



Fast track – ISH2022 KYOTO

Socioeconomic impact and burden of hypertension in the Philippines projected in 2050

Leilani B. Mercado-Asis^{1,2} · Deborah Ignacia D. Ona^{2,3,4} · Dolores Bonzon^{2,3} · Gilbert A. Vilela^{2,5} · Alejandro F. Diaz^{1,2} · Benjamin A. Balmores^{2,4} · Marlon Co^{2,6} · Arnold Benjamin Mina^{2,7} · Alberto A. Atilano^{1,2} · Esperanza I. Cabral^{2,8} · Abdias V. Aquino^{2,4} · Nelson S. Abelardo^{2,9} · Lyn A. Gomez^{2,10} · Les Paul Valdez¹ · Rafael R. Castillo^{2,9}

Received: 15 August 2022 / Revised: 1 September 2022 / Accepted: 12 September 2022 / Published online: 14 October 2022
© The Author(s), under exclusive licence to The Japanese Society of Hypertension 2022

Abstract

Hypertension has remained the number one cause of cardiovascular death in the Philippines for over three (3) decades. Despite this finding, the burden accounted for by hypertension is investigated to a lesser extent. We performed this study to determine the socioeconomic impact of hypertension in the Philippines, and it was projected in the next 30 years. We gathered primary data through interviews, Labor Force Survey ($N = 806$), and secondary data from various government published reports. The cost of illness (COI) was calculated using the direct morbidity and mortality costs. The impact (% of respondents) of uncontrolled hypertension on productivity at work showed the following; four (4) days missing work (72%) and ten (10) days lost of productivity (63%). The impact (% of respondents) of uncontrolled hypertension on productivity at home showed the following: six (6) days of household suspended (66%), eleven (11) days reduced household work (78%), and five (5) days affected social activity (60%). The productivity loss of premature mortality accounts for 17% of the total economic burden in 2020 and will increase to 20% by 2050. In 2020, 70% of the total economic burden was accounted for direct & indirect care. At its present value, the economic cost of hypertension is expected to increase from US\$1 billion in 2020 to US\$1.9 billion by 2050. The socioeconomic impact of uncontrolled hypertension in the Philippines was enormous, challenging, and overwhelming for the next 30 years.

Keywords Burden of disease · Cost of illness · Hypertension · Projection · Socioeconomic impact

Introduction

In a recent global network study that covered the period 1990–2019 among adults aged 30–79 years, individuals affected with hypertension increased from 650 million to 1.28 billion in the last thirty (30) years [1]. Although there was little change in the overall prevalence of hypertension, the burden has shifted from wealthy nations to low- and middle-income countries, where 82% of people (1 billion) with hypertension reside [1, 2]. In some low-income and middle-income countries such as Eritrea, Bangladesh, Ethiopia, and the Solomon Islands, age-standardized hypertension prevalence was low and lowest in Southeast Asian countries like Taiwan, South Korea, and Japan [1].

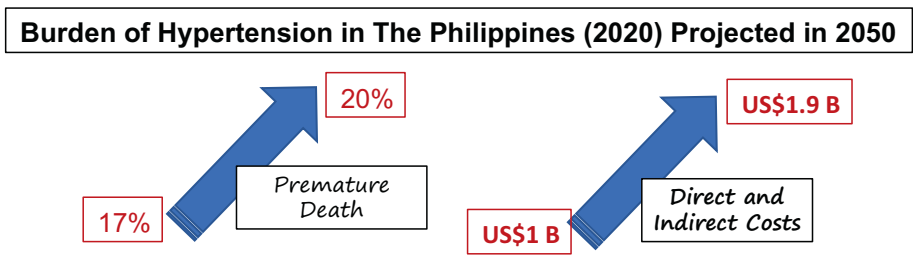
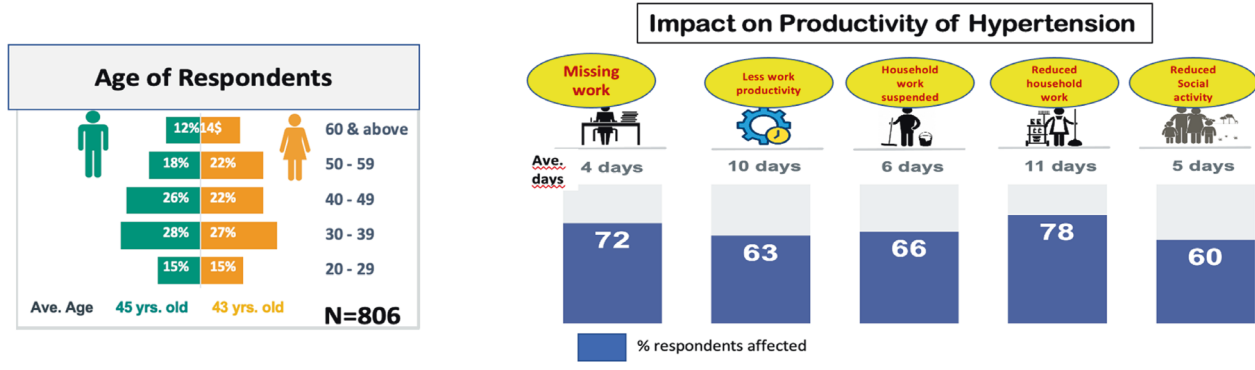
Hypertension treatment gaps continuously remain a dilemma in numerous published reports. Although treatment rates have successfully scaled up in some middle-income countries, there has been little change in

✉ Leilani B. Mercado-Asis
lmais@ust.edu.ph

¹ University of Santo Tomas Hospital, Manila, Philippines
² Philippine Society of Hypertension, Pasig City, Philippines
³ University of the Philippines-Philippine General Hospital, Manila, Philippines
⁴ St. Luke's Medical Center, Quezon City, Philippines
⁵ Philippine Heart Center, Quezon City, Philippines
⁶ Cebu Doctors University Hospital, Cebu City, Philippines
⁷ Adventist University of the Philippines College of Medicine, Silang, Cavite, Philippines
⁸ Makati Medical Center, Makati City, Philippines
⁹ Manila Doctors Hospital, Manila, Philippines
¹⁰ Asian Hospital and Medical Center, Muntinlupa City, Philippines

Graphical Abstract

Socioeconomic Impact and Burden of Hypertension in The Philippines Projected in 2050



sub-Saharan Africa, central, south, southeast Asia, and Pacific Islands nations [1]. Treatment rates remain below 20%, creating a massive global inequity in hypertension therapy [1, 3–5].

Variations in the levels of risk factors for hypertension, such as high sodium intake, obesity, alcohol consumption, smoking, physical inactivity, and unhealthy diet, may explain regional heterogeneity in hypertension prevalence. Likewise, screening, diagnosis, and management schemes for hypertension may explain differences in hypertension prevalence [2, 3, 5–10]. Socioeconomic status, including educational attainment, type of work, employment, and area of residency, may significantly influence how affected individuals confront their health problems [5–10]. Furthermore, even countries in the low-income bracket may have a different medical system for healthcare coverage complicated by the socio-cultural environment [6–11].

Although such factors mentioned above have long been recognized and addressed by global governmental policies, the issue remains a serious challenge, with a high rate of hypertension unawareness and undiagnosed, over 50%, in the forefront [1].

The burden of disease is a concept to describe death and loss of health due to diseases. It is estimated by calculating the number of life a person loses as a consequence of dying early because of a disease (called YLL, or years of life lost) and the number of years of life a person lives with a disability caused by the disease (called YLD or years of life

lived with disability). The disease burden is calculated to have scientific, accurate, and meaningful health information on which national and international health policies will be based [12, 13].

Although numerous reports have already been published on the burden of hypertension, only a few have specifically addressed productivity loss and mortality due to uncontrolled blood pressure [4, 14]. We performed this study to determine hypertension’s socioeconomic impact and burden on the Philippine economy and projected results in the next 30 years. We investigated how uncontrolled blood pressure affects Filipinos’ productivity at work, at home, and in social activities. To date, this is the first report of the calculated burden of hypertension with projection in a South-east Asian country.

Methods

Briefly, the prevalence of hypertension by age was projected (until 2050) using historical values from 1993 to 2018 (linear regression). The population projections (until 2050) by age were obtained from the United Nations World Prospect. Both reports and deaths due to hypertension in the Philippines were included in our recently published paper [15]. A combination of primary and secondary research was implemented to capture costs incurred due to hypertension and its sequelae.

The conduct of a literature review or analysis of other secondary data aims to determine the probabilities of hypertension severity and the presence of comorbidities. Data from different sources such as Philippine Statistics Authority [16], Family Income and Expenditure Survey (FIES) [17], National Demographic and Health Survey (NDHS) [18], National Nutrition Survey [19], Institute for Health Metrics and Evaluation (IHME) [20], United Nations World Population Prospects [21], World Health Organization (WHO) [22] and Labor Force Survey were used to get data on the parameters used in computing the economic burden of hypertension.

The primary research conducted was via online quantitative interviews (patient surveys). It covered 806 hypertensive sufferers who were the primary decision-makers in choosing and purchasing hypertension medicines and were familiar with the costs of medicines and treatment. The sample was broken down into socioeconomic classes, areas, and patient types. Demographic profiles of respondents were obtained.

Estimating the cost of illness (COI) on hypertension

The cost of illness (COI) study on hypertension uses a top-down method to estimate the resource consumption using survey and government administrative data. The method is similar to previous studies examining COI of various conditions and diseases [23]. For each age group, i , COI is the sum of healthcare cost (H), mortality (Mt) and morbidity (Md) costs associated with hypertension.

$$COI_i = H_i + Mt_i + Mdi$$

Economic burden of hypertension with projection to 2050

Healthcare cost (H) comprises direct and indirect healthcare costs during hospitalization and outpatient care visits. The annual inpatient costs were obtained by multiplying the expected number of hypertensives, Hyp , in the age group, i , and the probability of hospitalization (IP) and unit costs (UI) for the age group, i . The probability of hospitalization (IP) and unit costs (UI) for each group, i , was derived from the patient survey. The unit cost of hospitalization captures both the direct healthcare costs (e.g., hospital fees; professional fees; drugs; diagnostics) and non-healthcare costs (e.g., food admissions, linen, transportation). The annualized probability of outpatient visits (OP), frequency of outpatient visits (FO), and unit cost for each age group were derived for outpatient care. Similar to the cost of inpatient care, both direct health and non-healthcare costs were included. The total healthcare costs could be summarized

below

$$H_i = (Hyp_i \times IP_i \times UI_i) + (Hyp_i \times OP_i \times FO_i \times UO_i)$$

The morbidity costs associated with hypertension, Md , were estimated. The associated cost was obtained by multiplying the number of hypertensives, Hyp , for each age group, i , with the probability of having a hypertension attack in a given year, Att , and productive days cost due to hypertension, $Prod$, and the average daily wage, Lab . The probability of hypertension attack, the number of productive days lost, and the annualized average wage was derived from the patient survey and the 2018 Labor Force Survey of the Philippine Statistical Authority (PSA) [16], respectively.

$$Md_i = Hyp_i \times Att_i \times Prod_i \times Lab_i$$

Productivity loss: years lost due to disability (YLD) and years life lost (YLL)

For the cost of premature deaths, the human capital approach (HC) was used, assuming that the value to society of an individual's life is measured by future production potential, usually calculated as the present discounted value of expected labor earnings [24]. The mortality cost was calculated by multiplying the expected deaths for each age group, i , and discounting the average wage. A standard discounting rate, r , of 3% was used, and the remaining life years, t , for each age group, i , was accounted. The remaining life years were obtained from PSA's [16] life tables.

$$Mt_i = Deaths_i \frac{Lab_i}{(1+r)^t}$$

The medium and long-term costs of hypertension were examined by projecting the number of hypertension cases, Hyp , and deaths, $Deaths$. The prevalence of hypertension among adults was projected by the five-year age group (20 years old and above) and sex using a linear regression model. The historical values of the prevalence of hypertension were obtained from 1990 to 2018 National Nutrition Survey [19]. The estimated hypertension cases until 2050 were obtained by multiplying the projected prevalence by the age-sex population from United Nations' population projection [21]. At the same time, the number of deaths attributable to hypertension was estimated by multiplying the age-sex projected deaths from the United Nations by the share of the following causes of death: ischemic heart diseases, chronic kidney disease, stroke, and hypertensive heart [21]. The share was obtained from the Institute for Health Metrics and Evaluation (IHME) [20]. To further isolate the number of cases attributable to hypertension, it

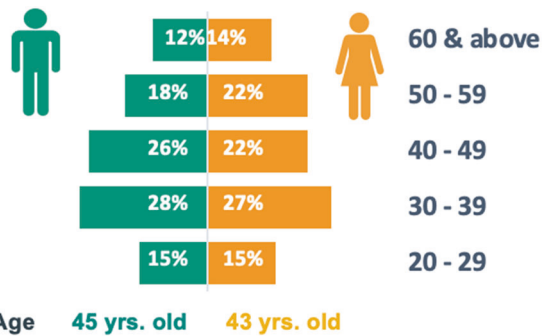


Fig. 1 Age grouping of respondents of both gender, $N = 806$

was multiplied further with the attributable risk factor (ARF) of the four diseases. The ARF for the specific diseases was also obtained from IHME [20]. The calculation of hypertension prevalence and the number of hypertensive Filipinos projected in 2050 using 806 respondents was performed in the present study. Better data results, however, using the projected Philippine population in 2050 have been recently published [15].

Results

Demographic profile of respondents

Eight hundred six respondents participated in the survey. Figure 1 shows their age groupings with an average age of 43 and 45 years in males and females, respectively. Most respondents (72%) have suffered from hypertension for five years or less. The diagnosis was made thru routine screening (55%) or exhibiting symptoms (45%). The diagnosing physicians were more family medicine doctors or generalists (45%) and internists (34%). Further, the institutions patients go to for diagnosis were either government hospitals (40%) or barangay/district health units (28%).

Using the classification based on the American Heart Association, sampled respondents' current blood pressure status was within Stage 2 (64%, $\geq 140/90$) [25]. Upon asking the respondents to compare their current BP status against the status when they were diagnosed, patients felt that their BP was either the same (31%) or better (33%). However, it is essential to note that quite many few patients were unaware of their current BP status (29%). Looking at the BP level on a per segment basis, patients from the greater Manila area (GMA) (56%), patients with multiple consults (33%), and patients without comorbidities (33%) have lesser monitoring despite having more critical status (77%, 67%, and 68%, respectively). The incidence of more severe BP levels increased with higher income (70%) and was observed more among males (70%) than females (58%). The majority (87%) do not have comorbidities. However,

for those who have (13%), heart problems (4%), stroke (2%), and kidney problems (2%) were the top comorbid conditions.

There was high compliance among respondents who were medicating (100%). Majority purchase medicines at least monthly (33%) or every 2–3 months (21%) via personal visits (96%) to chain drugstores (72%) in the past six months. On average, per purchase occasion, a patient spent a total of US\$17.74, wherein 88% purchased medicines, while 12% was allotted for other charges like parking fees, transportation, and food. The fund was usually out-of-pocket (83%), mainly from the patient's monthly salary (52%). In the past six months, 7 in 10 patients have visited a healthcare facility, on average, every other month. The main reasons for visiting a healthcare facility were symptomatic high blood pressure (58%) or follow-up medical check-ups (40%). Generalists and internists (32%) were the doctors usually visited by respondents. Private hospitals were the most commonly visited facility for their first visit (44%) and their current visits (39%). On average, the patient spent US \$37.63 during their last consultation, wherein 29% went on drugs/medicine expenses, 27% on transportation, 21% on diagnostic tests, 14% on professional fees, 5% on hospital administration fees, and 4% on food expenses. Similarly, spending was mainly out-of-pocket (41%), coming from the patient's monthly salary (24%).

Owning a BP device was not common among the respondents; 65% do not own a BP device. For those who own a device, it was portable primarily for the upper arm (48%). Fifty percent (50%) claimed their doctors advised them to purchase one. A BP device costs around US\$25.18 is usually purchased out-of-pocket, mainly from their salary (58%).

Only less than a tenth of hypertensive patients were hospitalized in the past year (8%). For the few hospitalized, it was mainly due to hypertensive emergency (97%). On average, the patient spent five days in a public hospital (80%). On average, per hospitalization, a patient spent US \$79.50, wherein 32% went to hospital fees, 7% to doctor's professional fees, and 12% on food expenses.

Parameters used in estimating the cost of illness (COI) for hypertension (Table 1)

The prevalence of hospitalization increases by age group; young adults aged 20–29 with hypertension are four times less likely to be hospitalized than their counterparts aged 60. The unit cost of hospitalization also increases with age. The unit cost of hospitalization among the older age group (60 years old-up) is almost twice as young adults. In terms of outpatient visits, young adults are more likely to have an outpatient visit but with lesser frequency and lower unit costs.

Table 1 Parameter values estimating the cost of illness for hypertension among age group

	20–29 years old	30–39 years old	40–59 years old	60 years old & above
Hospitalization (%)	4	5	8	15
Outpatient visits (%)	75	68	67	61
Frequency (#) of healthcare facility visit (past 6 months)	2	2	3	3
Unit cost per inpatient visit (US\$)	54.52	75.44	65.72	99.33
Unit cost per outpatient visit (US\$)	11.64	22.13	26.61	28.79
Productivity losses (days)	8	9	9	12
Population without HTN attack (%)	43%	34%	33%	42%
Years expected to live (average)	50.6	41.2	27.9	9.8

HTN hypertension

The unit cost of hospitalization and outpatient visits (Fig. 2)

For inpatient care, approximately 71% of the total inpatient care accounted for is direct healthcare spending (e.g., hospital administration fee, professional fee, diagnostics, and medicines), and the remaining is direct non-healthcare spending (e.g., food and transportation, Fig. 2A). Direct healthcare spending accounts for about 88% of outpatient care. Among direct healthcare spending, drugs appear to be the most significant contributor (Fig. 2B).

Projected economic burden of hypertension (Fig. 3)

In 2020, ~75% of the total economic burden was accounted for direct & indirect care, but the economic burden of premature mortality is expected to increase. In the next 30 years (2021–2050), the economic cost of hypertension is expected to increase from US\$1 B in 2020 to US\$1.9 B by 2050 (Fig. 3A). In 2020, healthcare costs from outpatient care services account for about 65% of the total economic burden. While outpatient spending is expected to increase in the medium to long-term, the share will slightly decline as the share of productivity loss due to premature mortality is expected to accelerate. The productivity loss due to premature mortality accounts for 17% of the total economic burden in 2020, which is expected to increase to 20% by 2050 (Fig. 3B). Majority of the expenses were incurred due to uncontrolled hypertension.

Productivity loss due to years lost due to disability (YLD) and years of life lost (YLL) projected in 2050 (Table 1, Fig. 4)

Hypertension sufferers 40 years and older will get the most significant share of productivity loss due to uncontrolled hypertension (Table 1). Productivity loss of patients between the age of 40–59 years old shall increase as they move up to the older age—with 60 years old and above. This

age group will be the main contributor to the productivity loss due to morbidity or disability (Fig. 4A). In addition, patients aged 60 years old and above will be the main contributor to the loss of productivity due to mortality (Fig. 4B). The cost of burden of from both losses (years lost due to disability, (YLD) and years of life lost, (YLL) are in US\$ billions.

Impact of uncontrolled hypertension on the socioeconomic status of Filipinos (Fig. 5)

The impact (% of respondents) of uncontrolled hypertension on productivity at work showed the following average number of days affected; four (4) days missing work (72%) and ten (10) days lost of productivity (63%). The impact (% of respondents) of uncontrolled hypertension on productivity at home showed the following: six (6) days of household suspended (66%), eleven (11) days reduced household work (78%), and five (5) days affected social activity (60%). Overall, an average total of 36 days of productivity were affected.

Hypertensive patients with comorbidities significantly impact productivity, with a total loss or decrease of 73 days. Senior respondents (60 years and older) were also significantly impacted, totaling 43 days.

Discussion

The global prevalence of hypertension

The increased number of individuals affected by hypertension thru the years seems to have been masked by an apparent stable hypertension prevalence reported across continents [1]. This observation has been demonstrated in sub-Saharan Africa, Oceania, and south Asia [1]. In the NCS RisC study, hypertensive individuals doubled from 331 to 626 million women and 317 to 652 million men from 1990 to 2019 [1]. In our recent projection prevalence report

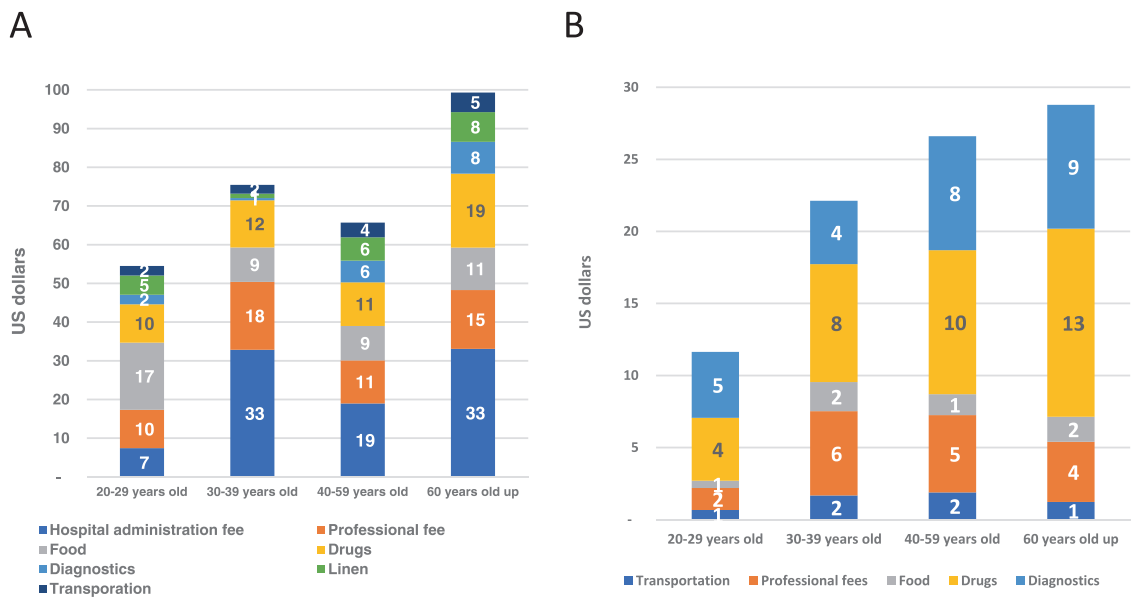


Fig. 2 Unit cost for hospitalization (A) and outpatient visits (B) expressed in US dollars

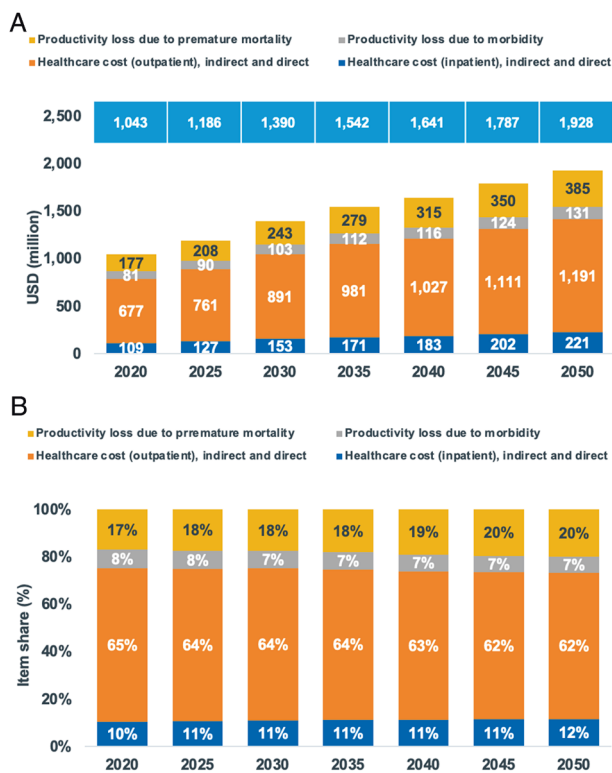


Fig. 3 Inpatient and outpatient direct and indirect healthcare cost and productivity loss due to morbidity and premature mortality expressed in US dollars (A) and in percentage share by item (B)

based on population, the Philippine hypertension prevalence from 23% in 2015 will merely increase to 28% in 2050. However, with a projected increase in the population from 101.60 million in 2015 to 142.10 million in 2050, Filipinos affected with hypertension will significantly increase from

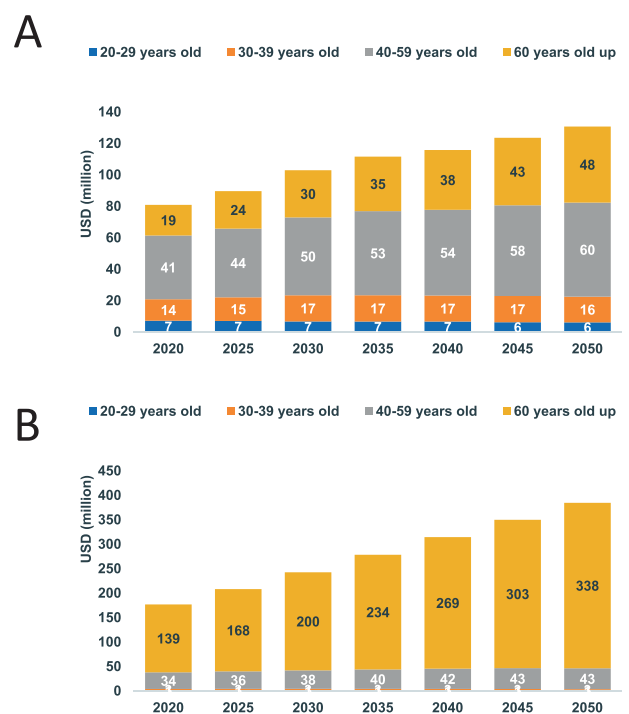
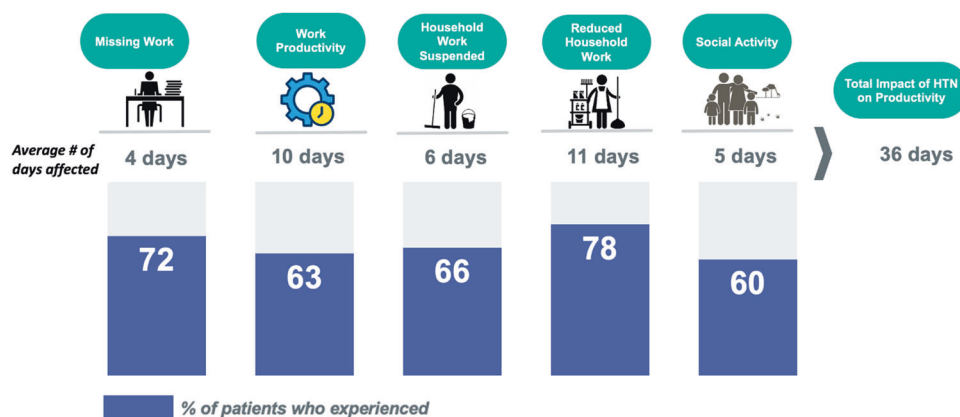


Fig. 4 Productivity loss due to years lost due to disability (YLD, A) and years of life lost (YLL, B) in US dollars grouped by age projected in 2050

24.28 million to 33.82 million, with an increase of 10 million in the next three (3) decades [15]. Similarly, Jin et al. have reported an estimate of 270.9 million increase in individuals aged >20 years with BP >140/90 mm Hg from 2000 to 2025 in China, India, and some Asian countries [26].

Fig. 5 Impact of uncontrolled blood pressure on productivity and social activity (# of days affected) among hypertensive patients (% of respondents affected, $N = 806$). HTN hypertension



Factors for increased burden of hypertension

With the continuous increase in the aging population and prolonged life expectancy, disease burden will significantly occur, especially in the Asian region like India, China, and Japan [15, 27–29]. The global scenario of increasing numbers of hypertensive individuals affected by uncontrolled blood pressure observed in the middle-and low-income countries with adverse cardiovascular consequences of ischemic heart disease, stroke, and kidney disease has grown a significant concern. The recent report by the NCD RisC resonates with contributing factors that have been reported worldwide: unawareness, low rates of detection, high rate of untreated, low treatment and control rates, and gender inequity and differences. Only about 50% are diagnosed, and only two-thirds are treated. Of those treated, only half are controlled [1, 4, 26–28, 30]. These factors lead to increased burden of disease leading to high premature death worldwide [1, 26, 30].

Loss of productivity and socioeconomic impact of uncontrolled hypertension

Individuals with hypertension are now getting younger. This observation was shown in our projected prevalence report and another middle- and low-income countries [1, 4, 15, 25, 29]. In our current study, 68% of the respondents were in the age of the active workforce. Uncontrolled hypertension has been shown to decrease work productivity and increases the risk of premature death. Hird and colleagues reported that among young hypertensives aged 20–69 years, over 149,846 excess deaths led to the loss of over 548,794 years of life and 609,801 productivity-adjusted life years, equating to AUD\$137.2 billion (US\$19.6) lost in gross domestic product (GDP) [4]. In our study, hypertension costs will take 0.3% of the GDP and gradually increase up to almost ~1% in the coming years.

Hypertension was the leading cause of increased cost-of-illness that significantly affected the economic status, as Stevens and his group reported in Mexico [14]. Absenteeism was estimated at three days per year and increased to 75 days when admitted to hospital because of myocardial infarction, which imposes the most significant financial cost (US\$2.5 B), of which half goes to hypertension-related expenses. Of the 1.63 million disability-adjusted life years (DALYs) adjusted for comorbidities, there are 902,081 healthy years lost [14]. In our projected prevalence and burden of hypertension studies, we have shown similar alarming socioeconomic impacts and challenges. Both years of life lost (YLL) and years lived with disability (YLD) doubled up in billions of pesos/US dollars (Fig. 4). Majority of the respondents experienced decreased productivity both at work and at home. Social activity was significantly affected as well (Fig. 5).

Strategies and solutions

Several governmental and non-governmental programs have been shown to curb the looming effect of uncontrolled blood pressure effectively. The expansion of universal health coverage and primary care can be leveraged to enhance hypertension care. We have reported how Sin Tax Law has succeeded in decreasing the proportion of smokers and alcohol drinkers in its 6th year of implementation. Collaborative efforts between local and international agencies (Philippine Department of Health and WHO) thru the Package of Essential (PEN) program increased the availment of anti-hypertensive medications [15]. In our current study, we have shown the valuable role of the generalists and internists as front liners in diagnosing and managing hypertensive individuals. The Philippine Society of Hypertension is now in its 19th year of providing annual clinical courses on hypertension fundamentals, empowering medical and non-medical professionals.

Conclusion

The increasing burden of hypertension stems from several factors affecting diagnosis and management, leading to increased morbidity and mortality. For the next 30 years, the economic burden of hypertension in the Philippines will double due to increased indirect and direct costs, loss of productivity, and premature death. Multisectoral call-to-action initiatives are warranted to curb the challenges incurred by this preventable illness.

Funding The study was supported by a research grant from the Philippine Society of Hypertension.

Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

References

- NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *Lancet*. 2021;398:957–80.
- Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. *Nat Rev Nephrol*. 2020;16:223–37.
- Galson SW, Staniffer JW, Hertz JT, Temu G, Thielman N, Gafaar T, et al. The burden of hypertension in the emergency department and linkage to care: a prospective cohort study in Tanzania. *PLoS One* 2019;14: <https://doi.org/10.1371/journal.pone.0211287>. eCollection 2019.
- Hird TR, Zomer E, Owen AJ, Magliano DJ, Liew D, Ademi Z. Productivity burden of hypertension in Australia. *Hypertension*. 2019;73:777–84.
- Kothavale A, Pun P, Yadav S. The burden of hypertension and unmet need for hypertension care among men aged 15–54 years: a population-based cross-sectional study in India. *J Biosoc Sci* 2021;1–22. <https://doi.org/10.1017/S0021932021000481>.
- Guwatudde D, Nankya-Mutyoba J, Kalyesubula R, Laurence C, Adebamowo C, Ajayi I, et al. The burden of hypertension in sub-Saharan Africa: a four-country cross sectional study. *BMC Public Health*. 2015;15:1211.
- Goswami AK, Gupta SK, Kalaivani M, Nongkynrih B, Pandav CS. Burden of hypertension and diabetes among urban population aged >60 years in South Delhi: a community-based study. *J Clin Diagn Res*. 2016;10:LC01–5. <https://doi.org/10.7860/JCDR/2016/17284.7366>. Epub 2016 Mar 1.
- Miraglia JL, Mafra ACCN, Monteiro CN, Borges LM. The variation of the burden of hypertension and diabetes in two large districts of the city of Sao Paulo, Brazil, based on primary health care routinely-collected data. *PLoS One*. 2019;14:e0213998 <https://doi.org/10.1371/journal.pone.0213998>.
- Dereje N, Earsido A, Temam L, Abebe A. Uncovering the high burden of hypertension and its predictors among adult population in Hosanna town, southern Ethiopia: a community-based cross-sectional study. *BMJ Open*. 2020;10:e035823 <https://doi.org/10.1136/bmjopen-2019-035823>.
- Hajri T, Caceres L, Angamarca-Armijos V. The burden of hypertension in Ecuador: a systematic review and meta-analysis. *J Hum Hypertens*. 2021;35:389–97.
- Keaseley J, Oyebo O, Shantikumar S, Proto W, McGranahan M, Sabouni A, et al. A systematic review of the burden of hypertension in humanitarian crisis settings. *BMJ Glob Health*. 2020;5:e002440 <https://doi.org/10.1136/bmjgh-2020-002440>.
- Total burden of disease (DALY, YLL and YLD)-states & territories. <https://health.act.gov.au/about-our-health-system/data-and-publications/healthstats/statistics-and-indicators/total-burden-0>. Accessed 15 August 2022.
- Clow B. Burden of disease: what it means and why it matters. <https://evidencenetwork.ca/burden-of-disease-what-it-means-and-why-it-matters/>. Accessed 15 August 2022.
- Stevens B, Pezzullo L, Verdian L, Tomlinson J, Estrada-Aguilar C, George A, et al. economic Burd hypertension, heart Fail, Myocard Infarct, Atr fibrillation Mex. 2018. <https://doi.org/10.1016/J.ACMX.2018.03.004>. Accessed on 13 August 2022.
- Mercado-Asis LB, Atilano AA, Ona DID, Bonzon DD, Vilela GA, Chua CL, et al. Prevalence of hypertension in the Philippines in the year 2050: confronting a major challenge. *J Clin Med Res*. 2022;3:1–13.
- Philippine Statistics Authority. Philippine projection statistics. 2019. <https://psa.gov.ph/statistics/census/projected-population>. Accessed 26 Dec 2020.
- Family Income and Expenditure Survey. <https://psa.gov.ph/fies-index>. Accessed on 15 August 2022.
- National Demographic and Health Survey (NDHS). <https://psa.gov.ph/content/national-demographic-and-health-survey-ndhs>. Accessed on 15 August 2022.
- Food and Nutrition Research Institute. Expanded National Nutrition Survey (ENNS): 2019 results. <http://enutrition.fnri.dost.gov.ph/site/uploads/2019%20ENNS%20Provincial%20Dissemination%20-%20Angeles%20City.pdf>.
- Institute for health metrics and evaluation. 2019. <https://vizhub.healthdata.org/gbd-compare/>. Accessed 2 Nov 2019.
- United Nations Department of Economic and Social Affairs. Population Dynamics. World Population Prospects 2019. <https://population.un.org/wpp/>. Accessed 8 Oct 2021.
- World Health Organization. Global health observatory data repository. Raised blood pressure (SBP > 140 or DBP >, crude (%), estimates by country 2017. <https://apps.who.int/gho/data/view.main.2464EST?lang=en>. Accessed 26 Dec 2020.
- Cost of Illness. <https://www.cdc.gov/policy/polaris/economics/cost-illness/index.html>. Accessed on 15 August 2022.
- Present Discounted Value. <https://philschatz.com/economics-book/contents/m48834.html>. Accessed 15 August 2022.
- Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran P, et al. 2020 International Society of Hypertension global hypertension practice guidelines. <https://www.ahajournals.org/doi/pdf/10.1161/HYPERTENSIONAHA.120.15026> Accessed 15 August 2022.
- Jin C-N, Yu C-M, Sun J-P, Fang F, Wen Y-N, Liu M, et al. The healthcare burden of hypertension in Asia. *Heart Asia*. 2013;5:238–43.
- Bhise MD, Patra S. Prevalence and correlates of hypertension in Maharashtra, India: a multilevel analysis. *Asia Pac J Public Health*. 2019;31:101–12.
- Lu JL, Lu Y, Wang X, Li X, Linderman GC, Wu C, et al. Prevalence, awareness, treatment, and control of hypertension in China: Data from 1.7 million in a population-based screening study (China PEACE Million Persons Project). *Lancet* 2017;390:2549–58.

29. Hisamatsu T, Segawa H, Kadota A, Ohkubo T, Arima H, Miura K. Epidemiology of hypertension in Japan: beyond the new 2019 Japanese guidelines. *Hypertens Res.* 2020;43: 1344–51.
30. Zhou B, Perel P, Mensah GA, Ezzati M. Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. *Nat Rev Cardiol.* 2021;18: 785–802.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.