Global prevalence and trends in hypertension and type 2 diabetes mellitus among slum residents: a systematic review and meta-analysis

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ABSTRACT

Objective First, to obtain regional estimates of prevalence of hypertension and type 2 diabetes in urban slums; and second, to compare these with those in urban and rural areas.

Design Systematic review and meta-analysis.

Eligibility criteria Studies that reported hypertension prevalence using the definition of blood pressure ≥140/90 mm Hg and/or prevalence of type 2 diabetes.

Information sources Ovid MEDLINE, Cochrane CENTRAL and EMBASE from inception to December 2020.

Risk of bias Two authors extracted relevant data and assessed risk of bias independently using the Strengthening the Reporting of Observational Studies in Epidemiology guideline.

Synthesis of results We used random-effects meta-analyses to pool prevalence estimates. We examined time trends in the prevalence estimates using meta-regression regression models with the prevalence estimates as the outcome variable and the calendar year of the publication as the predictor.

Results A total of 62 studies involving 108 110 participants met the inclusion criteria. Prevalence of hypertension and type 2 diabetes in slum populations ranged from 4.2% to 52.5% and 0.9% to 25.0%, respectively. In six studies presenting comparator data, all from the Indian subcontinent, slum residents were 35% more likely to be hypertensive than those living in comparator rural areas and 30% less likely to be hypertensive than those from comparator non-slum urban areas.

Limitations of evidence Of the included studies, only few studies from India compared the slum prevalence estimates with those living in non-slum urban and rural areas; this limits the generalisability of the finding.

Introduction Non-communicable diseases (NCDs) are currently the leading cause of death globally; even in low/middle-income countries (LMICs), the burden of disease is shifting from infectious diseases to NCDs. NCDs now account for about 41 million deaths annually, corresponding to nearly 7 in 10 of all deaths worldwide. Every year, 15 million people of ages 30–69 years die from these diseases, more than 85% of which are people living in LMICs. Most of the deaths from NCDs are caused by cardiovascular diseases, followed by cancer and respiratory diseases. NCDs affect people in all age groups, countries and geographical regions. The leading causes of these diseases include increased consumption of unhealthy foods, increased physical inactivity and population ageing. These factors are mediated through metabolic risk factors for NCDs, the most common of which include hypertension and type 2 diabetes.

Urbanisation is a global phenomenon that is occurring at a fast pace in most LMICs. For more than 20 years, urban settlements have been increasing in population size because of fast growth in urban births, significant movement of people from rural areas and sustained integration of the global economy. The United Nations defines slums as urban areas with overcrowding,
poor sanitation infrastructure, limited access to safe water, and/or poor structural quality of housing.\textsuperscript{7,8} Slums are now an important component of today's urban settlements and likely continue to be for the foreseeable future.\textsuperscript{7,8}

Despite increased global awareness about the presence and persistence of slums, and evidence that their populations are affected by different health problems and needs to other urban inhabitants, the health of their inhabitants is under-researched.\textsuperscript{7–10} The health of the urban poor, people with low socioeconomic status living in urban areas, is usually conflated with that of slum residents. Although there is substantial overlap between these groups, there are also richer residents within slum neighbourhoods, as well as urban poverty occurring in non-slum urban areas. Health outcomes for these two groups may differ depending on whether deprivation is at the individual (urban poverty) or neighbourhood level (slum resident) due to neighbourhood effects.\textsuperscript{7,8,11,12} For example, with respect to NCD risk factors, those residents in slums, whatever their personal socioeconomic status, may be more exposed to common physical environmental risk factors (for example: air pollution increasing risk of hypertension), social environmental risk factors (for example: crime rates which may increase stress and drive metabolic risk) or institutional risk factors (for example: stigma on the basis of their address reducing access to appropriate medical care). Many existing studies of NCD risk factors done in urban areas do not disaggregate the population’s health data by slum and non-slum status to allow for the detection of intraslab urban health disparities that are due to neighbourhood effects rather than individual socioeconomic status.\textsuperscript{13–22}

Understanding how the global challenges of hypertension, type 2 diabetes and rapid unplanned urbanisation intersect, by investigating whether the up to 1 billion people residing in slums\textsuperscript{23} are succumbing to these important metabolic risk factors for NCD, will inform priorities for health services and health policy in LMICs. To fill this research gap, we therefore systematically gathered all the publications that relate to the burden of hypertension among slum residents to (1) assess the contemporary prevalence estimates of hypertension among slum residents; (2) compare the prevalence of hypertension and type 2 diabetes in slums with those in two other types of settlement, that is, non-slum urban and rural areas; and (3) assess the proportion of those with hypertension who were aware of their hypertensive status, those on treatment and those with blood pressure (BP) under control.

**METHODS**

**Protocol and registration**

The study background, rationale, and methods were specified in advance and documented in a protocol that was published in the PROSPERO register (CRD42017077381).

**Search and information sources**

We searched Ovid MEDLINE, Cochrane CENTRAL and EMBASE from inception to December 2020 using the following keywords: slum, shanty town, ghetto, hypertension and type 2 diabetes. The search strategy for MEDLINE is shown in online supplemental annex 1.

**Eligibility criteria**

We evaluated each identified study against the following predefined selection criteria:

- **Types of studies**: we included all studies (cross-sectional studies, retrospective or prospective cohort studies) that reported prevalence of hypertension and type 2 diabetes mellitus among slum residents as a primary or secondary outcome. No language, publication date or publication status restrictions were imposed.

- **Types of participants**: adult population (18 years and above) living in slums (as defined by the authors of the original studies included).

- **Types of interventions**: not applicable.

- **Types of outcomes**: essential hypertension (also called primary or idiopathic hypertension), defined as persistent (seated) systolic BP (SBP) of 140 mm Hg or greater or had diastolic BP (DBP) 90 mm Hg or greater regardless of age and sex. We excluded studies that included subjects with pregnancy-induced, pre-eclampsia, malignant, portal, pulmonary, renal, intracranial or ocular hypertension. We also excluded studies that used only self-reported measure, that is, deductible from the use of antihypertensive drugs or self-reported physician-diagnosed cases. If data were available, we noted (1) the percentage of those aware of their hypertension status, (2) on any antihypertensive treatment and (3) BP controlled to a target level. Awareness of hypertension was defined as self-reporting of any prior diagnosis of hypertension by a healthcare professional. Treatment of hypertension was defined as receiving prescribed antihypertensive medication for management of high BP at some time in the 1 year preceding the survey. Control of hypertension was defined as the proportion of patients reporting antihypertensive therapy with SBP of less than 140 mm Hg and DBP of less than 90 mm Hg.

Type 2 diabetes was defined based on measured fasting plasma glucose, or oral glucose tolerance test. Type 2 diabetes was diagnosed if the fasting blood glucose was ≥126 mg/dL (≥7.0 mmol/L) after an overnight fast for at least 8 hours, or random capillary blood glucose of ≥11.1 mmol/L or if the participant was taking treatment for type 2 diabetes.

**Study selection**

Two reviewers (OAU, AA) independently evaluated the eligibility and methodological quality of the studies obtained from the literature searches. All articles yielded by the database search were initially screened by their titles and abstracts to obtain studies that met inclusion criteria. In cases of discrepancies, agreement was reached.
by discussion with a third reviewer. Two reviewers (OAU, AA) independently evaluated the full-text articles of all identified citations to establish relevance of the article according to the prespecified criteria. In cases of discrepancies, agreement was reached by discussion with a third reviewer.

Data collection process and data items
OAU extracted data, and AA and OO checked the extracted data. For each study that met the selection criteria, details extracted included year of publication, country of origin, study design, sample size, sampling strategy, study period, setting (rural/urban/slum), sociodemographic variables, prevalence estimates, etc.

Risk of bias (quality) assessment
We used the Risk of Bias Assessment tool for Non-randomized Studies24 to assess the risk of bias of included studies (see online supplemental box 1). The risk of bias in a study was graded as low, high or unclear on the basis of study features including the selection (selection of participants and confounding variables), performance (measurement of exposure), detection (blinding of outcome assessments), attrition (incomplete outcome data) and reporting (selective outcome reporting).

For each included study, we estimated the precision (C) or margin of error, considering the sample size (SS) and the observed prevalence (p) of hypertension among slum dwellers from the formula:

\[SS = Z^2 \times p \times (1 - p) / C^2\]  

where Z was the z-value fixed at 1.96 across studies (corresponding to 95% CI). The desirable margin of error is 5% (0.05) or lower.

Synthesis of results
For the meta-analysis, we used DerSimonian-Laird random-effects model25 due to anticipated variations in study population, healthcare delivery systems and stage of epidemic transition to pool the hypertension and type 2 diabetes prevalence estimates. We performed leave-one-study-out sensitivity analysis to determine the stability of the results.26 This analysis evaluated the influence of individual studies by estimating the pooled prevalence estimates in the absence of each study.26 We assessed heterogeneity among studies by inspecting the forest plots and using the X2 test for heterogeneity with a 10% level of statistical significance and using the I2 statistic where we interpret a value of 50% as representing moderate heterogeneity.27 28 We assessed the possibility of publication bias by evaluating a funnel plot for asymmetry. Because graphical evaluation can be subjective, we also conducted an Egger’s regression asymmetry test as formal statistical tests for publication bias.29

Following the overall analyses, we performed the following subgroup analyses: place of residence (rural vs urban slum vs non-slum urban); participants’ risk factors, including socioeconomic position; study design (cross-sectional, cohort); study location (low/middle-income vs high-income countries) and study precision.

We examined time trends in the prevalence estimates using meta-regression regression models with the prevalence estimates as the outcome variable and the calendar year of the publication as the predictor. In order to measure secular patterns in prevalence figures, we use the annual average percentage change (AAPC). We fitted a regression line to the natural logarithm of the prevalence estimates, that is, \(y = \alpha + \beta x + \varepsilon\), where \(y = \ln(\text{Prevalence})\), and \(x = \text{calendar year}\). The AAPC was calculated as \(100 \times (\exp(\beta) - 1)\). The 95% CI of the AAPC was also computed from the regression model.30 The prevalence calculations indicated an upward trend when both the AAPC estimate and the lower limit of its 95% CI were >0. However, they indicated a downward trend when both the AAPC and its upper limits were less than 0. The prevalence estimates were otherwise considered stable over time.30 This systematic review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses guideline (online supplemental annex 2).31

Patient and public involvement
No patient was involved.

RESULTS
Study selection and characteristics
The literature search yielded 1490 articles. Online supplemental figure 1 shows the study selection flow diagram. After review, 135 articles were selected for critical reading. Seventy-two studies did not meet the inclusion criteria and were excluded (see online supplemental table 1 for list of excluded studies). The other 62 studies involving 108110 participants met the inclusion criteria and were included in the meta-analyses.13–22 32–80 Forty-three studies reported only hypertension prevalence estimates, 29 studies reported only type 2 diabetes prevalence estimates and 8 reported both. Table 1 and online supplemental table 2 present the characteristics of the included studies. The studies were reported between 1989 and 2019. Studies were reported as full-text journal articles (n=61, 98%); except for one which was reported as a conference abstract. The number of participants included in the studies ranged from 100 to 15763. When reported, the mean age of participants ranged from 32 years to 47 years. Most of the studies were carried out in South Asia: India (n=30); Bangladesh (n=8), Nepal (n=1) and Pakistan (n=1); followed by sub-Saharan Africa: Kenya (n=9) and Nigeria (n=4); Latin America and Caribbean: Brazil (n=5) and Peru (n=1); and East Asia and Pacific: Thailand (n=1). Most of the studies were conducted in the following urban slums: Kibera (n=4), Delhi (n=3), Hyderabad (n=3), Ajegunle (n=2), Chandigarh (n=2), Chennai (n=2), Dhaka (n=2), Haryana (n=2) and Maceio (n=2).
| Subgroup                          | Hypertension | Type 2 diabetes |
|----------------------------------|--------------|----------------|
|                                  | n  | %           | I² | n  | %          | I² |        |
| Sample size                      |    |             |    |    |             |    |        |
| Smaller studies (<1000)          | 27 | 25.9 (21.6 to 30.6) | 97.1 | 15 | 11.0 (6.2 to 14.2) | 93.9 |        |
| Larger studies (1000+)           | 17 | 21.4 (17.2 to 26.1) | 99.6 | 15 | 7.8 (6.1 to 11.1) | 99.4 |        |
| Study precision                  |    |             |    |    |             |    |        |
| Imprecise studies                | 8  | 33.4 (25.7 to 41.7) | 91.2 | 1  | 25.2 (17.3 to 34.2) | – |        |
| Precise studies                  | 36 | 22.3 (18.9 to 25.9) | 99.2 | 29 | 8.9 (6.9 to 11.2) | 98.9 |        |
| Publication year                 |    |             |    |    |             |    |        |
| 2001–2005                        | 5  | 15.6 (9.0 to 23.8) | 94.7 | 4  | 8.2 (6.7 to 9.8) | 53.6 |        |
| 2006–2010                        | 6  | 28.6 (18.9 to 39.4) | 98.7 | 4  | 6.3 (3.3 to 10.3) | 90.6 |        |
| 2011–2020                        | 33 | 24.7 (21.0 to 28.6) | 99.2 | 22 | 10.2 (7.4 to 13.4) | 99.2 |        |
| Region                           |    |             |    |    |             |    |        |
| South Asia                       | 27 | 25.1 (20.7 to 29.8) | 98.9 | 19 | 11.9 (9.1 to 15.1) | 97.6 |        |
| Sub-Saharan Africa               | 10 | 24.4 (17.7 to 31.9) | 99.2 | 8  | 4.5 (2.4 to 7.2) | 98.8 |        |
| Latin America and Caribbean      | 6  | 18.3 (13.4 to 23.9) | 97.1 | 1  | 10.2 (8.1 to 12.3) | – |        |
| Middle East and North Africa     | 1  | 31.2 (28.4 to 34.1) | – | 1  | 8.8 (7.1 to 10.6) | – |        |
| East Asia and Pacific            | –  | –            | – | 1  | 7.9 (6.3 to 9.7) | – |        |
| Income category                  |    |             |    |    |             |    |        |
| Lower middle income              | 36 | 25.2 (21.2 to 29.4) | 99.1 | 28 | 9.3 (7.0 to 11.92) | 98.9 |        |
| Upper middle income              | 5  | 17.9 (12.1 to 24.6) | 97.6 | 2  | 9.0 (6.9 to 11.3) | 62 |        |
| Low income                       | 2  | 24.0 (16.9 to 32.0) | 92.2 |    |             |    |        |
| Sex                              |    |             |    |    |             |    |        |
| Male                             | 24 | 22.5 (16.0 to 29.7) | 99.2 | 11 | 8.1 (5.1 to 11.6) | 97.6 |        |
| Female                           | 24 | 23.2 (18.6 to 28.1) | 98.7 | 11 | 7.3 (4.6 to 10.6) | 97.5 |        |
| Age                              |    |             |    |    |             |    |        |
| Young adult                      | 8  | 15.7 (10.1 to 22.1) | 97.8 | 2  | 2.1 (0.3 to 5.4) | 96.7 |        |
| Middle-aged adult                | 9  | 35.0 (25.0 to 45.6) | 99.2 | 2  | 5.6 (4.5 to 6.8) | 60 |        |
| Age                              |    |             |    |    |             |    |        |
| Older adult                      | 9  | 49.6 (36.7 to 62.6) | 98.3 | 2  | 9.1 (7.0 to 11.4) | 0 |        |
| Body mass index                  |    |             |    |    |             |    |        |
| Underweight                      | 5  | 21.8 (11.4 to 34.4) | 87.3 |    |             |    |        |
| Normal weight                    | 6  | 21.9 (11.8 to 34.2) | 98.6 | 2  | 2.3 (1.8 to 2.8) | 0 |        |
| Overweight                       | 6  | 32.9 (21.2 to 45.8) | 97.4 | 4  | 4.2 (1.2 to 8.8) | 50 |        |
| Obese                            | 6  | 45.4 (34.5 to 56.6) | 93.3 | 2  | 6.4 (4.0 to 9.3) | 0 |        |
| Education status                 |    |             |    |    |             |    |        |
| Never studied                    | 7  | 39.1 (27.5 to 51.3) | 98 | 1  | 5.1 (3.0 to 7.8) | – |        |
| Less than primary                | 4  | 18.3 (13.9 to 23.1) | 87.1 | 1  | 4.6 (3.4 to 6.1) | – |        |
| Primary                          | 6  | 24.8 (12.0 to 40.4) | 99.4 | 1  | 4.4 (3.6 to 5.2) | – |        |
| Secondary or higher              | 7  | 22.4 (11.1 to 36.2) | 99.3 | 1  | 4.1 (3.2 to 5.2) | – |        |
| Income status                    |    |             |    |    |             |    |        |
| Poorest                          | 5  | 20.9 (10.4 to 33.8) | 98.9 |    |             |    |        |
| Middle                           | 5  | 25.3 (10.6 to 43.8) | 99.5 |    |             |    |        |
| Least poor                       | 5  | 29.2 (13.1 to 48.5) | 98.3 |    |             |    |        |
| Smoking status                   |    |             |    |    |             |    |        |
| Yes                              | 5  | 38.0 (19.1 to 59.0) | 99.1 |    |             |    |        |
| No                               | 5  | 30.5 (17.6 to 45.2) | 99.6 |    |             |    |        |
| Alcohol consumption              |    |             |    |    |             |    |        |
| Yes                              | 3  | 26.5 (18.0 to 35.9) | 83.4 |    |             |    |        |
| No                               | 3  | 29.1 (9.3 to 54.3) | 99.7 |    |             |    |        |
| Physically active                |    |             |    |    |             |    |        |
| Yes                              | 3  | 28.8 (11.1 to 50.8) | 99.6 |    |             |    |        |
| No                               | 3  | 30.8 (7.7 to 60.9) | 98.4 |    |             |    |        |
| Treatment cascade                |    |             |    |    |             |    |        |
| Aware of HBP                     | 12 | 33.6 (19.0 to 50.0) | 99.7 |    |             |    |        |
| On treatment                     | 9  | 51.9 (35.2 to 68.3) | 98.6 |    |             |    |        |
| BP controlled                    | 8  | 25.9 (18.4 to 34.3) | 87.8 |    |             |    |        |

World Bank Country Income Groups, 2018. Participants were divided into age groups that, broadly defined, covered young adulthood (18–35 years), middle age (36–55 years) and older adulthood (56 years and older). Underweight—body mass index under 18.5 kg/m². Normal weight—body mass index greater than or equal to 18.5–24.9 kg/m². Overweight—body mass index greater than or equal to 25–29.9 kg/m². Obesity—body mass index greater than or equal to 30 kg/m². Physical activity as defined by authors. Alcohol consumption as defined by authors. Smoking status as defined by authors. Income status as reported by authors. BP, blood pressure; HBP, high BP.
Risk of bias of included studies

Summary of risk of bias assessment for each study is shown in online supplemental table 3. The risk of bias in the selection of participants was low in most studies (n=56, 90%), high in three studies (5%) and unclear in three studies (5%). Risk of bias due to confounding variables was low in most studies (n=39, 63%), high in 22 studies (36%) and unclear in 1 study. Risk of bias due to measurement of exposure, blinding of outcome assessments and selective outcome reporting was low in all the 62 studies as we included all studies that used objective measure of hypertension and type 2 diabetes. Risk of bias due to incomplete outcome data was low in most studies (n=54, 87%), high in two studies (3%) and unclear in six studies (10%).

Variations in prevalence of hypertension and type 2 diabetes by geographical regions

Prevalence of hypertension and type 2 diabetes from individuals is shown in figures 1 and 2, respectively.

East Asia and Pacific

Thailand: one study from Klong-Toey slum found that 77 of the 976 respondents had type 2 diabetes in 1989 (7.9%, 95% CI 6.3% to 9.8%).

Latin America and Caribbean

Brazil: four studies reported the prevalence of hypertension from three different slums: Maceio (n=2), Rio de Janeiro (n=1) and Salvador (n=1). Ferreiro et al

South Asia

Bangladesh: four studies from Dhakan slums reported prevalence of hypertension. The reported prevalence of hypertension ranged from 11.6% (95% CI 9.7% to 13.8%) in 2012 to 19.56% (95% CI 17.85% to 21.37%) in 2018. Five studies from Dhakan slums reported prevalence of type 2 diabetes. The pooled prevalence (‘annualised year average’) of hypertension for the three studies yielded an estimate of 18.4% (95% CI 12.0% to 26.2%). One study from Bangladesh found that 1 in 10 had type 2 diabetes in 2017.

India: 22 studies from India reported prevalence of hypertension from more than 15 different slums. The reported prevalence varied across and within the slums. For example, Kar et al estimated the prevalence of hypertension to be 27.6% (95% CI 21.4% to 34.4%) among 196 Chandigarh and Haryana slum residents in 2008; however, they estimated the prevalence of hypertension to be 16.5% (95% CI 15.1% to 18.0%) among 2 562 196 Chandigarh and Haryana slum residents in 2010. Prevalence of type 2 diabetes also varied across slums in India. The pooled prevalence (‘annualised year average’)
of hypertension for the 22 studies yielded an estimate of 26.8% (95% CI 22.5% to 31.3%). In Delhi, the reported prevalence of type 2 diabetes ranged from 12.7% (95% CI 11.3% to 14.2%) in 2007 to 31.5% (95% CI 27.8% to 35.4%) in 2012. The pooled prevalence (‘annualised year average’) of type 2 diabetes for the six studies yielded an estimate of 4.5% (95% CI 2.0% to 7.9%).

**Nigeria:** four studies from five different slums reported prevalence of hypertension. The reported prevalence varied across and within the slums. Ezeala-Adikie et al found that half of the respondents from Enugu slum were hypertensive in 2016 (52.5%, 95% CI 48.9% to 56.0%). While Daniel et al and Sovemimo et al found that almost one-third of the Ajegule (38.2%, 95% CI 35.1% to 41.3%, 2013) and Yemetu (33.1%, 95% CI 30.0% to 36.5%, 2015) slum residents were hypertensive. However, Akinwale et al found that only 12.8% of the respondents from Ijora Oloye, Ajegunle and Makoko were hypertensive in 2013. The pooled prevalence (‘annualised year average’) of hypertension for the four studies yielded an estimate of 33.2% (95% CI 15.6% to 53.5%). Akinwale et al found that only 3.3% of the respondents from Ijora Oloye, Ajegunle and Makoko had type 2 diabetes in 2013.

**Secular trends in hypertension and type 2 diabetes prevalence estimates**

Secular trends in hypertension, in five countries for which there were data across multiple time points, and type 2 diabetes, in three countries in which we had data across multiple time points, among slum residents are shown in figures 3 and 4. We observed a continuous increase in prevalence of hypertension among slum residents in four out of five countries. The increase is more pronounced in India, followed by Kenya and Bangladesh. The prevalence of hypertension increased by 204.6% from 11.7% in 2001 to 35.5% in 2019 in India. The prevalence of hypertension increased by 98.8% from 12.3% in 2013 to 24.5% in 2019 in Kenya. However, the results of the trend analysis showed statistically significant upward trends only in India, such that the prevalence of hypertension increased +6.9% (95% CI +2.0% to +12.0%) per year between 2001 and 2019. There was no statistically significant trend observed in Brazil using trend analyses (trend=−0.0%, 95% CI −22.7% to +29.2%). We also observed a continuous increase in prevalence of type 2 diabetes among slum residents in India and Bangladesh. The prevalence of type 2 diabetes increased by 123.6% from 8.1% in 2004 to 18.1% in 2019 in India. The prevalence of type 2 diabetes increased by 95.8% from 10.3% in 2001 to 20.2% in 2019 in India. However, the results of the trend analysis showed statistically significant upward trends only in Bangladesh such that the prevalence of type 2 diabetes increased +5.9% (95% CI +1.1% to +10.8%) per year between 2004 and 2019. A non-statistically significant downward trend...
in type 2 diabetes prevalence was also observed in Kenya (trend=-11.1%, 95% CI -45.7% to +45.6%).

**Prevalence of hypertension by different hypertension and type 2 diabetes subgroups**

**Study characteristics**

As shown in table 1, the pooled prevalence of hypertension was higher in studies conducted in lower middle-income countries (23.2%, 95% CI 21.5% to 29.0%, 36 studies) than those from upper middle-income countries (17.9%, 95% CI 12.1% to 24.6%, 5 studies). The pooled prevalence of hypertension tended to be higher among studies from South Asia (25.3%, 95% CI 21.3% to 29.6%, 26 studies) and sub-Saharan Africa (24.4%, 95% CI 17.7% to 31.9%, 10 studies) than those from Latin America and Caribbean (18.3%, 95% CI 13.4% to 23.9%, 6 studies). The pooled prevalence tended to be higher among imprecise studies (33.4%, 95% CI 25.7% to 41.7%, 8 studies) than those from precise studies (22.4%, 95% CI 18.9% to 26.1%, 35 studies). The pattern was similar for type 2 diabetes prevalence estimates.

**Sociodemographic characteristics**

As shown in table 1, the pooled prevalence of hypertension was similar among men (22.5%, 95% CI 16.0% to 29.7%, 24 studies) and women (23.5%, 95% CI 18.6% to 28.1%, 24 studies). The pooled prevalence of hypertension tended to be higher among older adults (49.6%, 95% CI 36.7% to 62.6%, 9 studies) than middle-aged (35.0%, 95% CI 25.0% to 45.6%, 9 studies) and young adults (15.7%, 95% CI 10.1% to 22.1%, 8 studies). Similarly, the pooled prevalence of hypertension tended to be higher in obese (45.4%, 95% CI 34.5% to 56.5%, 6 studies) and overweight (32.9%, 95% CI 21.2% to 45.8%, 6 studies) participants than participants with normal (21.9%, 95% CI 11.8% to 34.2%, 6 studies) and underweight (21.8%, 95% CI 11.4% to 34.4%, 5 studies). The pooled prevalence of hypertension tended to be higher among those who never studied (39.1%, 95% CI 27.5% to 51.3%) than those with less than primary (18.3%, 95% CI 13.9% to 23.1%, 4 studies), primary (24.8%, 95% CI 12.0% to 40.4%, 6 studies) or secondary/higher education (15.1%, 95% CI 8.5% to 25.7%, 8 studies).

Figure 3  Secular trends in hypertension prevalence estimates among slum residents across different regions.

Figure 4  Secular trends in type 2 diabetes mellitus prevalence estimates among slum residents across different regions.
educational attainment (22.4%, 95% CI 11.2% to 36.2%, 7 studies). The pooled prevalence of hypertension tended to be higher among the least poor (29.2%, 95% CI 13.1% to 48.5%, 5 studies) than those with middle (25.3%, 95% CI 10.6% to 43.8%, 5 studies) and poorest income (20.9%, 95% CI 10.4% to 33.8%, 5 studies). The pattern was similar for type 2 diabetes prevalence estimates.

**Lifestyle factors**

The pooled prevalence of hypertension tended to be higher among smokers (38.0%, 95% CI 19.1% to 59.0%, 5 studies) than those not smoking (30.5%, 95% CI 17.6% to 45.2%, 5 studies). We found that the pooled prevalence of hypertension tended to be higher for those not physically active (30.8%, 95% CI 7.7% to 60.9%, 3 studies) than those physically active (28.8%, 95% CI 11.1% to 50.8%); tended to be higher among those with no history of alcohol consumption (29.1%, 95% CI 9.3% to 54.3%, 3 studies) than those who reported alcohol consumption (26.5%, 95% CI 18.0% to 35.9%, 3 studies).

**Comparative prevalence by place of residence**

Six studies from India included non-slum populations alongside data from the slum population, and reported prevalence of hypertension by place of residence.36 38 46 48 49 51 As shown in figure 5, the pooled prevalence of hypertension was highest among those residing in non-slum urban areas (13.06%, 95% CI 6.53% to 24.43%, 4 studies; 2813 participants), followed by urban slum residents (7.88%, 95% CI 3.32% to 17.55%; 4 studies; 1811 participants) and was lowest among rural residents (1.64%; 95% CI 0.06% to 32.21%; 3 studies; 405 participants). Prevalence of type 2 diabetes tended to be higher among urban slum residents than those living in rural areas (OR=3.78, 95% CI 0.75 to 18.93). Urban slum residents were 46% less likely to be diabetic than those from other urban areas (OR=0.54, 95% CI 0.44 to 0.66).

**Treatment cascade**

Among those diagnosed with hypertension, only one-third were aware of their hypertensive status (33.6%, 95% CI 19.1% to 50.0%, 12 studies) (table 1). Among those aware of their high BP, half of them were on antihypertensive medications (51.9%, 95% CI 35.2% to 68.3%, 9 studies) and was lowest among rural residents (24.4%, 95% CI 18.4% to 31.5%, 5 studies). Slum residents were 35% more likely to be hypertensive than those living in rural areas (OR=1.35, 95% CI 1.29 to 1.42) and 30% less likely to be hypertensive than those living in other urban areas (OR=0.70, 95% CI 0.51 to 0.96).

Four studies from India (n=3) and Bangladesh reported prevalence of type 2 diabetes by place of residence.46 59 71 As shown in figure 6, the pooled prevalence of type 2 diabetes was highest among those residing in non-slum urban areas (13.06%, 95% CI 6.53% to 24.43%, 4 studies; 2813 participants), followed by urban slum residents (7.88%, 95% CI 3.32% to 17.55%; 4 studies; 1811 participants) and was lowest among rural residents (1.64%; 95% CI 0.06% to 32.21%; 3 studies; 405 participants). Prevalence of type 2 diabetes tended to be higher among urban slum residents than those living in rural areas (OR=3.78, 95% CI 0.75 to 18.93). Urban slum residents were 46% less likely to be diabetic than those from other urban areas (OR=0.54, 95% CI 0.44 to 0.66).
**DISCUSSION**

**Main findings**

This systematic review and meta-analysis summarises available evidence on the global prevalence of hypertension and type 2 diabetes among slum residents. There were several key findings: first, the burden of hypertension and type 2 diabetes among slum dwellers is high and may be rising globally, with wide variation between countries and regions and, to some degree, also within countries. Using data from within-study comparator populations when presented, the pooled prevalence of hypertension and type 2 diabetes was highest among those residing in non-slum urban areas, followed by slum residents, and was lowest among rural residents. This finding corroborates those of previous reviews that observed higher prevalence of hypertension among urban residents than those living in rural areas.81 82 This high prevalence may be due to rapid urbanisation, lifestyle changes, dietary changes and increased life expectancy,83 84 or a combination of these factors.85 86 In addition, the observed difference could be due to other factors including but not limited to lack of access to testing and care of NCD risk factors in rural areas and urban areas.

The observed gradient in burden of hypertension and type 2 diabetes among rural, slum and urban residents is consistent with the effects of urbanisation and wealth, as residents experience an economic transition when moving from one area to the next.87–92 LMICs are now undergoing epidemiological transition, the change from a burden of infectious diseases to chronic diseases.93 In addition, it could be due to increase in awareness in (non-slum) urban areas and recent availability of testing in some places. Recent systematic reviews of dietary risk behaviour in sub-Saharan Africa have found that urban populations tended to consume more salt than rural populations and consume fewer portions of vegetables.12 The rapid pace of urbanisation and economic growth is accelerating the rate of this epidemiological transition; as such LMICs are at great risk of an explosive growth in the burden of NCDs, including hypertension and type 2 diabetes.97 88

We found evidence of significant unmet need for hypertension care among urban slum residents. A significant proportion of the urban slum residents were unscreened, undiagnosed, untreated or uncontrolled. This huge unmet need has been documented in previous studies from low/middle-income settings.95–101 We also found that control of hypertension among slum residents was poor, such that only one in four slum residents on treatment had their BP controlled. The poor control of BP noted in our study, despite the fact the one-half of those who were unaware of high BP being on antihypertensive medications, needs further exploration. One possible explanation is availability and affordability of the medications and there could be minimal additional contact with a health professional.15 It has been documented that the control of BP was related to the frequency of follow-up visits.96 Another possible explanation could be low adherence to prescribed medications, as they may not be able to afford the medications.

As expected, we found that the burden of hypertension increased with the participants’ age, which may be attributed to age-related structural changes in blood vessels which potentially cause narrowing of the vascular lumen, and consequently increasing BP, as have been reported in previous studies.102 103 The association between combined overweight/obesity and hypertension shown in our results exemplifies the role of excess body weight in hypertension prevalence, which has been long recognised and consistent across numerous observational and trial data.104–106 We found evidence of significantly high prevalence of hypertension among smokers compared with non-smokers. Direct relation of chronic
tobacco consumption to hypertension however is not yet well established,\textsuperscript{107,108} although tobacco consumption has been shown to cause an acute elevation of BP.\textsuperscript{109}

**Study limitations and strengths**

To the best of our knowledge, this paper is the first systematic review that summarises data about prevalence of hypertension and type 2 diabetes among slum residents. Strengths of this study include the use of a predefined and published protocol, a comprehensive search strategy and involvement of two independent reviewers in the review process. Nevertheless, the findings of this study should be interpreted with caution. Prevalence estimates from different regions and published over the course of 11 years were pooled in this meta-analysis, and as expected, high heterogeneity between studies was found in the meta-analyses. Nonetheless, as affirmed by previous evidence, meta-analyses are the preferred options to narrative syntheses for interpreting the results in a review, even in spite of the presence of a considerable amount of heterogeneity.\textsuperscript{110} Heterogeneity appeared to be the norm rather than exception in published meta-analyses of observational studies.\textsuperscript{111}

In conclusion, the burden of hypertension and type 2 diabetes varied widely between countries and regions and, to some degree, also within countries. In addition, many individuals with hypertension are not aware of their condition, not on treatment and control of hypertension is poor. The burden of hypertension and type 2 diabetes was higher among urban residents than their counterparts living in urban slums and rural areas. There is a need for public health strategies to improve the awareness, control and overall management of hypertension and type 2 diabetes in urban areas.

**Contributors**

OAU, AA, OO and RJL conceived the study. OAU, AA and OO collected and analysed initial data. OAU, AA, OO, JS, FG and RJL participated in and contributed to refining the data analysis. OAU wrote the first manuscript. OAU, AA, OO, JS, FG and RJL contributed to further analysis, interpreting and shaping of the argument of the manuscript and participated in writing the final draft. OAU is the guarantor of this study.

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**Competing interests**

None declared.

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Not required.

**Ethics approval**

This study does not involve human participants.

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**Data availability statement**

All data relevant to the study are included in the article or uploaded as supplemental information.

**Supplemental material**

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**REFERENCES**

1. GBD 2016 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2016: a systematic analysis for the global burden of disease study 2016. *Lancet* 2017;390:1345–422.

2. Bickler SW, Wang A, Amin S, et al. Urbanization in sub-Saharan Africa: declining rates of chronic and recurrent infection and their possible role in the origins of non-communicable diseases. *World J Surg* 2018;42:1617–28.

3. Goryakin Y, Rocco L, Suhrcke M. The contribution of urbanization to non-communicable diseases: evidence from 173 countries from 1980 to 2008. *Econ Hum Biol* 2017;26:151–63.

4. Khorrami Z, Etmedad K, Yarahmadi S, et al. Urbanization and noncommunicable disease (Ncd) risk factors: who stepwise Iranian ncd risk factors surveillance in 2011. *East Mediterr Health J* 2017;23:469–79.

5. Cohen B. Urban growth in developing countries: a review of current trends and a caution regarding existing forecasts. *World Dev* 2004;32:23–51.

6. Cohen B. Urbanization in developing countries: current trends, future projections, and key challenges for sustainability. *Technol Soc* 2006;28:63–80.

7. Ezeh A, Oyebode O, Satterthwaite D, et al. The history, geography, and sociology of slums and the health problems of people who live in slums. *Lancet* 2017;389:547–58.

8. Lillford RJ, Oyebode O, Satterthwaite D, et al. Improving the health and welfare of people who live in slums. *Lancet* 2017;389:559–70.

9. Riley LW, Ko Al, Unger A, et al. Slum health: diseases of neglected populations. *BMJ Int Health Hum Rights* 2007;7:2.

10. Unger A, Riley LW. Slum health: from understanding to action. *PLoS Med* 2007;4:1561–6.

11. Lillford R, Kyobutungi C, Ndugwa R, et al. Because space matters: conceptual framework to help distinguish slum from non-slum urban areas. *BMJ Global Health* 2019;4:e001267.

12. Mensah DO, Nunes AR, Bockarie T, et al. Meat, fruit, and vegetable consumption in sub-Saharan Africa: a systematic review and meta-regression analysis. *Nutr Rev* 2021;79:651–92.

13. Ahmad S, Goel K, Parashar P, et al. A Community Based Cross Sectional Study on Life Style & Morbidity Status of Elderly in Urban Slums of Meerut. *Indian J Public Health* 2004;32:23–51.

14. Anand K, Shah B, Yadav K, et al. Are the urban poor vulnerable to non-communicable diseases? A survey of risk factors for non-communicable diseases in urban slums of Faridabad. *Nat Med J India* 2007;20:115–20.

15. Banerjee S, Mukherjee TK, Basu S. Prevalence, awareness, and control of hypertension in the slums of Kolkata. *Indian Heart J* 2016;68:286–94.

16. Daniel OJ, Adejumo OA, Adejumo EN, et al. Prevalence of hypertension among urban slum dwellers in Lagos, Nigeria. *J Urban Health 2013;90:1016–25.*

17. Heitlinger K, Montour S, Hawes SE, et al. A community-based cluster randomized survey of noncommunicable disease and risk factors in a peri-urban slumshyntown in Lima, Peru. *BMJ Int Health Hum Rights* 2014;14:19.

18. Nirmala DB, Vijay KM, Sreedhar M. Prevalence of risk factors for non communicable diseases in urban slums of Hyderabad. *Telangana Indian Journal of Basic and Applied Medical Research* 2014:4:487–93.

19. Oni N, Vaidya A, Thapa G. Behavioural risk factors of noncommunicable diseases among Nepalese urban poor: a descriptive study from a slum area of Kathmandu. *Epidemiol Res Int* 2013;2013:1–13.
Rawal LB, Biswas T, Khandker NN, et al. Non-Communicable disease (Ncd) risk factors and diabetes among adults living in slum areas of Dhaka, Bangladesh. PLoS One 2017;12:e0184967.

Singh R, Mukherjee M, Kumar R, et al. Study of risk factors of coronary heart disease in urban slums of Patna. Nepal J Epidemiology 2012;2:205–12.

Vigneswari A, Manikandan R, Satyavani K. Prevalence of risk factors of diabetes among urban poor South Indian population. J Assoc Physicians India 2015;63:32–4.

UN-Habitat. UN-Habitat urbanization and development: emerging futures. world cities report 2016. Nairobi, Kenya, 2016.

Kim SY, Park JE, Lee YJ, et al. Testing a tool for assessing the risk of bias for nonrandomized studies showed moderate reliability and promising validity. J Clin Epidemiol 2013;66:408–14.

Prior Simonian R, Laird N. Meta-analysis in clinical trials. Control Clin Trials 1986;7:177–88.

Normand SL. Meta-Analysis: formulating, evaluating, combining, and reporting. Stat Med 1999;18:321–59.

Higgins JPT, Thompson SG. Quantifying heterogeneity in a meta-analysis. Stat Med 2002;21:1539–58.

Higgins JPT, Thompson SG, Deeks JJ, et al. Measuring inconsistency in meta-analyses. BMJ 2003;327:557–60.

Cogg M, Davey Smith G, Schneider M, et al. Bias in meta-analysis detected by a simple, graphical test. BMJ 1997;315:629–34.

Cleeg LX, Hankey BF, Tivari R, et al. Estimating average annual per cent change in trend analysis. Stat Med 2009;28:3670–82.

Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ 2009;339:b2700.

Acharyya T, Kaur P, Murhekar MV. Prevalence of behavioral risk factors, overweight and hypertension in the urban slums of North 24 Parganas district, West Bengal, India, 2010. Indian J Public Health 2014;58:195–8.

Akinwale O, Oyefara J, Adejoh P. The benefits of using a community-engaged research approach to promote a healthy lifestyle in three Nigerian urban slums. Southern African Journal of Epidemiology and Infection 2014;29:48–50.

Ayah R, Joshi MD, Wanjuru R, et al. A population-based survey of prevalence of obesity and correlates of urban slum community in Nairobi, Kenya. BMC Public Health 2013;13:20.

Chakraborty R, Bose K. Comparison of body adiposity indices in predicting blood pressure and hypertension among slum-dwelling men in Kolkata, India. Malays J Nutr 2012;18:319–28.

Chaturvedi S, Pan I, et al. Neelam. Hypertension in Delhi: prevalence, awareness, treatment and control. Trop Doct 2007;37:142–5.

Dasappa H, Fathima FN, Prabhakar R, et al. Prevalence of diabetes and pre-diabetes and assessments of their risk factors in urban slums of Bangalore. Indian J Family Med Care 2015;17:196–201.

Deepa M, Pradeepa R, Anjana R, et al. Noncommunicable diseases risk factor surveillance: experience and challenge from India. Indian J Community Med 2011;36:550–6.

Edwards JK, Bygrave H, Van den Bergh R, et al. HIV with non-communicable diseases in primary care in Kibera, Nairobi, Kenya: characteristics and outcomes 2010-2013. Trans R Soc Trop Med Hyg 2015;109:440–6.

Ezeala-Adikaiba BA, Orjioko C, Ekenze OS, et al. Population-Based prevalence of high blood pressure among adults in an urban slum in Enugu, South East Nigeria. J Hum Hypertens 2016;30:285–91.

Ferreira HDS, TMTDM F, MDAC F. Hypertension, abdominal obesity and short stature: aspects of nutritional transition within a shantytown in the city of Maceio (northeastern Brazil). Revista de Nutricao 2006;19:404–9.

Florioncio TT, Ferreira HS, Cavalcante JC, et al. Short stature, obesity and arterial hypertension in a very low income population in north-eastern Brazil. Nutrition, Metabolism and Cardiovascular Diseases 2004;14:226–33.

Haregu TN, Oti S, Ngomi N, et al. Interlinkage among cardiometabolic disease markers in an urban poor setting in Nairobi, Kenya. Glob Health Action 2016;9:pp 30626.

Huda MN, Alam KS. Prevalence of chronic kidney disease and its association with risk factors in disadvantageous population. Int J Nephrol 2012;2012:1–7.

Jalil F, Moore SE, Butt NS, et al. Early-Life risk factors for adult chronic disease: follow-up of a cohort born during 1964-1978 in an urban slum of Lahore, Pakistan. J Health Popul Nutr 2008;26:12–21.

Joshu A, Purcell S. Portable reliable health information Kiosk to assess chronic disease burden in remote settings. Rural Remote Health 2013;13:2279.

Joshi MD, Ayah R, Njau EK, et al. Prevalence of hypertension and associated cardiovascular risk factors in an urban slum in Nairobi, Kenya: a population-based survey. BMC Public Health 2014;14:1177.

Kar SS, Thakur JS, Jain S, et al. Cardiovascular disease risk management in a primary health care setting of North India. Indian Heart J 2008;60:19–25.

Kar SS, Thakur JS, Virdi NK, et al. Risk factors for cardiovascular diseases: is the social gradient reversing in northern India? Natl Med J India 2010;23:206–9.

Kumari SMV, Humaira B, Sreedhar M. A study on prevalence of hypertension in urban slum field practice area of osmania medical college – Hyderabad. Indian Journal of Basic and Applied Medical Research 2014;4:462–70.

Lubbee HG, Rege SS, Bhat DS, et al. Body fat and cardiovascular risk factors in Indian men in three geographical locations. Food Nutr Bull 2002;23:146–9.

Marins VMR, Almeida RMV, Pereira RA, et al. The association between socioeconomic indicators and cardiovascular disease risk factors in Rio de Janeiro, Brazil. J Biosoc Sci 2007;39:221–8.

Misra A, Pandey RM, Devi JR, et al. High prevalence of diabetes, obesity and dyslipidaemia in urban slum population in northern India. Int J Obes Relat Metab Disord 2001;25:1722–9.

Ollack B, Wabwire-Mangen F, Smeeth L, et al. Risk factors of hypertension among adults aged 35–64 years living in an urban slum in Nairobi, Kenya. BMC Public Health 2015;15:1251.

Ongeti K, Ong’o J, Pulei A. Blood pressure characteristics among slum dwellers in Kenya. Global Advanced Research 2013;2:80–5.

Oti SO, van de Vijver SJM, Agyemang C, et al. The magnitude of diabetes and its association with obesity in the slum of Nairobi: results from a cross-sectional survey. Trop Med Int Health 2013;18:1520–30.

Patil RS, Gothankar JS. Assessment of risk of type 2 diabetes using the Indian diabetes risk score in an urban slum of Pune, Maharashtra, India: a cross-sectional study. WHO South East Asia J Public Health 2016;5:53–61.

Rahim MA, Vaaler S, Keramat Ali SM, et al. Prevalence of type 2 diabetes in urban slums of Dhaka, Bangladesh. Bangladesh Med Res Counc Bull 2004;30:60–70.

Sayeds MA, Mahfut H, Kusum PA, et al. Prevalence of diabetes and impaired fasting glucose in urban population of Bangladesh. Bangladesh Med Res Counc Bull 2007;33:1–12.

Singh AK, Mani K, Krishnan A, et al. Prevalence, awareness, treatment and control of diabetes among elderly persons in an urban slum of Delhi. Indian J Community Med 2012;37:236–9.

Sinha P, Taneja DK, Singh NP, et al. Seasonal variation in prevalence of hypertension: implications for interpretation. Indian J Public Health 2010;54:7–10.

Sithi-Amorn C, Chandraprisert S, Bunnag SC, et al. The prevalence and risk factors of hypertension in Klong Toey slum and Klong Toey government apartment houses. Int J Epidemiol 1989;18:89–94.

Snyder RE, Lopes LA, Tavares LCC, et al. O Dia de Dona Maria – using technology and community based participatory research to improve healthcare delivery in a Brazilian urban slum. Ann Glob Health 2016;82:599.

Sowemimo I, Ajayi I, Akpa O. Prevalence of hypertension and associated factors among residents of Ibadan-North local government area of Nigeria. Journal of Hypertension 2016;13:67–75.

Sunita M, Singh AK, Royge A, et al. Prevalence of diabetic retinopathy in urban slums: the Aditya Jyot diabetic retinopathy in urban Mumbai slums Study-Report 2. Ophthalmic Epidemiol 2017;24:303–10.

Unger A, Felzembur L, Remy D, et al. Hypertension in a Brazilian urban slum population. J Urban Health 2015;92:446–59.

Uthakakilla VK, Kishore Kumar KJ, Jena SK. Prevalence study of overweight/obesity among adults (20-60yrs) of urban field practice area of osmania medical college, Hyderabad. Indian Journal of Public Health Research and Development 2012;3:250–3.

van de Vijver S, Otto S, Tervaert TC, et al. Introducing a model of cardiovascular prevention in Nairobis slums by integrating a public health and private-sector approach: the scale-up study. Glob Health Action 2013;6:22510.

Vikram NK, Pandey RM, Misra A, et al. Non-obese (body mass index < 25 kg/m²) Asian Indians with normal waist circumference have high cardiovascular risk. Nutrition 2003;19:503–9.

Vlas JS, Arora A, Vikram NK, et al. C-Reactive protein, obesity, and insulin resistance in postmenopausal women in urban slums of North India. Diabetes Metab Syndr 2007;1:83–9.
Open access

71 Yajnik CS, Joglekar CV, Lubree HG, et al. Adiposity, inflammation and hyperglycaemia in rural and urban Indian men: coronary risk of insulin sensitivity in Indian subjects (crisis) study. Diabetologia 2008;51:39–46.

72 Choudhury S, Al-Shoabi AAA, Khalequzzaman M, et al. A16358 hypertension detection, treatment and control rates in urban slum population in Bangladesh. J Hypertens 2018;36:e337–8.

73 Dwivedi S, Gonmei Z, Toteja GS, et al. Assessment of risk factors of hypertension among adults residing in urban slum of Delhi. Asian J Healthw Care Pharmaceut 2019;11:405–7.

74 Gonmei Z, Dwivedi S, Singh Toteja G, et al. Prevalence of hypertension among elderly residing in slums of West. Asian J of Pharmaceutical and Clinical Research 2018;11:337–9.

75 Abhinav J. A study of prevalence of diabetes mellitus and its risk factors in the urban slum population. Indian Journal of Public Health Research & Development 2019;10:141–5.

76 Bawah AT, Abaka-Yawson A, Seini MM, et al. Prevalence of diabetes among homeless and slum dwellers in Accra, Ghana: a survey study. BMC Res Notes 2019;12:572.

77 Gadallah M, Abdel Megid S, Mohamed A, et al. Hypertension and associated cardiovascular risk factors among urban slum dwellers in Egypt: a population-based survey. East Mediterr Health J 2018;24:435–42.

78 George CE, Nnorom G, Wadugopadya P, et al. Health issues in a Bangalore slum: findings from a household survey using a mobile screening tool in Devarajeewanahalli. BMJ Public Health 2019;19:456.

79 Tymiejczyk O, McNairy ML, Peterson JS, et al. Hypertension prevalence among people of four slum communities: population-representative findings from Port-au-Prince, Haiti. J Hypertens 2019;37:685–95.

80 Vusirikala A, Wekesa F, Kiyobutungi C, et al. Assessment of cardiovascular risk in a slum population in Kenya: use of World Health Organization/International Society of Hypertension (WHO/ISH) risk prediction charts - secondary analyses of a household survey. BMJ Open 2019;9:e029304.

81 Addo J, Smeeth L, Leon DA. Hypertension in sub-Saharan Africa: a systematic review. Hypertension 2019;75:1012–8.

82 Pereira M, Patel SA, Ali MK. Non-Communicable diseases in South Asia: contemporary perspectives. Br Med Bull 2014;111:31–44.

83 Streafield PK, Khan WA, Bhuiya A, et al. Adult non-communicable disease mortality in Africa and Asia: evidence from indepth health and demographic surveillance system sites. Glob Health Action 2014;7:25365.

84 Gazzano TA, Bilton A, Anand S, et al. Growing epidemic of coronary heart disease in low- and middle-income countries. Curr Probl Cardiol 2010;35:72–115.

85 Oyebode O, Oli S, Chen Y-F, et al. Salt intakes in sub-Saharan Africa: a systematic review and meta-regression. Popul Health Metr 2016;14:1.

86 Adeleye D, Basquiell C. Estimating the prevalence and awareness rates of hypertension in Africa: a systematic analysis. PLoS One 2014;9:e104300.

87 Macia E, Duboz R, Gueye L. Prevalence, awareness, treatment and control of hypertension among adults 50 years and older in Dakar, Senegal. Cardiovasc J Afr 2012;23:265–9.

88 Mohan V, Deepa M, Farooq S, et al. Prevalence, awareness and control of hypertension in Chennai—The Chennai Urban Rural Epidemiology Study (CURES-52). J Assoc Physicians India 2007;55:326–32.

89 Pilav A, Doder V, Brankovic S. Awareness, treatment, and control of hypertension among adult population in the Federation of Bosnia and Herzegovina over the past decade. J Public Health Res 2014;3:323.

90 Supiyeva A, Kossourov A, Utepova L, et al. Prevalence, awareness, treatment and control of arterial hypertension in Astana, Kazakhstan. A cross-sectional study. Public Health 2015;129:948–53.

91 Tialak A, Evangelista LS, Mentes JC, et al. Hypertension prevalence, awareness, and control in Arab countries: a systematic review. Nurs Health Sci 2014;16:126–30.

92 Yazdanpanah L, Shahbazian H, Shahbazian H, et al. Prevalence, awareness and risk factors of hypertension in Southwest of Iran. J Renal Inj Prev 2015;4:51–6.

93 Landahl S, Bengtsson C, Sigurdsson JA, et al. Age-Related changes in blood pressure. Hypertension 1986;8:1044–9.

94 Pinto E. Blood pressure and ageing. Postgrad Med J 2007;83:109–14.

95 Dyer AR, Elliott P, Shippy M. Body mass index versus height and weight in relation to blood pressure. findings for the 10,079 persons in the INTERSALT study. Am J Epidemiol 1990;131:589–96.

96 Folsom AR, Kushi LH, Anderson KE, et al. Associations of general and abdominal obesity with multiple health outcomes in older women: the Iowa women’s health study. Arch Intern Med 2000;160:2117–25.

97 Hu G, Barengo NC, Tuomilehto J, et al. Relationship of physical activity and body mass index to the risk of hypertension: a prospective study in Finland. Hypertension 2004;43:25–30.

98 Hu G, Barengo NC, Tuomilehto J. Correlation between cigarette smoking and blood pressure and pulse pressure among teachers residing in Shiraz, southern Iran. Iran Cardiovasc Res J 2011;5:97–102.

99 Primatesta P, Falaschetti E, Gupta S, et al. Association between smoking and blood pressure: evidence from the health survey for England. Hypertension 2001;37:187–93.

100 Westman EC. Does smokeless tobacco cause hypertension? South Med J 1995;88:716–20.

101 Ioannidis JPA, Patsopoulos NA, Rothstein HR. Reasons or excuses for avoiding meta-analysis in forest plots. BMJ 2008;336:1413–5.

102 Higgins JPT. Commentary: heterogeneity in meta-analysis should be expected and appropriately quantified. Int J Epidemiol 2008;37:1158–60.
Supplementary Digital Content

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eFigure 1: Study selection and inclusion flow chart

- Records identified through database searching (n=1,490)
- Records after duplicates removed (n=1,306)
- Records screened (n=1,306)
- Titles and abstracts excluded (n=1,172)
- Full-text articles excluded (n=72)
  - Adolescent (n=18)
  - Duplicate (n=3)
  - No relevant outcome (n=31)
  - No relevant population (n=9)
  - Old BP cut-off (n=5)
  - Review (n=3)
  - Self-reported only (n=3)
- Full-text articles assessed for eligibility (n=134)
- Studies included in qualitative synthesis (n=62)
- Studies included in quantitative synthesis (meta-analysis) (n=62)
### Box 1: Study selection and inclusion flow chart

| Domain                      | Details                                                                 | Risk of bias |
|-----------------------------|-------------------------------------------------------------------------|--------------|
| Selection of participants   | Selection bias caused by the inadequate selection of participants       | - Low        |
|                             |                                                                         | - High        |
|                             |                                                                         | - Unclear    |
| Confounding variables       | Selection bias caused by the inadequate confirmation and consideration of confounding variable | - Low        |
|                             |                                                                         | - High        |
|                             |                                                                         | - Unclear    |
| Measurement of exposure     | Performance bias caused by the inadequate measurement of exposure       | - Low        |
|                             |                                                                         | - High        |
|                             |                                                                         | - Unclear    |
| Blinding of outcome assessments | Detection bias caused by the inadequate blinding of outcome assessments | - Low        |
|                             |                                                                         | - High        |
|                             |                                                                         | - Unclear    |
| Incomplete outcome data     | Attrition bias caused by the inadequate handling of incomplete outcome data | - Low        |
|                             |                                                                         | - High        |
|                             |                                                                         | - Unclear    |
| Selective outcome reporting | Reporting bias caused by the selective reporting of outcomes            | - Low        |
|                             |                                                                         | - High        |
|                             |                                                                         | - Unclear    |
**eTable 1: List of Excluded Studies**

| s/n | Study                  | Reason                  |
|-----|------------------------|-------------------------|
| 1   | Maiti 2016             | Adolescent              |
| 2   | Khopkar 2015          | Adolescent              |
| 3   | Paul 2013             | Adolescent              |
| 4   | Kamath 2012           | Adolescent              |
| 5   | Simsek 2012           | Adolescent              |
| 6   | Saha 2011             | Adolescent              |
| 7   | Oria 2010             | Adolescent              |
| 8   | Saha 2008             | Adolescent              |
| 9   | Saha 2008             | Adolescent              |
| 10  | Sesso 2004            | Adolescent              |
| 11  | Fernandes 2003        | Adolescent              |
| 12  | Zeelie 2010           | Adolescent              |
| 13  | van de Vijver 2016    | Duplicate               |
| 14  | Haregu 2016           | Duplicate               |
| 15  | Ezenwaka 1997         | Old BP cut-off          |
| 16  | Suriyawongpaisal 1993 | Old BP cut-off          |
| 17  | Suriyawongpaisal 1991 | Old BP cut-off          |
| 18  | Suthi-Amorn 1989      | Old BP cut-off          |
| 19  | Bunnag 1990          | Old BP cut-off          |
| 20  | E. Sharmin Trisha 2016| No relevant outcome     |
| 21  | Bhandari 2015         | No relevant outcome     |
| 22  | Oti 2014              | No relevant outcome     |
| 23  | Hiremath 2014         | No relevant outcome     |
| 24  | Joshi 2013            | No relevant outcome     |
| 25  | van de Vijver 2013    | No relevant outcome     |
| 26  | Itat 2011             | No relevant outcome     |
| 27  | Ahmed 2011            | No relevant outcome     |
| 28  | Haregu 2015           | No relevant outcome     |
| 29  | van de Vijver 2015    | No relevant outcome     |
| 30  | Kohli 2016            | No relevant outcome     |
| 31  | Mudgapalli 2016       | No relevant population  |
| 32  | Natarajan 2014        | No relevant population  |
| 33  | Kumaramanickavel 2014 | No relevant population  |
| 34  | Kumaramanickavel 2015 | No relevant population  |
| 35  | Huizebosch 2015       | No relevant population  |
| 36  | Madhu 2016            | No relevant population  |
| 37  | Mugure 2014           | No relevant population  |
| 38  | Mukhopadhyay 2012     | No relevant population  |
| 39  | Khan 2010             | No relevant population  |
| 40  | Jey Song 13           | Review                  |
| 41  | Dhar 2014             | Review                  |
| 42  | Bhargava 1991         | Review                  |
| 43  | Kien 2015             | Self-reported only      |
| 44  | Sur 2007              | Self-reported only      |
| 45  | Thakur 2013           | Self-reported only      |
| 46  | Ahmedani 2019         | No relevant outcome     |
| 47  | Ashe 2019             | No relevant outcome     |
| 48  | Asiki 2018            | No relevant outcome     |
| 49  | Bagdey 2019           | No relevant outcome     |
| 50  | Cope 2020             | No relevant outcome     |
| 51  | De Silva 2018         | No relevant outcome     |
| 52  | Kapwata 2018          | No relevant outcome     |
| 53  | Kawazoe 2018          | No relevant outcome     |
|   | First Name Last Name 20XX   | Outcomes                          |
|---|---------------------------|-----------------------------------|
| 57| Khanam 2019               | No relevant outcome               |
| 58| Kolak 2018                | No relevant outcome               |
| 59| Korn 2018                 | No relevant outcome               |
| 60| Kotian 2019               | No relevant outcome               |
| 61| Kumar 2018                | No relevant outcome               |
| 62| Ma 2018                   | No relevant outcome               |
| 63| Maharana 2019             | No relevant outcome               |
| 64| Nagarkar 2018             | No relevant outcome               |
| 65| Narendran 2018            | No relevant outcome               |
| 66| Rajapakshe 2018           | No relevant outcome               |
| 67| Sarkar 2019               | No relevant outcome               |
| 68| Scazufca 2019             | No relevant outcome               |
| 69| Wang 2018                 | No relevant outcome               |
| 70| Wekasah 2020              | No relevant outcome               |
| 71| Wilson 2020               | No relevant outcome               |
| 72| Yadav 2018                | No relevant outcome               |
| 73| Zhang 2019                | No relevant outcome               |
List of excluded studies

1. Maiti M, Bandyopadhyay L. Variation in blood pressure among adolescent schoolchildren in an urban slum of Kolkata, West Bengal. *Postgraduate Medical Journal (no pagination)*, 2016; Date of Publication: July 25. doi: [http://dx.doi.org/10.1136/postgradmedj-2016-134227](http://dx.doi.org/10.1136/postgradmedj-2016-134227)

2. Khopkar SA, Virtanen SM, Kulathinal S. Mental health, anthropometry and blood pressure among adolescents living in slums of Nashik, India. *Tanzania Journal of Health Research* 2015;17(4) doi: [http://dx.doi.org/10.4314/thrb.v17i4.6](http://dx.doi.org/10.4314/thrb.v17i4.6)

3. Paul B, Saha I, Mukherjee A. Adolescent Hypertension and Family History. *Pakistan Paediatric Journal* 2013;37(3):177-79.

4. Kamath N, Goud BR, Phadke KD, et al. Use of oscillometric devices for the measurement of blood pressure-comparison with the gold standard. *Indian Journal of Pediatrics* 2012;79(9):1230-32. doi: [http://dx.doi.org/10.1007/s12098-011-0600-0](http://dx.doi.org/10.1007/s12098-011-0600-0)

5. Simsek E, Selver B, Dallar Y, et al. Obesity epidemiology in children living in the lower socio-economic status. *Hormone Research in Paediatrics* 2012; Conference: 51st Annual Meeting of the European Society for Paediatric Endocrinology. doi: [http://dx.doi.org/10.1159/000343184](http://dx.doi.org/10.1159/000343184)

6. Saha I, Paul B, Mukherjee A, et al. Validity of the WHO criteria for adolescent hypertension. *East African journal of public health* 2011;8(2):135-37.

7. Oria RB, Patrick PD, Oria MOB, et al. ApoE polymorphisms and diarrheal outcomes in Brazilian shanty town children. *Brazilian Journal of Medical and Biological Research* 2010;43(3):249-56.

8. Saha I, Paul B, Dasgupta A. Prevalence of hypertension and variation of blood pressure with age among adolescents in Chetta, India. *Tanzania journal of health research* 2008;10(2):108-11.

9. Saha I, Paul B, Dasgupta A, et al. Variations of adolescent blood pressure by multifactorial analysis in an urban slum of Kolkata. *Journal of the Indian Medical Association* 2008;106(9)

10. Sesso R, Barreto GP, Neves J, et al. Malnutrition is associated with increased blood pressure in childhood. *Nephron Clinical Practice* 2004;97(2):c61-c66. doi: [http://dx.doi.org/10.1159/000078402](http://dx.doi.org/10.1159/000078402)

11. Fernandes MTB, Sesso R, Martins PA, et al. Increased blood pressure in adolescents of low socioeconomic status with short stature. *Pediatric Nephrology* 2003;18(3):435-39.

12. Zeelie A, Moss SJ, Kruger HS. The relationship between body composition and selected metabolic syndrome markers in black adolescents in South Africa: the PLAY study. *Nutrition* 2010;26(11-12):1059-64. doi: 10.1016/j.nut.2010.03.001 [published Online First: 2010/06/15]

13. Soudarssanane M, Mathanraj S, Sumanth M, et al. Tracking of blood pressure among adolescents and young adults in an urban slum of puducherry. *Indian journal of community medicine : official publication of Indian Association of Preventive & Social Medicine* 2008;33(2):107-12. doi: 10.4103/0970-0218.40879 [published Online First: 2008/04/01]

14. Werner ME, van de Vijver S, Adhiambo M, et al. Results of a hypertension and diabetes treatment program in the slums of Nairobi: a retrospective cohort study. *BMC health services research* 2015;15(pp 512) doi: [http://dx.doi.org/10.1186/s12913-015-1167-7](http://dx.doi.org/10.1186/s12913-015-1167-7)

15. van de Vijver S, Oti SO, Gomez GB, et al. Impact evaluation of a community-based intervention for prevention of cardiovascular diseases in the slums of Nairobi: the SCALE-UP study. *Glob Health Action* 2016;9(1):30922. doi: 10.3402/gha.v9.30922 [published Online First: 2017/02/06]
16. Haregu TN, Oti S, Egondi T, et al. Measurement of overweight and obesity in an urban slum setting in sub-Saharan Africa: a comparison of four anthropometric indices. *BMC Obesity* 2016;3:46. doi: 10.1186/s40608-016-0126-0 [published Online First: 2016/11/12]

17. Ezenwaka CE, Akanji AO, Akanji BO, et al. The prevalence of insulin resistance and other cardiovascular disease risk factors in healthy elderly southwestern Nigerians. *Atherosclerosis* 1997;128(2):201-11. doi: [http://dx.doi.org/10.1016/S0021-9150(96)05991-6](http://dx.doi.org/10.1016/S0021-9150(96)05991-6)

18. Suriyawongpaisal P, Underwood P. Situation of hypertension in some Bangkok slums. *Journal of the Medical Association of Thailand = Chotmaithet thangphaet* 1993;76(3):123-28.

19. Suriyawongpaisal P, Underwood P, Rouse IL, et al. An investigation of hypertension in a slum of Nakhon Ratchasima. *The Southeast Asian journal of tropical medicine and public health* 1991;22(4):586-94.

20. Sitthi-Amorn C, Chandraprasert S, Bunnag SC, et al. The prevalence and risk factors of hypertension in Klong Toey Slum and Klong Toey government apartment houses. *International Journal of Epidemiology* 1989;18(1):89-94.

21. Bunnag SC, Sitthi-Amorn C, Chandraprasert S. The prevalence of obesity, risk factors and associated diseases in Klong Toey slum and Klong Toey government apartment houses. *Diabetes Res Clin Pract* 1990;10(1)

22. N EST, Jelinek HF, Tarvainen MP, et al. Socioeconomic status, age and heart rate variability in a Bangladeshi community. *Conference proceedings : Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE Engineering in Medicine and Biology Society Annual Conference* 2016;01 doi: [http://dx.doi.org/10.1109/EMBC.2016.7591919](http://dx.doi.org/10.1109/EMBC.2016.7591919)

23. Bhandari S, Sarma PS, Thankappan KR. Adherence to antihypertensive treatment and its determinants among urban slum dwellers in Kolkata, India. *Asia Pacific journal of public health / Asia Pacific Academic Consortium for Public Health* 2015;27(2) doi: [http://dx.doi.org/10.1177/1010539511423568](http://dx.doi.org/10.1177/1010539511423568)

24. Oti SO, van de Vijver S, Kyobutungi C. Trends in non-communicable disease mortality among adult residents in Nairobi's slums, 2003-2011: applying InterVA-4 to verbal autopsy data. *Global health action* 2014;7(pp 25533) doi: [http://dx.doi.org/10.3402/gha.v7.25533](http://dx.doi.org/10.3402/gha.v7.25533)

25. Hiremath RN, Venkatesh G, Sharvesh, et al. Hypertension status and awareness among geriatric population living in Urban slum. *Nepal Journal of Epidemiology* 2014;Conference:International Conference on Research Methodology and Scientific Writing.

26. Joshi A, Mehta S, Grover A, et al. Knowledge, attitude, and practices of individuals to prevent and manage metabolic syndrome in an Indian setting. *Diabetes Technology and Therapeutics* 2013;15(8):644-53. doi: [http://dx.doi.org/10.1089/dia.2012.0309](http://dx.doi.org/10.1089/dia.2012.0309)

27. van de Vijver SJ, Oti SO, Agyemang C, et al. Prevalence, awareness, treatment and control of hypertension among slum dwellers in Nairobi, Kenya. *Journal of hypertension* 2013;31(5):1018-24. doi: 10.1097/HJH.0b013e32835e3a56 [published Online First: 2013/02/22]

28. Itrat A, Ahmed B, Khan M, et al. Risk factor profiles of South Asians with cerebrovascular disease. *International Journal of Stroke* 2011;6(4):346-48. doi: [http://dx.doi.org/10.1111/j.1747-4949.2011.00622.x](http://dx.doi.org/10.1111/j.1747-4949.2011.00622.x)

29. Ahmed B, Itrat A, Khan M, et al. Risk factor profiles of south asians with cerebrovascular disease: Findings from a community-based prevalence study in semiurban Pakistan. *Circulation: Cardiovascular Quality and Outcomes* 2011;Conference:Quality of Care
30. Haregu TN, Oti S, Egondi T, et al. Co-occurrence of behavioral risk factors of common non-communicable diseases among urban slum dwellers in Nairobi, Kenya. *Glob Health Action* 2015;8(28697) doi: https://dx.doi.org/10.3402/gha.v8.28697

31. van de Vijver S, Oti S, Moll van Charante E, et al. Cardiovascular prevention model from Kenyan slums to migrants in the Netherlands. *Global health* 2015;11(11):07. doi: https://dx.doi.org/10.1186/s12992-015-0095-y

32. Kohli C, Gupta K. LBOS 03-03 ECONOMIC IMPACT OF HYPERTENSION. *Journal of hypertension* 2016;34 Suppl 1 - ISH 2016 Abstract Book:e551-e52. doi: 10.1097/01.hjh.0000501509.98288.ad [published Online First: 2016/10/19]

33. Mudgapalli V, Sharan S, Amadi C, et al. Perception of receiving SMS based health messages among hypertensive individuals in urban slums. *Technology and Health Care* 2016;24(1):57-65. doi: http://dx.doi.org/10.3233/THC-151097

34. Natarajan S, Mohan S, Satagopan U, et al. Elderly patients with T2DM should be periodically screened for diabetic retinopathy and its complications to reduce visual morbidity - A study from slums of Western India. *Investigative Ophthalmology and Visual Science* 2014;Conference:2014 Annual Meeting of the Association for Research in Vision and Ophthalmology.

35. Kumaramanickavel G, Mohan S, Satagopan U, et al. Diabetic retinopathy in urban slums of Mumbai, India - Social, lifestyle, clinical and genetic risk factors. *Investigative Ophthalmology and Visual Science* 2014;Conference:2014 Annual Meeting of the Association for Research in Vision and Ophthalmology.

36. Kumaramanickavel G, Mohan S, Kumar Singh A, et al. AJDRUMSS-diabetic retinopathy prevalence study in Mumbai slums of India-association of demographic, genetic and medical risk factors. *Investigative Ophthalmology and Visual Science* 2015;Conference:2015 Annual Meeting of the Association for Research in Vision and Ophthalmology.

37. Hulzebosch A, van de Vijver S, Oti SO, et al. Profile of people with hypertension in Nairobi's slums: a descriptive study. *Globalization and health* 2015;11(pp 26) doi: http://dx.doi.org/10.1186/s12992-015-0112-1

38. Madhu B, Srinath KM, Chandresh S, et al. Quality of diabetic care in an urban slum area of Mysore: A community based study. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews* 2016 doi: http://dx.doi.org/10.1016/j.dsx.2016.03.014

39. Mugure G, Karama M, Kyobutungi C, et al. Correlates for cardiovascular diseases among diabetic/hypertensive patients attending outreach clinics in two Nairobi slums, Kenya. *Pan African Medical Journal* 2014;19(no pagination) doi: http://dx.doi.org/10.11604/pamj.2014.19.526

40. Mukhopadhyay A, Sundar U, Adwani S, et al. Prevalence of stroke and post-stroke cognitive impairment in the elderly in Dharavi, Mumbai. *Journal of Association of Physicians of India* 2012;60(10):29-32.

41. Khan RMA, Ahmad M. To assess the public awareness about obesity among adult populace of lahore. *Pakistan Journal of Medical and Health Sciences* 2010;4(4)

42. Etyang A, Harding S, Cricikshank JK. Slum living and hypertension in tropical settings: Neglected issue, statistical artifact or surprisingly slight? Insights amidst adversity. *Journal of Hypertension* 2013;31(5):877-79. doi: http://dx.doi.org/10.1097/HJH.0b013e32836103fb

43. Dhar L. Preventing coronary heart disease risk of slum dwelling residents in India. *Journal of family medicine and primary care* 2014;3(1):58-62. doi: 10.4103/2249-4863.130278 [published Online First: 2014/05/03]
44. Bhargava SK, Singh KK, Saxena BN. ICMR Task Force National Collaborative Study on Identification of High Risk Families, Mothers and Outcome of their Off-springs with particular reference to the problem of maternal nutrition, low birth weight, perinatal and infant morbidity and mortality in rural and urban slum communities. Summary, conclusions and recommendations. Indian Pediatrics 1991;28(12):1473-80. [published Online First: 1991/12/01]

45. Kien VD, Van Minh H, Giang KB, et al. Socioeconomic inequalities in self-reported chronic non-communicable diseases in urban Hanoi, Vietnam. Global Public Health 2015 doi: http://dx.doi.org/10.1080/17441692.2015.1123282

46. Sur D, Mukhopadhyay SP. A study on smoking habits among slum dwellers and the impact on health and economics. Journal of the Indian Medical Association 2007;105(9):492-98.

47. Thakur R, Banerjee A, Nikumb V. Health problems among the elderly: a cross-sectional study. Annals of medical and health sciences research 2013;3(1):19-25. doi: 10.4103/2141-9248.109466 [published Online First: 2013/05/02]

48. Ahmedani MY, Fawwad A, Shaheen F, et al. Optimized health care for subjects with type 1 diabetes in a resource constraint society: A three-year follow-up study from Pakistan. World J Diabetes 2019;10(3):224-33. doi: 10.4239/wjd.v10.i3.224

49. Ashe S, Routray D. Prevalence, associated risk factors of depression and mental health needs among geriatric population of an urban slum, Cuttack, Odisha. International Journal of Geriatric Psychiatry 2019;34(12):1799-807. doi: 10.1002/gps.5195

50. Asiki G, Mohamed SF, Wambui D, et al. Sociodemographic and behavioural factors associated with body mass index among men and women in Nairobi slums: AWI-Gen Project. Global health action 2018;11(sup2):1470738-38. doi: 10.1080/16549716.2018.1470738

51. Bagdey PS, Ansari JA, Barnwal RK. Prevalence and epidemiological factors associated with hypertension among post-menopausal women in an urban area of central India. Clinical Epidemiology and Global Health 2019;7(1):111-14. doi: 10.1016/j.cegh.2018.02.008

52. Cope AB, Edmonds A, Ludema C, et al. Neighborhood Poverty and Control of HIV, Hypertension, and Diabetes in the Women's Interagency HIV Study. AIDS Behav 2020;24(7):2033-44. doi: 10.1007/s10461-019-02757-5

53. De Silva AP, De Silva SHP, Haniffa R, et al. Inequalities in the prevalence of diabetes mellitus and its risk factors in Sri Lanka: a lower middle income country. Int J Equity Health 2018;17(1):45-45. doi: 10.1186/s12939-018-0759-3

54. Kapwata T, Manda S. Geographic assessment of access to health care in patients with cardiovascular disease in South Africa. BMC health services research 2018;18(1):197-97. doi: 10.1186/s12913-018-3006-0

55. Kawazoe N, Zhang X, Chiang C, et al. Prevalence of hypertension and hypertension control rates among elderly adults during the cold season in rural Northeast China: a cross-sectional study. J Rural Med 2018;13(1):64-71. doi: 10.2185/jrm.2959 [published Online First: 2018/05/29]

56. Khanam F, Hossain MB, Mistry SK, et al. Prevalence and Risk Factors of Cardiovascular Diseases among Bangladeshi Adults: Findings from a Cross-sectional Study. J Epidemiol Glob Health 2019;9(3):176-84. doi: 10.2991/jegh.k.190531.001

57. Kolak M, Bradley M, Block DR, et al. Urban foodscape trends: Disparities in healthy food access in Chicago, 2007–2014. Health & Place 2018;52:231-39. doi: 10.1016/j.healthplace.2018.06.003
58. Korn A, Bolton SM, Spencer B, et al. Physical and Mental Health Impacts of Household Gardens in an Urban Slum in Lima, Peru. *Int J Environ Res Public Health* 2018;15(8):1751. doi: 10.3390/ijerph15081751

59. Kotian S, Waingankar P, Mahadik V. Assessment of compliance to treatment of hypertension and diabetes among previously diagnosed patients in urban slums of Belapur, Navi Mumbai, India. *Indian Journal of Public Health* 2019;63(4):348. doi: 10.4103/ijph.ijph_422_18

60. Kumar R, Kaur N, Pilania M. Morbidity Pattern of Patients Attending a Primary Healthcare Facility in an Urban Slum of Chandigarh, India. *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH* 2018 doi: 10.4103/jcdr.jcdr_491_17

61. Ma C. The prevalence of depressive symptoms and associated factors in countryside-dwelling older Chinese patients with hypertension. *Journal of Clinical Nursing* 2018;27(15-16):2933-41. doi: 10.1111/jocn.14349

62. Maharana S, Garg S, Dasgupta A, et al. A study on impact of oral health on general health among the elderly residing in a slum of Kolkata: A cross-sectional study. *Indian Journal of Dental Research* 2019;30(2):164. doi: 10.4103/ijdr.ijdr_491_17

63. Nagarkar AM, Kulkarni SS. Obesity and its Effects on Health in Middle-Aged Women from Slums of Pune. *J Midlife Health* 2018;9(2):79-84. doi: 10.4103/jmjh.JMH_8_18

64. Narendran M, Rani BBS, Kulkarni P, et al. Interdependence of communicable and Non-Communicable diseases among elderly population in declared slum in Mysuru City, Karnataka. *Indian Journal of Public Health Research & Development* 2018;9(11):62. doi: 10.5958/0976-5506.2018.01426.2

65. Rajapakshe OBW, Sivayogan S, Kulatunga PM. Prevalence and correlates of depression among older urban community-dwelling adults in Sri Lanka. *Psychogeriatrics* 2018;19(3):202-11. doi: 10.1111/psyg.12389

66. Sarkar A, Roy D, Chauhan MM, et al. A lay epidemiological study on coexistent stress in hypertension: Its prevalence, risk factors, and implications in patients' lives. *Journal of family medicine and primary care* 2019;8(3):966-71. doi: 10.4103/jfmpc.jfmpc_60_19

67. Scazufca M, de Paula Couto MCP, Henrique MG, et al. Pilot study of a two-arm non-randomized controlled cluster trial of a psychosocial intervention to improve late life depression in socioeconomically deprived areas of São Paulo, Brazil (PROACTIVE): feasibility study of a psychosocial intervention for late life depression in São Paulo. *BMC public health* 2019;19(1):1152-52. doi: 10.1186/s12889-019-7495-5

68. Wang H, Su M, Fang P-q, et al. Analysis on Medical Expenses of Hypertensive Inpatients in Urban Areas from 2010 to 2013—Evidence from Two Provinces in South of China. *Current Medical Science* 2018;38(4):741-48. doi: 10.1007/s11596-018-1939-5

69. Wekesah FM, Klipstein-Grobusch K, Grobbbee DE, et al. Determinants of Mortality from Cardiovascular Disease in the Slums of Nairobi, Kenya. *Glob Heart* 2020;15(1):33-33. doi: 10.5334/gh.787

70. Wilson V, Nittoori S. Risk of type 2 diabetes mellitus among urban slum population using Indian Diabetes Risk Score. *Indian Journal of Medical Research* 2020;152(3):308. doi: 10.4103/ijmr.ijmr_1597_18

71. Yadav S, Saraswat N, Saini AK, et al. A REVIEW ON THE PREVALENCE OF HYPERTENSION IN SIDE-LINED POPULATIONS; SLUM DWELLERS, SHIFT JOB WORKERS AND OCCUPATIONAL NOISE AFFECTED WORKERS: ATTRIBUTABLE TO LIFESTYLE AND ENVIRONMENTAL FACTOR. *Asian Journal of Pharmaceutical and Clinical Research* 2018;11(10):18. doi: 10.22159/ajpcr.2018.v11i10.27007
72. Zhang X, Chen X, Gong W. Type 2 diabetes mellitus and neighborhood deprivation index: A spatial analysis in Zhejiang, China. *J Diabetes Investig* 2019;10(2):272-82. doi: 10.1111/jdi.12899 [published Online First: 2018/08/28]
eTable 2: Characteristics of included studies

| Study                  | Country       | Slum                              | Sample size | Age group | % female |
|------------------------|---------------|-----------------------------------|-------------|-----------|----------|
| Acharyya (2014)        | India         | North-Parganas                    | 1052        | 25-64     | 49.8     |
| Ahmad (2014)           | India         | Meerut                            | 196         | >60       | 50       |
| Akinwale (2013)        | Nigeria       | Ijora Oloye, Ajegunle & Makoko    | 2434        |           |          |
| Anand (2007)           | India         | Faridabad                         | 2562        | 15+       | 50.9     |
| Ayah (2013)            | Kenya         |                                   | 2061        | 18-90     | 49.1     |
| Banerjee (2016)        | India         | Kolkata                           | 10167       | >20 years | 60       |
| Chakerborty (2012)     | India         | Kolkata                           | 470         | 18-60     | 0        |
| Chaturvedi (2007)      | India         | Delhi                             | 596         | >20       |          |
| Daniel (2013)          | Nigeria       | Ajegunle                          | 964         | 20-81     | 65.8     |
| Dasappa (2015)         | India         | Bangalore                         | 2013        | 35+       | 50.8     |
| Deepa (2011)           | India         | Ballabgarh, Delhi, Chennai, Trivandrum, Dibrugarh and Nagpur | 15763 | 15-64     |          |
| Edwards (2015)         | Kenya         | Kibera                            | 774         | >20       | 64.7     |
| Ezeala-Adikaibe (2016) | Nigeria       | Enugu                             | 223         | 18-65     | 100      |
| Ferreira (2005)        | Brazil        | Maceio                            | 416         | 18-60     | 57       |
| Florencio (2004)       | Brazil        | Maceio                            | 416         | 18-60     | 57       |
| Haregu (2016)          | Kenya         | Nairobi                           | 5190        | 18+       | 46.2     |
| Heitinger (2014)       | Peru          | Lima                              | 142         | 18-81     | 69.7     |
| Huda (2012)            | Bangladesh    | Mirpur, Dhaka                      | 1000        | 15-65     | 33.4     |
| Jalil (2008)           | Pakistan      | Lahore                            | 695         |           | 43.6     |
| Joshi (2013)           | India         | Rourkela & Bhubaneswar            | 100         | >18       | 69       |
| Joshi (2014)           | Kenya         | Kibera                            | 2045        | 18-90     | 49.1     |
| Kar (2008)             | India         | Chandigarh & Haryana              | 1010        | >30       | 58.9     |
| Kar (2010)             | India         | Chandigarh & Haryana              | 150         | >30       | 62       |
| Khalequzzaman (2017)   | Bangladesh    | Dhakar                            | 2551        | 18+       | 46.7     |
| Kumari (2014)          | India         | Hyderabad                         | 250         |           | 78       |
| Lubree (2002)          | India         | Pune                              | 150         | 30-50     | 100      |
| Marins (2007)          | Brazil        | Rio-de-Janeiro                    | 3279        |           | 56.9     |
| Misra (2001)           | India         | Gautam-Nagar, Delhi               | 532         |           | 68       |
| Nirmala (2014)         | India         | Hyderabad, Telangana              | 700         | >20       | 50.8     |
| Olack (2015)           | Kenya         | Kibera                            | 1528        | 35-64     | 58.1     |
| Oli (2013)             | Nepal         | Kathmandu                         | 689         | 15-64     | 58.9     |
| Ongeti (2013)          | Kenya         | Kibera                            | 400         | 14-75     | 70.3     |
| Ott (2013)             | Kenya         | Vivasandani & Korogocho           | 400         | 18+       | 46       |
| Patil (2016)           | India         | Pune, Maharashtra                 | 425         | 20+       |          |
| Rahim (2004)           | Bangladesh    | Dhakar                            | 1555        | 20+       | 52.99    |
| Rawal (2017)           | Bangladesh    | Dhaka                             | 507         |           | 50       |
| Sayeed (2007)          | Bangladesh    | Dhakar                            | 592         |           |          |
| Singh (b) (2012)       | India         | Delhi                             | 474         | 60+       | 48       |
| Singh (2012)           | India         | Patna                             | 3118        | >30       | 56.5     |
| Sinha (2010)           | India         | Gokulpuri                         | 275         | 18-40     | 100      |
| Sithi-Amorn (1989)     | Thailand      | Klong-Toey                        | 976         |           | 54.7     |
| Author          | Country | City or Region          | Sample Size | Median Age |
|-----------------|---------|-------------------------|-------------|------------|
| Snyder (2017)   | Brazil  | 792                     | 64.5        |
| Sowemimo (2015) | Nigeria | Yemetu, Ibadan           | 806         | 18-90      |
| Sunita (2017)   | India   | Mumbai                  | 6464        | >40        |
| Unger (2015)    | Brazil  | Salvador                | 5649        | >18        |
| Uthakalla (2012)| India   | Hyderabad               | 20-60       | 56         |
| Vigneswari (2014)| India | Chennai                  | 529         | 18+        |
| Vigneswari (2015)| India |                         | 529         | 18+        |
| Vikram (2003)   | India   | New-Delhi               | 639         | 73.4       |
| Wasir (2007)    | India   | Delhi                   | 278         |            |
| Yajnik (2008)   | India   |                         | 142         | 30-50      |
| van de Vijver (2013) | Kenya | Viwandani & Korogocho     | 5190        | >18        |
| Chiang (2019)   | Bangladesh | Dhaka                 | 423         |            |
| Choudhury (2018)| Bangladesh | Dhaka                | 984         | 43.4       |
| Dwivedi (2018)  | India   | Bangalore               |             | 73         |
| Gadallah (2018) | Egypt   | West Delhi              |             |            |
| George (2019)   | India   | Bangalore               |             | 57.6       |
| Gonmei (2018)   | India   | Delhi                   |             |            |
| Jain (2019)     | India   | Delhi                   | 984         | 43.4       |
| Tymejczyk (2019)| Haiti   | Gurugram                | 420         | 57.6       |
| Vusirikala (2019)| Kenya | Nairobi                 |             |            |
## eTable 3: Risk of bias of included studies

| Study                  | Selection of participants | Confounding variables | Measurement of exposure | Blinding of outcome assessments | Incomplete outcome data | Selective outcome reporting |
|------------------------|---------------------------|-----------------------|-------------------------|---------------------------------|-------------------------|-----------------------------|
| Acharyya (2014)        | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Ahmad (2014)           | Low risk                  | Low risk              | High risk               | Low risk                        | Unclear risk            | Low risk                    |
| Akinwale (2013)        | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Anand (2007)           | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Ayah (2013)            | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Banerjee (2016)        | Low risk                  | Low risk              | Low risk                | Low risk                        | Unclear risk            | Low risk                    |
| Chakerborty (2012)     | High risk                 | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Chaturvedi (2007)      | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Daniel (2013)          | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Dasappa (2015)         | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Deepa (2011)           | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Edwards (2015)         | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Ezeala-Adikiebe (2016) | High risk                 | Low risk              | Low risk                | Low risk                        | High risk               | Low risk                    |
| Ferreira (2005)        | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Florencio (2004)       | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Haregu (2016)          | Unclear risk              | Low risk              | Low risk                | Low risk                        | Unclear risk            | Low risk                    |
| Heitzinger (2014)      | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Huda (2012)            | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Jalil (2008)           | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Joshi (2013)           | High risk                 | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Joshi (2014)           | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Kar (2008)             | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Kar (2010)             | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Khalequzzaman (2017)   | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Kumari (2014)          | Low risk                  | Low risk              | High risk               | Low risk                        | Low risk                | Low risk                    |
| Lubree (2002)          | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Marins (2007)          | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Misra (2001)           | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Nirmala (2014)         | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Olack (2015)           | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Oli (2013)             | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Ongeti (2013)          | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Oti (2013)             | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Patil (2016)           | Low risk                  | Low risk              | High risk               | Low risk                        | Low risk                | Low risk                    |
| Rahim (2004)           | Low risk                  | Low risk              | High risk               | Low risk                        | Low risk                | Low risk                    |
| Rawal (2017)           | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Sayeed (2007)          | Low risk                  | High risk             | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Singh (b) (2012)       | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Singh (2012)           | Low risk                  | Low risk              | Low risk                | Low risk                        | Low risk                | Low risk                    |
| Study                  | Selection of participants | Confounding variables | Measurement of exposure | Blinding of outcome assessments | Incomplete outcome data | Selective outcome reporting |
|-----------------------|---------------------------|-----------------------|-------------------------|--------------------------------|-------------------------|-----------------------------|
| Sinha (2010)          | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Sithi-Amorn (1989)    | Low risk                  | High risk             | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Snyder (2017)         | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Sowemimo (2015)       | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Sunita (2017)         | Low risk                  | High risk             | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Unger (2015)          | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Uthakalla (2012)      | Low risk                  | High risk             | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Vigneswari (2014)     | Low risk                  | High risk             | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Vigneswari (2015)     | Low risk                  | High risk             | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Vikram (2003)         | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Wasir (2007)          | Low risk                  | High risk             | Low risk                | Low risk                       | Low risk                | High risk                   |
| Yajnik (2008)         | Low risk                  | High risk             | Low risk                | Low risk                       | Low risk                | Low risk                    |
| van de Vijver (2013)  | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Bawah (2019)          | Unclear risk              | Low risk              | Low risk                | Low risk                       | Low risk                | Unclear risk                |
| Chiang (2019)         | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Choudhury (2018)      | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Dwivedi (2018)        | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Gadallah (2018)       | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| George (2019)         | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Gonmei (2018)         | Unclear risk              | Unclear risk          | Low risk                | Low risk                       | Low risk                | Unclear risk                |
| Jain (2019)           | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Tymejczyk (2019)      | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
| Vusinikala (2019)     | Low risk                  | Low risk              | Low risk                | Low risk                       | Low risk                | Low risk                    |
### Annex 1: MEDLINE Search Strategy

| 1 | exp hypertension/ |
| 2 | hypertens$.mp. |
| 3 | exp blood pressure/ |
| 4 | (blood pressure or bloodpressure).mp. |
| 5 | (essential adj3 hypertension).ti,ab. |
| 6 | (isolat* adj3 hypertension).ti,ab. |
| 7 | (elevat* adj3 blood adj pressur*).ti,ab. |
| 8 | (high adj3 blood adj pressur*).ti,ab. |
| 9 | (increase* adj3 blood pressur*).ti,ab. |
| 10 | ((systolic or diastolic or arterial) adj3 pressur*).ti,ab. |
| 11 | essential hypertension.mp. |
| 12 | isolated hypertension.mp. |
| 13 | elevated blood pressure.mp. |
| 14 | high blood pressure.mp. |
| 15 | increase blood pressure.mp. |
| 16 | diastolic pressure.mp. |
| 17 | pre-hypertension.mp. |
| 18 | pre-hypertensive.mp. |
| 19 | prehypertension.mp. |
| 20 | prehypertensive.mp. |
| 21 | arterial pressure.mp. |
| 22 | cardiovascular diseases/ |
| 23 | exp coronary disease/ |
| 24 | cardiovascular risk factor$.tw. |
| 25 | (cardiovascular adj3 disease$).tw. |
| 26 | (Coronary adj3 disease$).tw. |
| 27 | heart disease$.tw. |
| 28 | coronary risk factor$.tw. |
| 29 | or/1-28 |

| 1 | exp Diabetes Mellitus, Type 2/ |
| 2 | exp DIABETES MELLITUS/ |
| 3 | T2DM.ti,ab. |
| 4 | (Type* adj3 ("2" or "II" or two*) adj3 (diabete* or diabetic*)).tw. |
| 5 | ((Maturit* or adult* or slow*) adj3 onset* adj3 (diabete* or diabetic*)).tw. |
| 6 | ((Ketosis-resistant* or stable*) adj3 (diabete* or diabetic*)).tw. |
| 7 | ((Non-insulin* or Non insulin* or Noninsulin*) adj3 depend* adj3 (diabete* or diabetic*)).tw. |
| 8 | IDDM.ti,ab. |
| 9 | diabet$.ti. |
| 10 | PREDIABETIC STATE/ |
| 11 | prediabet$.ti,ab. |
| 12 | impaired glucose tolerance.ti,ab. |
| 13 | IGT.ti,ab. |
| 14 | Impaired fasting glucose.ti,ab. |
| 15 | IFG.ti,ab. |
| 16 | Impaired glucose regulation.ti,ab. |
| 17 | IGR.ti,ab. |
| 18 | GLUCOSE INTOLEANCE/ |
| 19 | (diabet* or glucose or hyperglycaemia or hyperglycaemia or postprandial or post-prandial or insulin or hypoglycaemia or IGT or OGTT or CGMS).tw. |
| 20 | (subclinical diabetes" or "subclinical diabetic" or "sub-clinical diabetes" or "sub-clinical diabetic").tw. |
| 21 | or/1-20 |

| 22 | (baladi or bandas de miseria or barraca or barrio marginal or barrio or bidonville or brarek or bustee or chalis or chereka bete or dagutan or estero or favela or galoos or gecekondu or hrousheb)b.mp. |
| 23 | (ishash or karyan or katras or looban or loteamento or medina achouaia or morro or mudun safi or musseque or solares or tanake or taudis or township or tugurio or udukku or umjonjolo or waata or zapadpatti).mp. |
| 24 | (slum or slums or ghetto or ghettos or informal settlement$ or shantytown$ or shanty town$).mp. |
| 25 | slum/ |
| 26 | ghetto/ |
| 27 | or/22-26 |