smartphones further extends the reach of web-based interventions to address health disparities. The Personalized Patient Data and Behavioral Nudges to Improve Adherence to Chronic Cardiovascular Medications (Nudge) Study is an ongoing project using mobile technology to deliver reminders and motivation to patients to improve adherence to medications for chronic diseases, including dyslipidemia [68]. It employs strategies from behavioral economics and is meant to be accessible to a wide range of populations, including Spanish speakers and those with low literacy.

Multimodal interventions

Finally, recent interventions have recognized the importance of multimodal approaches to address the above cascade elements, often using population health management programs and community health workers.

The 2017 *Community Heart Health Actions for Latinos at Risk* study utilized CHWs to screen and refer 1099 at-risk patients to medical care while providing a 12-week multimodal curriculum including health education, skill building, healthy eating, physical activity strategies, social support, and walking groups [58•]. Participants completing the program had significant reductions in LDL-C levels. Interestingly, following adjustment, LDL-C level decreases (approximately 30%) were greatest in patients who had newly been prescribed lipid-lowering medications.

Another 2017 study analyzed the impact of population health coordinators (PHCs) and an information technology (IT) program that identified patients not meeting LDL-C and blood pressure goals in a network of Boston primary

care centers in hopes of improving care access among vulnerable populations [55]. The study assigned practices to a control group that used the IT program alone against an intervention group that used the IT program and employed PHCs who assisted patients not at goal with administrative issues (appointment and lab test scheduling, obtaining home BP measurements) and met with providers to develop patient-centric plans to improve treatment. At baseline, African American and Hispanic patients were significantly less likely than NHWs to be at LDL-C goal. At study conclusion, NHW patients in both intervention and control groups had significantly improved LDL-C control, and the rates of control were significantly higher in the intervention group. Though the intervention and control arms did see improvements in African Americans and Hispanics as well, the authors concluded that the interventions did not succeed in reducing disparities due to a lack of differential improvement by race and ethnicity.

Similarly, the *South Asian Cardiovascular Health Assessment and Management Program* (2013) examined a CVD screening, education, and referral program at South Asian religious centers in Calgary [54]. Using point-of-care lipid testing and ASCVD risk stratification, results were sent to participants' primary care physicians, while high-risk participants were encouraged to follow up with culturally sensitive CVD assessment clinics. At 6–13 months of follow-up, the first 100 participants to volunteer for follow-up screening had statistically significant reductions in TC (9%) and TC/HDL ratios (18%), especially among men and those without diabetes.

Discussion

The above interventions represent efforts to reduce racial/ethnic disparities in dyslipidemia through a variety of approaches, and generally suggest that patient and community-facing interventions meeting individuals at their cultural settings can be helpful at multiple levels of the treatment cascade. Diet and lifestyle interventions showed at best mild to moderate improvement in lipid control, however, with many studies showing no significant effect. Multimodal approaches utilizing CHWs, NPs, and creative linked screening and referral policies to PCPs tended to result in more significant improvements in participant lipid profiles.

This review revealed several shortcomings regarding the recent body of work on reducing disparities in dyslipidemia. Relative to diabetes and hypertension, there are fewer interventions focusing specifically on lipid disorders, with most found as parts of comprehensive CVD risk reduction initiatives. Many of the reviewed studies focused on high-risk populations with diabetes or prediabetes, where lipid control was often a secondary outcome. More investigations addressing dyslipidemia as a primary outcome are necessary. In addition, the interpretability of many of the discussed analyses was limited by selection bias and lack of a true control arm. Furthermore, there is a dearth of interventions directly targeting physicians and other primary care providers to increase physician-initiated lipid screening, statin prescription, and medication dose adjustment for their minority patients. Whether this can be achieved by provider education, electronic medical record best practice alerts or quality metric reviews remain to be seen.

As the diversity of the US population continues to increase, it will become even more important to understand the specific risks and effective treatments for dyslipidemia in racial/ethnic groups. One of the recurrent themes apparent in this review was the limited data on specific Hispanic and Asian subgroups, and the absence of representation of these groups in available clinical trials, cohort, and registry data that are currently used for risk estimation and treatment guidelines. The rise of genome-wide association studies to better discern high-risk individuals has the potential to further widen this gap—it is thus important to include racial/ethnic minorities to ensure that the benefits of technology and increased risk delineation are applied equitably. While increased understanding of and focus on specific risks and tailored interventions for Hispanics and South Asians are emerging, it still lags behind the current understanding of dyslipidemia in NHWs and African Americans. Treatment of dyslipidemia in Asian Americans also remains understudied.

The development of new drugs and technologies offer both promise and the risk of widened disparities in the management of dyslipidemia in racial/ethnic minorities. While statins remain the backbone of treatment for lipid disorders, data for and use of proprotein convertase subtilisin/kexin type 9 (PCSK9) inhibitors is rising, particularly for very high-risk subgroups. Given the high cost of this class of drugs, it is important to ensure that racial/ethnic minorities already vulnerable to disparities receive similar access to studies, consideration for treatment, and support in medication initiation and promotion of adherence. Information technology and mobile health interventions have also been shown to provide possible positive effect on reducing disparities at both the patient and provider levels, but will require cultural competence, language support, and cost-conscious pricing to avoid alienating minorities [53•, 69].

Acknowledgements

The authors would like to thank Dr. Connie Wong, MLIS, MPVM, DVM for her assistance with devising a search strategy for the literature review.

Compliance with Ethical Standards

Conflict of Interest
The authors declare that they have no conflicts of interest.

Human and Animal Rights Statement
All reported studies/experiments with human or animal subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

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