

Management of hypertension and dyslipidemia in Mexico: evidence, gaps, and approach

Manejo de la hipertensión y dislipidemia en México: evidencia, brechas y aproximaciones

Enrique C. Morales-Villegas^{1*}, Carlos Yarleque², and María L. Almeida³

¹Cardiometabolic Research Center at MAC Hospital, Aguascalientes, Mexico; ²Research, Development and Medical, Upjohn Division, Pfizer, Lima, Peru; ³Medical Affairs, Viatris Division, Pfizer, Mexico City, Mexico.

Abstract

Hypertension and dyslipidemia are key risk factors for cardiovascular disorders and mortality worldwide. To understand the local health system challenges faced in the management of the two conditions, a semi-systematic approach was adopted for quantifying stages of the journey of care of adult Mexican patients, namely, awareness, screening, diagnosis, treatment, adherence, and control. A structured literature search was conducted for articles published in English from 2010 to 2019 in EMBASE and MEDLINE databases. The articles restricted to patient subgroups, or not having national representativeness, thesis abstracts, letters to the editor, editorials, or case studies were excluded. In addition, an unstructured unrestricted literature search was conducted, on websites of Incidence and Prevalence Database, World Health Organization, Country's Ministry of Health, and Google. Last search was run on 28 August 2020 for Hypertension and 12 November 2019 for Dyslipidemia. Weighted or simple means were calculated for the pooled data. Seven articles of 647 retrievals for hypertension and 11 articles of 1265 retrievals for dyslipidemia were included in the review. The prevalence of hypertension was estimated to be 24.1%, while 59.9% of patients had awareness, 97.5% underwent screening, 18.4% had diagnosis, 50% received treatment, 50% were adherent to treatment, and 49.9% had disease control. Prevalence of dyslipidemia was estimated as 36.7%, while 8.6% of patients had awareness, 48.1% underwent screening, 28% had diagnosis, 68.9% received treatment, 50% were adherent to treatment, and 30% had disease control. The study suggested that addressing the synergistic effect of hypertension and dyslipidemia could reduce cardiovascular risk associated with these conditions.

Keywords: Cardiovascular disease. Dyslipidemia. Hypertension. Management. Mexico. Patient journey.

Resumen

La hipertensión y la dislipidemia -especialmente la hipercolesterolemia- son factores de riesgo cardiovascular que impactan directamente en la prevalencia e incidencia de enfermedades cardiovasculares en todo el mundo y México no es la excepción. Para comprender los desafíos que enfrenta el sistema de salud de nuestro país, especialmente en lo relacionado con el diagnóstico, tratamiento y control de los factores de riesgo cardiovascular mencionados, realizamos un análisis semi-sistemático de la literatura con el objetivo de evaluar las fases del proceso de atención de pacientes adultos mexicanos en lo relacionado con el conocimiento, detección, diagnóstico, tratamiento, adherencia y control de hipertensión y dislipidemia. Se

*Correspondence:

Enrique Morales-Villegas
E-mail: drmorvi@prodigy.net.mx

Date of reception: 24-10-2021

Date of acceptance: 11-02-2022

DOI: 10.24875/ACM.21000330

Available online: 29-03-2022

Arch Cardiol Mex. 2023;93(1):77-87

www.archivoscardiologia.com

2604-7063 / © 2022 Instituto Nacional de Cardiología Ignacio Chávez. Published by Permanyer. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

llevó a cabo una investigación bibliográfica semi-sistemática de los artículos publicados en inglés del año 2010 al año 2019; las bases de datos exploradas fueron EMBASE y MEDLINE. Se excluyeron del análisis los artículos sin representatividad nacional, así como los resúmenes de tesis, cartas al editor, editoriales o estudios de casos. Además, se realizó una búsqueda bibliográfica sin restricciones, en los sitios Web de las bases de datos sobre Incidencia y Prevalencia, Organización Mundial de la Salud, Secretaría de Salud de México y Google. La última búsqueda sobre hipertensión se realizó el 28 de agosto del 2020 y sobre dislipidemia el 12 de noviembre del 2019. Se calcularon las medias ponderadas o simples para la recolección de datos. En la revisión, se incluyeron 7 artículos de 647 sobre hipertensión y 11 artículos de 1,265 sobre dislipidemia. Se estimó que la prevalencia de hipertensión en México es de 24.1%; 97.5% de la población reportó haber sido sometida a alguna prueba de detección; 59.9% tuvo conocimiento del diagnóstico; 18.4 % se reconocen con hipertensión; 50% reciben tratamiento; 50% es adherente al mismo, y finalmente solo un 49.9 % tienen control de la hipertensión. Se estimó que la prevalencia de dislipidemia en México es de 36.7%; 48.1% de la población reportó haber sido sometida a alguna prueba de detección; 8.6% tuvo conocimiento del diagnóstico; 28% se conocen con dislipidemia; 68.9% reciben tratamiento; 50% es adherente al mismo, y finalmente solo 30% tuvo control de la dislipidemia. La evidencia revisada hace evidente una gran área de oportunidad para mejorar los índices de diagnóstico, tratamiento y control de estos dos factores sinérgicos para el riesgo de enfermedades cardiovasculares.

Palabras clave: Enfermedad cardiovascular. Dislipidemia. Hipertensión. Manejo. Mexico. Ruta del paciente.

Introduction

Cardiovascular disease (CVD) remains the leading cause of death globally and is an increasing contributor to disability and rising health care costs^{1,2}. Hypertension and dyslipidemia are key risk factors of CVD. The risk of CVD complications associated with co-existing hypertension and dyslipidemia are generally greater than the sum of the individual risk factors³. Worldwide, hypertension is estimated to cause 10.4 million deaths/year⁴, while dyslipidemia, especially high cholesterol levels, causes an average of 2.6 million deaths and 29.7 million disability-adjusted life years (DALYS)⁵. In Latin America (LATAM), CVDs contribute almost a million deaths annually⁶. Out of the estimated 1.13 billion people worldwide living with hypertension, most (two-thirds) live in low- and middle-income countries including the ones in LATAM⁷.

Dyslipidemia based on triglyceride levels in LATAM has been reported to range from 25.5% to 31.2%⁸, while hypertension ranges from 9% to 29% in select cities of South America⁹. The World Health Organization targets to reduce the prevalence of hypertension by 25% by 2025 (baseline 2010)⁷.

Hypertension, dyslipidemia, and diabetes have common pathophysiology related with overweight and obesity; hence, when co-existing in a person, they have a synergistic and negative effect on the cardiovascular health¹⁰. Hypertension and dyslipidemia co-exist in almost 15-31% of cases causing more than an additive adverse impact resulting into enhanced risk for atherosclerosis and CVDs¹¹. To reduce the combined burden of the two conditions, it is vital to comprehend local

health system challenges and the prevalent country-specific issues which contribute to the current state of poor control of these two conditions. Appropriate strategies for detection, diagnosis, treatment, and control are needed based on country-specific data to tackle these diseases together, which can compound into a major economic and social problem in a middle-income country like Mexico¹⁰.

Despite the government's attempts to provide health-care access to everyone, CVDs are the leading cause of death in Mexico¹². In spite of more than two decades of healthcare reform projects in Mexico, the universal coverage of care for non-communicable diseases such as hypertension, dyslipidemia, and diabetes suffers from large disparities and inequality in access^{13,14}. The percentage of people who have received plasma lipid measurement at least once and those who have received measurement of fasting lipids remains low. Many of the dyslipidemias are never enrolled in treatment programs¹⁴. The Mexican government has addressed non-communicable diseases through prevention plans, regulations, and policies (PRPs) that seek to address social and environmental factors. PRPs face a variety of challenges in terms of efficacy, the majority of which are linked to resources, implementation, and adherence. PRPs have also failed to adequately address the integration of individual, medical, social, pharmaceutical, and environmental approaches such as access to physical activity and healthy diet¹⁵. Unlike the multiple government and private systems in other countries, the government health system in Mexico is fragmented into multiple, parallel, and redundant health systems for different population groups (such as Health Maintenance Organizations,

indemnity health plans, and the like) which ends up creating incentives that maintain or increase inequity rather than channeling public resources to the most pressing needs¹⁶.

There is a scarcity of country-specific data with respect to hypertension and dyslipidemia in LATAM countries including Mexico, owing to lack of updated situational analysis to understand the current scenario and related issues⁹. To overcome this shortcoming and to reflect current status of healthcare provision, the authors adopted a patient journey approach based on the Mapping the Patient Journey Towards Actionable Beyond the Pill Solutions for Non-communicable Diseases (MAPS) methodology¹⁷. The current semi-systematic review aimed to synthesize country-specific data for hypertension and dyslipidemia in various stages of the patient disease journey including, awareness, screening, diagnosis, treatment, adherence, and control of these conditions in Mexico. The study also aimed to identify data gaps across patient journey touchpoints that can help mitigate cardiovascular risk and subsequent mortality in patients. This would give a ground for making recommendations for a better management of patients with hypertension and dyslipidemia.

Materials and methods

The current study was a semi-systematic review conducted for published articles describing patient journey stages for hypertension and dyslipidemia. The definitions used in the review are described in [table 1](#). Six steps were used to construct the evidence map: (1) developing a comprehensive search strategy; (2) establishing the inclusion and exclusion criteria; (3) screening and shortlisting; (4) supplementing with additional and/or local data; (5) data extraction and synthesis; and (6) evidence mapping.

Search strategy

A structured search was conducted on EMBASE and MEDLINE using OVID access for articles concerning the Mexico region published in English from 2010 till 2019, whose full text was available, except for conference abstracts. All types of articles were included except thesis abstracts, letters to the editor, and editorials.

Keywords used for the search included:

– Hypertension OR blood pressure (BP) OR hypertensives AND epidemiology OR prevalence OR

Table 1. Definitions of the terms used in the study

Criteria	Definitions
Hypertension	Hypertension was defined as % of respondents having average systolic blood pressure (SBP) ≥ 140 mmHg and/or average diastolic blood pressure (DBP) ≥ 90 mmHg
Hypercholesterolemia	Hypercholesterolemia was defined as total cholesterol (TC) of ≥ 5.0 mmol/L OR ≥ 200.0 mg/dL
Awareness	Self-reported or any prior diagnosis of high total serum cholesterol or hypertension by a healthcare professional
Screening	Proportion of respondents who had their cholesterol levels or blood pressure (BP) measured by a doctor or any other health worker
Diagnosis	Patients diagnosed with hypercholesterolemia disorder or hypertension by a healthcare professional
Treatment	Use of medications for management of the respondent's high cholesterol or high BP
Adherence	Proportion of respondents indicating adherence and/or compliance to the prescribed cholesterol lowering medications or BP medications
Control	Proportion of patients achieving a target cholesterol of ≤ 5.0 mmol/L OR ≤ 200 mg/dL with treatment or a target BP of $\leq 140/90$ mmHg with treatment

incidence OR national OR survey OR registry AND awareness OR knowledge OR health literacy OR screening diagnosis OR diagnosed OR undiagnosed OR treatment OR treated OR untreated OR control OR controlled OR uncontrolled OR adherence OR compliance OR adhere OR therapy OR non-adherence AND Mexico.

– Dyslipidemia OR hypercholesterolemia OR cholesterol OR triglycerides OR LDL AND epidemiology OR prevalence OR incidence OR national OR survey OR registry OR Statistics AND health literacy OR screening OR awareness OR knowledge OR treated OR treatment OR diagnosis OR undiagnosed OR diagnosed OR therapy OR controlled OR control OR uncontrolled OR adherence OR adhere OR compliance AND Mexico OR Brazil OR Argentina OR Latin America.

To address data gaps in the structure search, an unstructured literature search was conducted without

any restrictions, on the websites of Incidence and Prevalence Database (IPD), World Health Organization (WHO), Mexican Ministry of Health, and Google. Last search was run on 28 August 2020 for hypertension and 12 November 2019 for dyslipidemia.

Inclusion/exclusion criteria and screening of articles:

Articles identified from the semi-systematic database search were eligible for inclusion if they met the following criteria were: (1) systematic review and/or meta-analysis, randomized controlled study, observational study, narrative reviews (both full-text articles published and conference abstracts), (2) concerning adult populations with the age of ≥ 18 years old, (3) reporting quantitative data from patients' journey touchpoints for hypertension and dyslipidemia, including awareness, screening, diagnosis, treatment, adherence and control, and (4) conducted on patient populations focusing exclusively on hypertension and dyslipidemia.

Articles related to specific patient subgroups, without nationally representative populations, thesis abstract, letters to the editor, editorials, or case studies were initially excluded from the review. In case patient journey data was not available from included articles, articles representative of the entire region and belonging to patient subgroups were included in the review. Furthermore, any identified data gaps were supplemented with publications in local languages and anecdotal data from authors who were also the local clinical experts.

An independent reviewer conducted the semi-systematic literature search to extract data from both structured and unstructured search. The titles and abstracts of the retrieved publications were screened against the inclusion and exclusion criteria. A second independent reviewer assessed these search results based on study title, article citation, author names, year of publication, abstract, study design, study participants, and study setting of the retrieved search publications and excluded the non-relevant publications. Any disagreements were reconciled by discussions among the reviewers and co-authors.

Data extraction and analysis

Relevant data from the included articles were exported to Microsoft Excel by the reviewers and was verified by the co-authors to maintain consistency. The synthesized evidence was represented as an evidence gap

map followed by synthesis. Anecdotal data was considered for adherence for the prescription of hypertension.

Data from the included articles with respect to the patient journey touchpoint such as prevalence, awareness, screening, diagnosis, treatment, adherence, and control of hypertension and dyslipidemia were pooled and synthesized by weighted or simple means to minimize bias arising from the methodological limitations of different studies. A summary of outcomes is visually presented in the form of a tabular summary of outcome results.

Results

Overview of the included studies

For hypertension, 639 articles from structured search and eight articles from unstructured search were retrieved, including three articles suggested by authors of this review who are key opinion leaders or experts of the subject in the country. Two articles from structured and five articles from unstructured searches were included in the final data synthesis including two articles suggested by authors. These articles included three reports, one secondary data analysis, one position paper, one cross-sectional study, and one comparative analysis of national surveys.

For dyslipidemia, 1258 articles from structured search and seven articles from unstructured search, including three articles suggested by authors, were retrieved. Six articles from structured and five records from unstructured searches were included in the final data synthesis; including three articles suggested by authors. These articles included four reports, four secondary data analyses of surveys, one secondary data analysis of registry data, one cross-sectional study, and one visualization tool.

The flow of the articles through the review is depicted in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow chart is presented in [figure 1](#) and [table 2](#).

Mapping the evidence

The total population of Mexico was estimated to be 127,576,000. Health literacy in Mexico, as assessed in a subset of adults aged ≥ 20 years old, was reported to be 18%. Pooled estimates for hypertension and dyslipidemia prevalence were 24.1% and 36.7%, respectively. The synthesized evidence

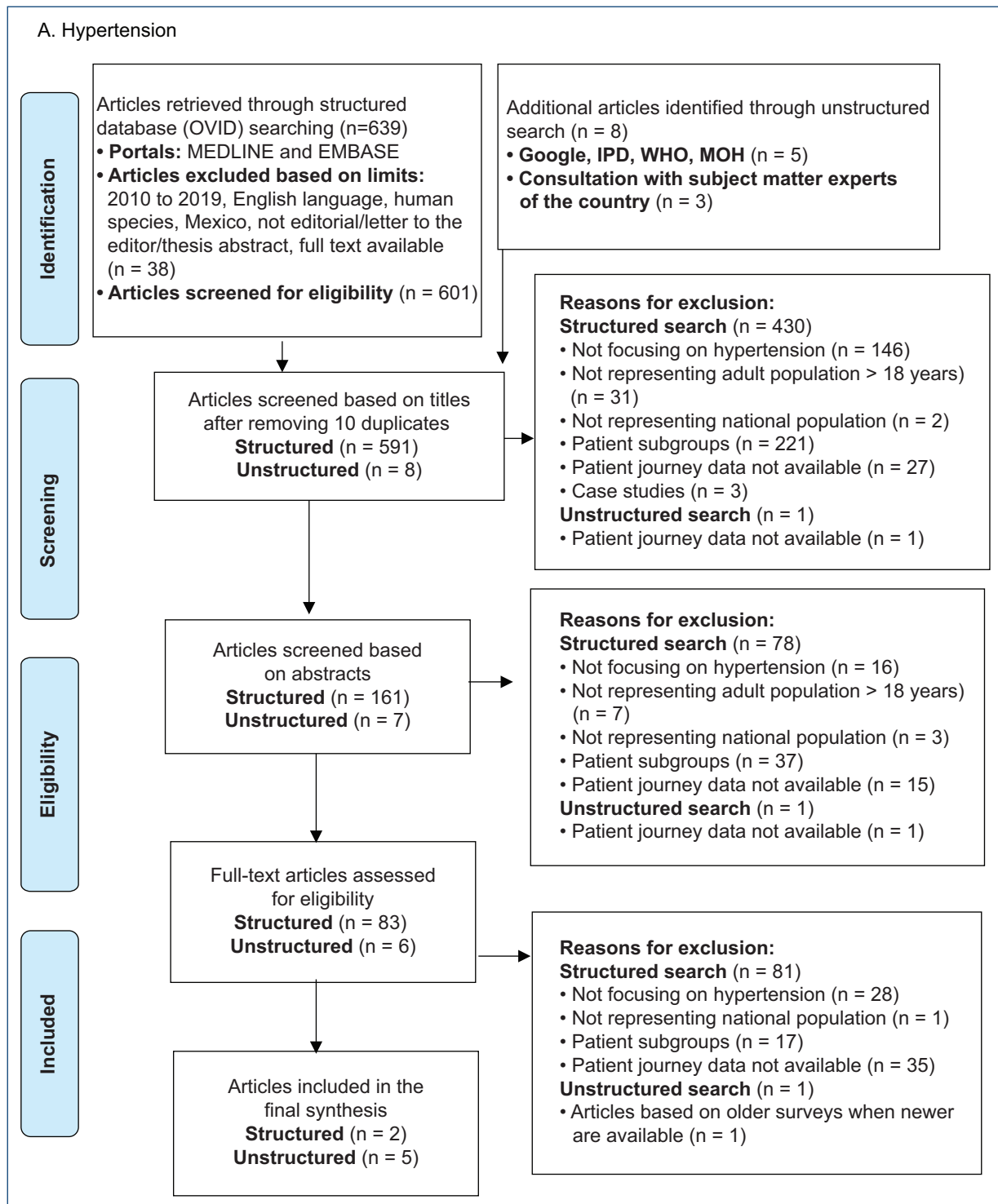


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram showing flow of articles. IPD: incidence and prevalence database; WHO: World Health Organization; MOH: Ministry of Health.

(Table 3) indicated that 97.5% underwent screening, 59.9% of patients had awareness of hypertension, 18.4% had hypertension diagnosis, 50% received treatment, 50% were adherent to treatment, and

49.9% had disease control. Similarly, the prevalence of dyslipidemia was estimated as 36.7%, while 48.1% underwent screening, 8.6% of patients had awareness, 28% had dyslipidemia diagnosis, 68.9%

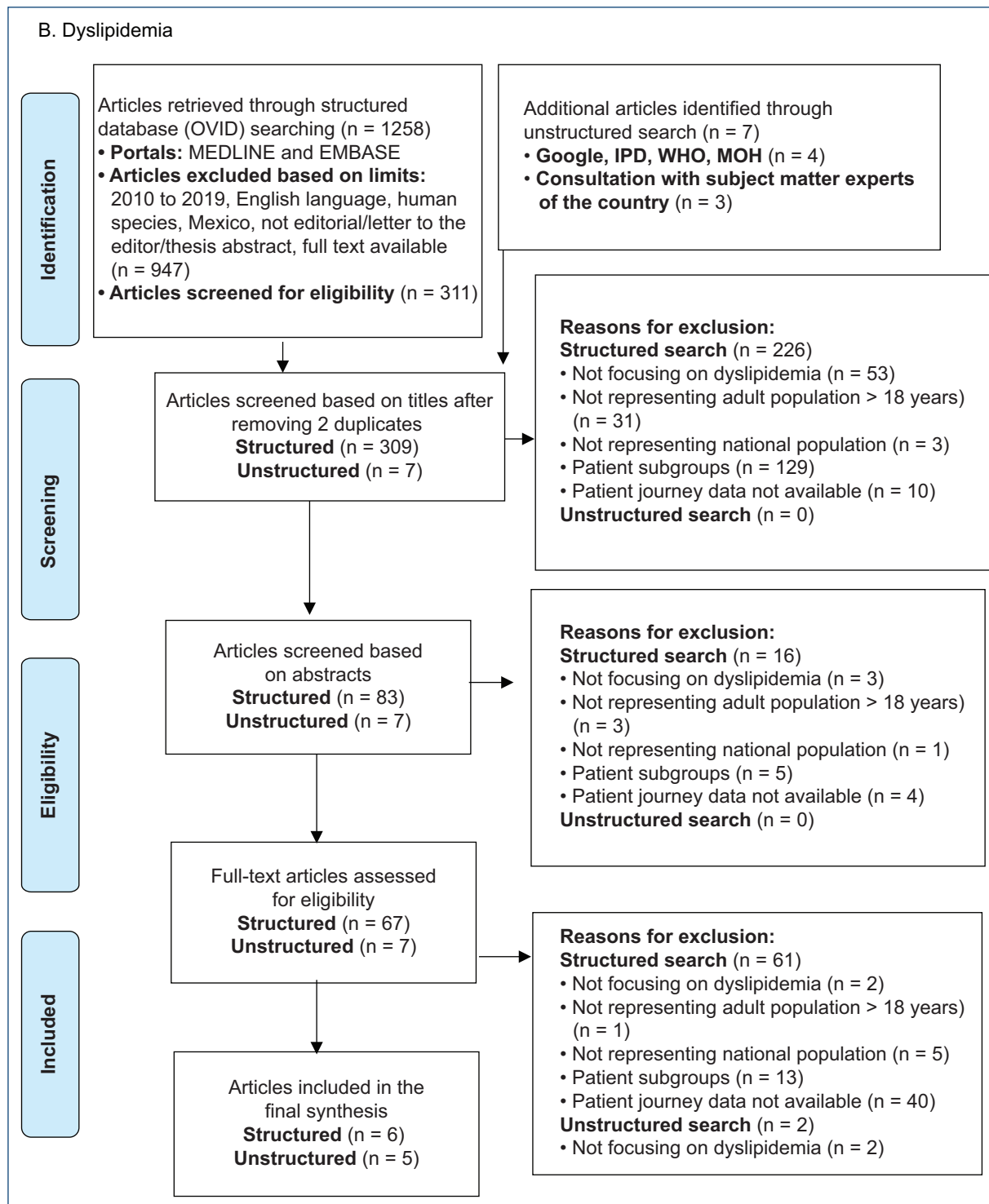


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram showing flow of articles. IPD: incidence and prevalence database; WHO: World Health Organization; MOH: Ministry of Health (Continued).

received treatment, 50% were adherent to treatment, and 30% had disease control (30%). No data was available for adherence in the published literature.

As per the co-authors opinion and anecdotal evidence, adherence was estimated to be 50% for both conditions.

Table 2. Description of the included studies

S.No.	Author/title	Year	Sample size	Patient journey touchpoints
Hypertension				
1	Nayu Ikeda et al. ²⁰	2014	11,406/21,230	Prevalence (14.8%/29.5%) Diagnosis (49.4%/55.8%) Treatment (40.9%/49.5%) Control (27.1%/28%)
2	Global Status Report on Noncommunicable Diseases 2014 ³²	2014	12,03,55,000	Prevalence (20%)
3	ENSANUT 2016 ^{10,20}	2016	8,352	Prevalence (25.5%) Awareness (60%) Diagnosis (59.6%) Treatment (79.3%) Control (45.6%)
4	ENSANUT 2018 ^{10,20}	2018	8,27,00,000	Diagnosis (18.4%)
5	Lloyd-Sherlock et al. ²²	2014	2,281	Prevalence (58.2%) Awareness (44.6%) Control (11.8%)
6	Hernandez-Hernandez et al. ²³	2010	1,722	Prevalence (11.7%) Screening (97.5%) Diagnosis (24.3%) Treatment (65.7%) Control (41%)
7	Alcocer et al. ¹⁰	2019	8,50,00,000	Prevalence (30%) Awareness (60%) Treatment (50%) Control (50%)
8	Anecdotal data (na)			Adherence (50%)
Dyslipidemia				
1	WHO GHV Visualizations Tool ⁵	2008	11,08,15,000	Prevalence (49.5%)
2	Aguilar-Salinas et al. ^{2,24}	2010	4,040	Prevalence (43.6%) Awareness (8.6%)
3	Gaxiola et al. ²⁶	2010	837	Prevalence (57.8%)
4	Incidence and Prevalence database ⁵	2019	1,179/96,031	Prevalence (48.7%/30.6%)
5	Gomez-Perez et al. ^{2,24}	2010	4,040	Awareness (8.6%) Control (30%)
6	ENSANUT 2018 ^{10,20}	2018	8,27,00,000	Prevalence (19.5%)
7	Vinueza et al. ²⁷	2010	1,722	Prevalence (16.4%) Treatment (22%)
8	Gakidou et al. ⁴	2011	45,446	Prevalence (35%)
9	Rivera-Hernandez et al. ¹²	2015	11,405	Screening (34.92%)
10	ENSANUT 2016 ^{10,20}	2016	8,412	Screening (44.5%) Diagnosis (28%)
11	ENSANUT 2012 ^{10,20}	2012	96,031	Screening (49.9%) Treatment (69.8%)

ENSANUT: National Health and Nutrition Survey; WHO: World Health Organization; GHV: Global Health Observatory.

Discussion

Lack of actionable data is a cause of concern for deriving meaningful conclusions. For hypertension as

well as dyslipidemia, screening, awareness, diagnosis, and treatment were quantified as low. Despite the high screening rate for hypertension, the diagnosis was not always established. This may be due to underreporting

Table 3. Pooled data of included articles for patient journey stages for hypertension and dyslipidemia

Condition	Prevalence	Awareness	Screening	Diagnosis	Treatment	Adherence	Control
Hypertension	24.1% ^{*a}	59.9% ^{*a}	97.5% ^a	18.4% ^{*a}	50.0% ^{*a}	50% ^b	49.9% ^{*a}
Dyslipidemia	36.7% ^{*a}	8.6% ^a	48% ^{*a}	28% ^a	69% ^{*a}	No data	30% ^a

^{*}Weighted Average; ^aPublished Data; ^bExpert Opinion Only.

This table shows a high Hypertension and Dyslipidemia prevalence. However, the awareness and screening are higher for Hypertension opening an opportunity window to increase screening and in consequence awareness for Dyslipidemia. This table also shows insufficient data about adherence, Hypertension adherence data is extrapolated of expert opinion and Dyslipidemia adherence is unknown; both are relevant opportunity areas for research.

of hypertension in Mexico due to lack of standardized definitions and cut-offs for both the conditions. According to the Mexican Norm of Hypertension (“Proyecto para la Norma Oficial Mexicana” NOM-030-SSA2-2016), $\geq 140/\geq 90$ mmHg is defined as hypertension. Recently the American College of Cardiology and American Heart Association guidelines defined hypertension if BP is $\geq 130/\geq 80$ mmHg, while the 2018 European Society of Cardiology and European Society of Hypertension guidelines preserve the $\geq 140/\geq 90$ mmHg criteria for the hypertension diagnosis^{10,18,19}. The multitude of definitions of high BP which healthcare practitioners use for hypertension in Mexico leads to inconsistencies in diagnosis¹⁰. For example, in the 2012 National Health and Nutrition Survey (ENSANUT or “Encuesta Nacional de Salud y Nutrición” 2012), the criteria for hypertension was $\geq 135/\geq 85$ mmHg (criteria used for metabolic syndrome) whereas it was $\geq 140/\geq 90$ mmHg in the 2018 National Health and Nutrition Survey (ENSANUT 2018)^{10,20}. Further, the heterogeneity in the measuring devices like oscilometric and mercury sphygmomanometer leads also to significant variations in diagnosis and prevalence.

Moreover, diagnostic criteria for hypercholesterolemia, which was taken as a proxy for dyslipidemia, have varied heavily from 200 mg/dL to 220 or 240 mg/dL and need standard and updated criteria for diagnosis. There is a strong need for a standardized protocol to measure BP and total cholesterol and fractions levels even in surveys²⁰. Heterogeneity and low knowledge and compliance to the practicing guidelines by practitioners is another matter of concern; “Official Mexican Norms” (Normas Oficiales Mexicanas) for hypertension and dyslipidemia have not been revised for a long time and are currently under review²¹.

The review noted that the prevalence of hypertension increased sharply with age, was associated with the poorer sections of the society, and in women^{22,23}. Southern Mexico has high prevalence of hypertensive adults who are untreated whereas northern Mexico has

high prevalence of dyslipidemia. Hence, region-specific strategies are needed to counter CVD risk²⁴. Recently an increasing rural awareness was also reported, which may be a consequence of an effective intervention like Mexico’s Popular Health Insurance Program²².

Cardiovascular risk due to combined effect of hypertension and dyslipidemia

The synergistic action of more than one risk factor in an individual, such as including hypertension and dyslipidemia, leads to atherosclerotic disease (detected via ultrasonography of carotids and femoral arteries) correlating it to cardiac or cerebrovascular damage²³, such as myocardial infarction, stroke, and other CVDs, and causes subsequent high mortality in Mexico¹⁰. Cardiovascular risk stratification indicates that most of the hypertensive population have concomitant risk factors²³. The risk scales utilized in Mexico are SCORE, Framingham Risk Score, and more recently introduced Pooled Cohort Equation. Other algorithms as Globorisk and Interheart methods are not used uniformly and usually utilized for patient subgroups only²⁵. This necessitates the uniform use of cardiovascular risk scales which may enable stratification of the patients based on combined risk from multiple variables.

Although articles report that patients receive cardiovascular risk management, the 1-year cardiovascular event rate remains high, indicating a need for adherence and persistence to evidence-based treatment of cardiovascular risk factors and disease²⁶. In spite of vast evidence on the effectiveness of cholesterol reduction in cardiovascular risk reduction, reports show low rates of prescription of lipid-lowering therapy²⁷, that poses a major challenge. Despite CVDs being the leading cause of mortality in Mexico, it is estimated that only 4% of total health expenditure was spent on CVDs in 2015²⁴. Around 7.9 million people need long-life treatment with statins in Mexico, which might prove to be a major economic load²⁸.

Estimates suggest that 11.9 million adults need a physician and a dietitian for pharmacologic and nutrition therapy, respectively, while the current number of patients availing diagnosis and treatment of dyslipidemia is inadequate²⁸. Unclear position about non-pharmacological interventions in this regard remains another challenge²⁹.

Mexican public health institutions aid in providing diagnostic tests and treatment for hypertension and dyslipidemia. Most of the population has access to public health insurance (formerly *Seguro Popular*, currently Instituto de Salud para el Bienestar or INSABI or Institute of Health for the Well-Being). Even then, reports show a significant usage of preventive and screening services with respect to cholesterol and hypertension in this insurance¹². However, low level of adherence among the Mexicans coupled with unhealthy nutrition, sedentary lifestyle and obesity negates the impetus achieved²⁴.

Poor quality and access to care in the public health institutions results due to difficulty in fixing appointments, distance to clinics, as well as dearth of medical personnel and facilities¹². This leads the population to private care and out-of-pocket spending for hypertension and dyslipidemia treatment³⁰. Around 25% of patients acquire the treatment in pharmacy and medical offices, and another 25% reach out to private practitioners or specialists. Overall, 80% of the Mexicans are treated by general practitioners and 20% by specialists^{10,30}.

Suggested interventions for reducing cardiovascular risk

The high prevalence of co-morbid factors like hypertension, dyslipidemia, and diabetes in Mexicans highlights the need for aggressive cardiovascular risk reduction through pharmacologic therapy and lifestyle modifications²⁶. There is a huge benefit of providing integrated, evidence-guided, long-term, and oversighted care of multiple cardiovascular risk factors. The need to detect, treat and control optimally all of the risk factors at the same time through innovative solutions is recommended³¹. Strategies aimed at early intervention with an inclusive assessment of hypertension, dyslipidemia, and other comorbidities are crucial in curtailing CVD effectively^{10,27}. Good quality and combination therapies in line with updated guidelines to treat hypertension and dyslipidemia will improve the acceptance, adherence, persistence, and in consequence control of these risk factors¹⁰.

The benefits of early diagnosis and free services offered by the government through public health

insurance need highlighting¹². Importantly, the Mexican healthcare system should incorporate methods to ensure adherence and persistence to the therapy²⁸. Government media advertisements are needed to reach people with low adherence and persistence levels. Brief and campaign-based government initiatives may not be as effective as new initiatives with an extensive, sustained, and oversighted population reach vision. These will also help to alleviate the social aspect of medical issues like CVDs. Mexican Institute of the Social Security (IMSS) has implemented a preventive model for non-communicable chronic diseases. It has educational programs for adult risk factors and is implementing an educational model in children for lifestyle modification³¹. Effective lifestyle modifications such as healthy diet and physical activity help to alleviate the ripple effect of high BP and dyslipidemia on the overall body mass index²². Mexicans must be educated and empowered on their responsibility about their health status and the importance of non-pharmacological measures to counter cardiovascular risk, such as wholesome nutrition and adequate physical activity¹⁰.

Accuracy in data can be achieved by considering nationally representative surveys in which BP and lipid levels were measured and not self-reported³². There is a strong need to have standardized modules to measure BP and blood lipids. These should include guidelines for training personnel on technique and equipment¹⁰. Devices used to measure BP and lipids should be checked for standard certifications to aid in effective diagnosis and management¹⁰.

Medical education should extensively teach treatment of hypertension and dyslipidemia. As patients' first contacts, primary care physicians and specialists should provide preventive therapy also²⁸. There is a need for training physicians for early categorization and stratification of cardiovascular risk based on established scales like atherosclerotic CVD risk score. Ideally, Mexican Government should initiate population-based research in order to have a national scale for risk stratification of risk (cerebral, cardiac, and renal). Continuing medical education programs for the first contact physicians and private practitioners on the end-to-end management of hypertension and dyslipidemia need to provide more comprehensive information and need to be conducted more frequently¹⁰.

Study limitations

Limited data were available for patient journey touch-points despite a comprehensive search. The review

was unable to find data on adherence of both hypertension and dyslipidemia. This study tries to talk about patient journey in the two indications, and basis the gap, it is recommended that both are addressed individually. However, we also need to be cognizant of the fact that many patients with hypertension may have underlying dyslipidemia too.

Conclusions

Quantification of patient journey stages revealed sub-optimal status of care for hypertension and dyslipidemia in Mexico. An early, integrated, evidence-based, long-term, and oversight approach to counter cardiovascular risk is urgently required for dealing with the synergistic effect of cardiovascular risk factors such as hypertension and dyslipidemia. Solutions should be drawn, keeping in mind the net-benefit concept, economic and social background of a middle-income country like Mexico.

Authors contributions

Enrique Morales contributed in conceptualization, validation, formal analysis, investigation, data curation, writing the original draft, reviewing and editing manuscript, visualization, and supervision. Carlos Yarleque contributed in conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing the original draft, reviewing and editing the manuscript, visualization, supervision, project administration, and funding acquisition. María L. Almeida contributed in conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing the original draft, reviewing and editing the manuscript, visualization, supervision, project administration, and funding acquisition.

Acknowledgments

Medical writing support was provided by Medical Writer/Reviewer at Indegene. The authors would also like to thank Utsavi Samel and Kaveri Sidhu from Pfizer Upjohn for their support in data mining and reviewing of the manuscript, respectively.

Funding

The study was funded by Viatriis.

Conflicts of interest

Dr. Enrique Morales received from Viatriis in past 36 months: payment or honorarium for lectures and presentations, support for attending meetings and travel, consulting fee, and payment for expert testimony. He is on speaker's bureau for Viatriis, has acted as CME organizer, and has participated on Data Safety Monitoring Board and Advisory Board for Viatriis.

Dr. Carlos Yarleque and Dr. María L. Almeida declare no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

References

1. World Health Organization. Cardiovascular Diseases. Geneva: World Health Organization; 2021. Available from: https://www.who.int/health-topics/cardiovascular-diseases/#tab=tab_1 [Last accessed on 2021 Jun 07].
2. World Health Organization. World Heart Federation, World Stroke Organization. Global Atlas on Cardiovascular Disease Prevention and Control. Geneva: World Health Organization; 2011. Available from: <https://www.who.int> [Last accessed on 2021 Jun 07].
3. Dyslipidemia an Overview. ScienceDirect; 2018. Available from: <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/dyslipidemia> [Last accessed on 2021 Jun 07].
4. Stanaway JD, Afshin A, Gakidou E, Lim SS, Abate D, Abate KH, et al. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the global burden of disease study. *Lancet*. 2018;392:1923-94.
5. World Health Organization. Global Health Observatory Data. Mean Cholesterol. Geneva: World Health Organization; <https://www.who.int/data/gho/indicator-metadata-registry/imr-details/3236> (aCCESSED september 20, 2020).
6. Lanas F, Serón P, Lanas A. Cardiovascular disease in Latin America: The growing epidemic. *Prog Cardiovasc Dis*. 2014;57(3):262-7.
7. World Health Organization. Hypertension Factsheet. Geneva: World Health Organization; 2021. Available from: <https://www.who.int/news-room/fact-sheets/detail/hypertension> [Last accessed on 2020 Oct 19].
8. Ponte-Negretti CI, Isea-Perez JE, Lorenzatti AJ, Lopez-Jaramillo P, Wyss-Q FS, Pintó X, et al. Atherogenic dyslipidemia in Latin America: prevalence, causes and treatment: expert's position paper made by the Latin American academy for the study of lipids (ALALIP) endorsed by the inter-American society of cardiology (IASC), the South American society. *Int J Cardiol*. 2017;243:516-22.
9. Rubinstein AL, Irazola VE, Calandrelli M, Chen CS, Gutierrez L, Lanas F, et al. Prevalence, awareness, treatment, and control of hypertension in the Southern cone of Latin America. *Am J Hypertens*. 2016;29:1343-52.
10. Alcocer L, Álvarez-López H, Borrayo-Sánchez G, Cardona-Muñoz E, Chávez-Mendoza A. Hypertension as a persistent public health problem. A position paper from alliance for a healthy heart, Mexico. *Ann Clin Hypertens*. 2019;3:9-30.
11. Gulati A, Dalal J, Padmanabhan TN, Jain P, Patil S, Vasawala H. Lipid-tension: interplay between dyslipidemia and hypertension. *Indian J Endocrinol Metab*. 2012;16:240.

12. Rivera-Hernandez M, Galarraga O. Type of insurance and use of preventive health services among older adults in Mexico. *J Aging Health*. 2015;27:962-82.
13. Arredondo A, Azar A, Recaman AL. Challenges and dilemmas on universal coverage for non-communicable diseases in middle-income countries: evidence and lessons from Mexico. *Global Health*. 2018;14:89.
14. Rivas-Gomez B, Almeda-Valdés P, Tussíé-Luna MT, Aguilar-Salinas CA. Dyslipidemia in Mexico, a call for action. *Rev Invest Clin*. 2018;70:211-7.
15. Aceves B, Ingram M, Nieto C, de Zapien JG, Rosales C. Non-communicable disease prevention in Mexico: policies, programs and regulations. *Health Promot Int*. 2020;35:409-21.
16. Barraza-Lloréns M, Bertozzi S, González-Pier E, Gutiérrez JP. Addressing inequity in health and health care in Mexico. *Health Aff*. 2002;21:47-56.
17. Tanaya B, Devi R, Huang PH, Javed A, Jeffers B, Lansberg P, et al. A methodology for mapping the patient journey for noncommunicable diseases in low-and middle-income countries. *J Healthc Leadersh*. 2021;13:35-46.
18. Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: A report of the American College of Cardiology/American Heart association task force on clinical practice guidelines. *J Am Coll Cardiol*. 2018;71:e127-248.
19. Williams B, Mancia G, Spiering W, Rosei EA, Azizi M, Burnier M, et al. 2018 ESC/ESH guidelines for the management of arterial hypertension. *Eur Heart J*. 2018;39:3021-104.
20. Ikeda N, Sapienz D, Guerrero R, Aekplakorn W, Naghavi M, Mokdad AH, et al. Contrôle de l'hypertension sous médication: une analyse comparative des enquêtes nationales dans 20 pays. *Bull World Health Organ*. 2014;92:10-9.
21. Mexico: Regulatory Background Transport Policy. Available from: <https://www.transportpolicy.net/standard/mexico-regulatory-background> [Last accessed on 2020 Oct 19].
22. Lloyd-Sherlock P, Beard J, Minicuci N, Ebrahim S, Chatterji S. Hypertension among older adults in low-and middle-income countries: prevalence, awareness and control. *Int J Epidemiol*. 2014;43:116-28.
23. Hernández-Hernández R, Silva H, Velasco M, Pellegrini F, MacChia A, Escobedo J, et al. Hypertension in seven Latin American cities: The cardiovascular risk factor multiple evaluation in Latin America (CARME-LA) study. *J Hypertens*. 2010;28:24-34.
24. Mendoza-Herrera K, Pedroza-Tobías A, Hernández-Alcaraz C, Ávila-Burgos L, Aguilar-Salinas CA, Barquera S. Attributable burden and expenditure of cardiovascular diseases and associated risk factors in Mexico and other selected mega-countries. *Int J Environ Res Public Health*. 2019;16:4041.
25. Galarza-Delgado DA, Azpiri-Lopez JR, Colunga-Pedraza IJ, Cardenas-de la Garza JA, Vera-Pineda R, Serna-Peña G, et al. Assessment of six cardiovascular risk calculators in Mexican mestizo patients with rheumatoid arthritis according to the EULAR 2015/2016 recommendations for cardiovascular risk management. *Clin Rheumatol*. 2017;36:1387-93.
26. Gaxiola E, Eng-Ceceña L, Ortiz-Galván F, Lamas-López L, Rangel-Guerra R, Alcocer Gamba MA, et al. Assessment of atherothrombosis and its treatment in Mexico: first-year data of the REACH registry. *Clin Cardiol*. 2010;33:445-51.
27. Vinuesa R, Boissonnet CP, Acevedo M, Uriza F, Benítez FJ, Silva H, et al. Dyslipidemia in seven Latin American cities: CARMELA study. *Prev Med (Baltim)*. 2010;50:106-11.
28. Prevention of Cardiovascular Disease Based on Lipid Lowering Treatment: A Challenge for the Mexican Health System. Available from: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0036-36342010000700009 [Last accessed on 2020 Oct 19].
29. Borrayo-Sánchez G. What is new in hypertension of Mexico 2018? Impact of the new classification of high blood pressure in adults from American College of Cardiology/American Heart Association (ACC/AHA). *Ann Clin Hypertens*. 2018;2:24-30.
30. OECD Reviews of Health Systems: Mexico. OECD; 2016 (OECD Reviews of Health Systems). Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/oecd-reviews-of-health-systems-mexico-2016_9789264230491-en [Last accessed on 2020 Oct 19].
31. Rosas-Peralta M, Borrayo-Sánchez G, Ramírez-Arias E, Jiménez-Genchi GM, Alicia Hernández-González M, Barraza-Félix R, et al. Annals of Clinical Hypertension Cardiovascular Risk Reduction: past, Present and Future in Mexico; 2018. Available from: <https://doi.org/10.29328/journal.ach.1001010> [Last accessed on 2020 Oct 19].
32. Global Status Report on Noncommunicable Diseases. Attaining the Nine Global Noncommunicable Diseases Targets; A Shared Responsibility; 2014.