

## Projection of Hypertension in the Philippines in the Year 2050: A Projection Study and Call-to-Action

### Abstract

**Aim:** To project the prevalence of hypertension in the Philippines using the national survey data in the year 2020 to 2050.

**Methods and results:** Data from the 2018 National Nutrition Survey (NNS) and the Philippine Statistical Authority (PSA) were utilized for the projection study. A spline regression, which utilizes a non-linear regression technique, estimated the missing data sets in the hypertension prevalence by age and sex from 1993 to 2018. Deaths from ischemic heart disease, stroke, chronic kidney disease, and hypertensive heart disease taken from the Institute for Health Metrics and Evaluation were extrapolated from the hypertension prevalence. Hypertension prevalence remains high at 23%, with a 28% increase in the number of cases (24.28 million to 33.82 million) by 2050 given the population projection (101.60 million in 2015 to 142.10 million in 2050) and seriously affecting extremes of ages (early 20's and 80's). Deaths related to hypertension will increase more than double from ~90,000 in 2015 to ~210,000 due to ischemic heart disease, stroke, and chronic kidney disease.

**Conclusion:** A significant increase in the burden of disease due to hypertension is foreseen in the next three decades. This call-to-action to legislate policies for systemic programs is urgent to decrease hypertension prevalence, thereby reducing morbidity and mortality.

**Keywords:** Hypertension; Blood pressure; Call-to-action; Projection study

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### Introduction

In the past four decades, the World Health Organization (WHO) reported a doubling in the number of affected individuals with Hypertension (HTN) or elevated blood pressure (BP) from 594 million to 1.13 billion, majority of which are living in low and middle-income countries [1]. With the increase in the aging population, prolonged life expectancy, and continued rise in the prevalence of hypertension, the burden of disease will significantly happen in the Asian region [2-20]. Globally, 51% of stroke and 45% of ischemic heart disease are attributable to uncontrolled blood pressure [4-10]. Majority of reports identified the determinants hypertension to male gender, obesity, smoking, unawareness of diabetes and hypercholesterolemia, low income, low educational attainment, and urban dwelling [11-23].

For the past three decades, the hypertension prevalence in the Philippines by the National Nutrition Survey done every five years showed results at 21% to 25% [16]. However, with the country's rapid increase in the population, the number of affected individuals with uncontrolled blood pressure continues to rise [2-4,16,17]. A parallel increase in deaths and disability due to cardiovascular complications has been observed with ischemic heart disease, heart failure, and stroke being the highest contributors to the burden of disease [3-11].

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The need to generate annual data to cover health and nutritional indicators for monitoring national programs led to the formulation of the Expanded National Nutrition Survey (ENNS) by the Food and Nutrition Research Institute (FNRI) of the Philippines [20]. In the recent reports, the prevalence of hypertension showed a downward trend of 23.9%, 19.2%, and 17.5% in 2015, 2018, and 2019, respectively [20]. Notably, similar results have been shown in Singapore [21], Korea [22], and Japan [23]. Initiatives and collaboration from both the governmental and non-governmental sectors have been reported to be contributory to the decline of prevalence of hypertension [19-26].

Hence, this study aims to project the prevalence of hypertension in the Philippines from the year 2015 to 2050.

## Methodology

Data from different sources, such as the National Nutrition Survey [19], the Philippine Statistical Authority (PSA) on the registered deaths and projected population [3], and other resources such as the Harvard School of Economics [7], and World Health Organization [1,6] were used to project the hypertension and cardiovascular disease (CVD) prevalence among Filipino adults from 2020 to 2050. The data gathered from the abovementioned sources were used to extrapolate the hypertension trend among Filipino adults on a 5-year interval from 2020 to 2050. A step-by-step process was conducted to derive the necessary prevalence. Because there were missing data sets for the prevalence of hypertension in the year 1993 to 2018, we used the data from the Philippine Statistics Authority [3] on the hypertension prevalence based on age and sex. We decided to do a spline regression, which utilizes a non-linear regression technique, and estimated the missing data sets in the hypertension prevalence by age and sex. This technique eventually estimated the hypertension prevalence by age and sex. The step-by-step process is outlined as follows:

- Data interpolation to get missing data of hypertension prevalence by age and sex;
- Spline regression to estimate the hypertension prevalence by age (yearly) and sex;
- Interpolation to estimate the hypertension prevalence by age and sex by year (1993-2018);
- Estimate the number of hypertension cases by age and sex for each year (1993 to 2018);
- Linear regression model by age and sex;
- Project number of hypertension cases from 2020 to 2050 using the estimated coefficient; and,
- Estimate the hypertension prevalence using the projected population by age and sex as denominator. Once the data sets for hypertension prevalence were completed, a simple linear regression model was used to extrapolate hypertension prevalence by age and sex. We also predicted the prevalence of hypertension by 2050 using the data from the PSA (3).

The death rates attributed to hypertension (HDR) was calculated using the equation below:

$$\text{HDR} = \text{Number of Deaths} \times \text{Share of Deaths} \times \text{Attributable Risk Factor}$$

The share of deaths caused by hypertension, such as ischemic heart disease, stroke, chronic kidney disease, and hypertensive heart disease, were obtained from the Institute for Health Metrics and Evaluation [4].

The National Nutrition Survey (NNS) by the Philippine Food and Nutrition Research Institute (FNRI) focuses on the anthropometric nutritional survey from children to adults 20 years and older. The survey employed a stratified multi-stage sampling design, covering all regions and 79 provinces of the Philippines from every 5 years from 1993 to 2008 then every 2-3 years from 2008 to 2015 [19]. In 2018, the design was changed to annual survey called Expanded National Nutrition Survey (ENNS) to address the need for local planning of specific and sensitive interventions. The design includes 37 to 40 provinces per year from 2018 to 2020, the grouping of which has replicates of rural and highly urbanized cities [20].

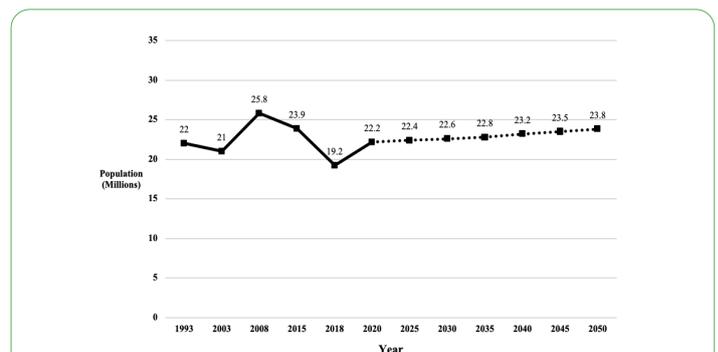
The 2018 Expanded National Nutrition Survey results were reported at the time of our projection study. There was a decrease in the prevalence of hypertension of 4.7%, from 23.9% to 19.2% in 2015 to 2018. To determine the prevalence of hypertension by 2050 if the deceleration continues, a simple linear regression was used.

## Results

### Projection of hypertension prevalence by 2050

In the past three decades (1993 to 2015), the prevalence of hypertension among adults remained relatively stagnant, with a series of increases and decreases [19]. Following this long-term historical trend, in the projection analysis, the prevalence of hypertension remains to be stagnant in the next 30 years, with 23.90% in 2015 [19] and 23.80% in 2050 (**Figure 1**). However, with increase in population by 2050; from 101.60 million in 2015 to 142.10 million in 2050, the number of Filipinos affected with hypertension will significantly increase from 24.28 million in 2015 to 33.82 million in 2050. There is a higher prevalence growth among females from 20.60% to 22.00% (**Table 1**).

As the population ages and grows, the number of Filipinos with hypertension among the adult population will significantly



**Figure 1:** Rate of prevalence of elevated blood pressure (BP) among Filipino adults aged 20 years old and above, historical (years 1993 to 2015) and projected 5-years interval from years 2020 to 2050 using projection from historical years 1993 to 2015.

	Year 2015		Year 2050	
	Prevalence rate	Number of Filipino adults with hypertension (Millions)	Prevalence rate	Number of Filipino adults with hypertension (Millions)
Male	27.50%	13.94	25.70%	17.81
Female	20.60%	10.34	22.00%	16.01
Total	23.90%	24.28	23.80%	33.82

**Table 1:** Prevalence rate of elevated blood pressure and number of Filipino adults with hypertension in 2015 (actual) and in 2050 (projected using historical trend of 1993 to 2015).

increase from 2015 to 2050 with an overall ratio of 1.39 (Table 1). With the ageing population, the projected prevalence in the next three decades will have a dramatic increase in the number of hypertensive elderly individuals by almost two-folds among the 60's, by almost three-folds among the 70's, and by more than five-times among the 80's (Table 2). The young ones in their 20's will also be affected with the hypertension prevalence presenting earlier among younger segment in males.

### Projection of deaths and cardiovascular complications due to uncontrolled hypertension by 2050

Death related to hypertension among Filipinos is projected to increase by more than double from an estimate of 90,000 in 2015 to 210,000 in 2050. As presented in (Figure 2), the increase in hypertension-attributed deaths from 2015 to 2050 is reflected in the over-doubling of affected individuals: ischemic heart disease (35,000 to 82,000), stroke (26,000 to 60,000), hypertensive heart

disease (17,000 to 40,000), and chronic kidney disease (12,000 to 29,000).

### Projection of the deceleration of hypertension prevalence in 2050 and the effect in cardiovascular mortality

Using a momentum of 4.70% decline in the prevalence of hypertension, based in the 2018 ENNS result [20], the eventual prevalence of hypertension in the Philippines by 2050 will decrease to 15.60% (Figure 3), providing a significant total reduction of 8.30% from 2015. The decrease in the prevalence was more among females (31.38%) than among males (17.00%). Moreover, a greater decline in prevalence rate was noted in extreme age groups (20's to 30's and 60's to 80's) regardless of sex (Table 3).

On the other hand, the projected mortality, if deceleration continues until 2050, will decrease from 210,272 to 137,685. This

Age group	SEX										Ratio (Projected 2050 Via Actual (2015))
	Males				Females				Total		
	2015 (Actual)		2050 (Projected)		2015 (Actual)		2050 (Projected)		2015 (Actual)	2050 (Projected)	
Prevalence Rate	Number of Filipino adults with hypertension (Million)	Prevalence Rate	Number of Filipino adults with hypertension (Million)	Prevalence Rate	Number of Filipino adults with hypertension (Million)	Prevalence Rate	Number of Filipino adults with hypertension (Million)	Number of Filipino adults with hypertension (Million)			
20-24 years old	12.40%	1.2	8.70%	0.66	3.00%	0.26	1.00%	0.07	1.41%	0.73	0.52
24-25 years old	15.80%	1.3	12.70%	0.94	5.10%	0.39	1.00%	0.07	1.66%	1.01	0.61
30-34 years old	19.60%	1.4	17.30%	1.23	8.50%	0.58	3.80%	0.26	1.96%	1.49	0.76
35-39 years old	23.70%	1.5	21.40%	1.61	14.00%	0.86	10.70%	0.8	2.37%	2.39	1.01
40-44 years old	28.10%	1.6	25.10%	1.78	21.00%	1.16	14.50%	1.01	2.73%	2.79	1.02
45-49 years old	32.70%	1.6	30.00%	2.01	27.00%	1.35	17.70%	1.15	2.99%	3.18	1.06

50-54 years old	37.00%	1.6	35.50%	2.23	31.10%	1.31	22.30%	1.4	2.88%	3.63	1.26
55-59 years old	39.80%	1.4	38.60%	2.15	34.50%	1.22	29.60%	1.73	2.56%	3.88	1.52
60-64 years old	40.90%	1	38.50%	1.72	37.90%	1.03	39.20%	1.94	2.05%	3.62	1.77
65-69 years old	41.00%	0.7	37.00%	1.3	41.10%	0.81	48.40%	2	1.49%	3.32	2.23
70-74 years old	40.50%	0.4	35.60%	0.95	43.40%	0.58	55.30%	1.92	98.00%	2.87	2.94
75-79 years old	40.50%	0.3	34.80%	0.63	44.50%	0.43	59.10%	1.59	68.00%	2.23	3.28
>80 years old	39.60%	0.2	35.60%	0.59	42.50%	0.36	58.20%	2.07	53.00%	2.67	5.06
total	27.50%	14	25.70%	17.8	20.60%	10.3	22.00%	16.01	24.28%	33.82	1.39

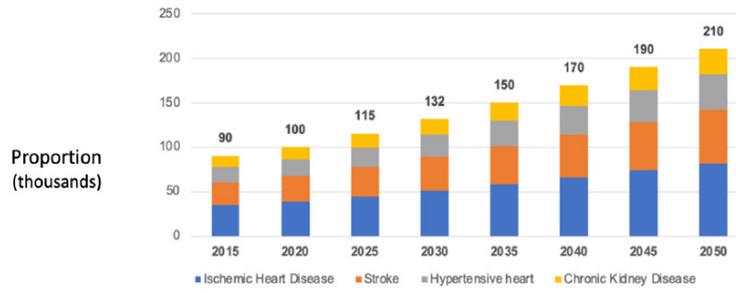
**Table 2:** Number of Filipino adults with elevated blood pressure (BP) in 2015 (actual) and in 2050 (projected using historical trend of 1993 to 2015) according to age and sex.

Age group	Sex			
	Males		Females	
	Historical trends up to 2015	Historical trend using 2018 momentum	Historical trends up to 2015	Historical trend using 2018 momentum
20-24 years old	-1.00%	-3.70%	0.00%	0.00%
25-29 years old	-0.50%	-1.60%	-5.60%	-8.20%
30-34 years old	-0.20%	-0.70%	-3.00%	-0.80%
35-39 years old	-0.10%	-0.50%	-0.70%	-0.10%
40-44 years old	-0.20%	-0.60%	-0.90%	-0.60%
45-49 years old	-0.30%	-0.80%	-1.30%	-1.90%
50-54 years old	-0.30%	-0.90%	-1.20%	-4.60%
55-59 years old	-0.20%	-0.90%	-0.80%	-5.30%
60-64 years old	-0.20%	-0.90%	-0.30%	-3.50%
65-69 years old	-0.40%	-1.20%	0.00%	-3.20%
70-74 years old	-0.70%	-2.20%	0.20%	-4.40%
75-79 years old	-0.90%	-3.20%	0.20%	-5.30%
≥ 80 years old	-0.60%	-2.00%	0.40%	-1.60%

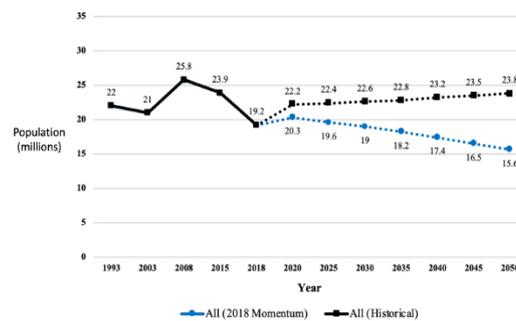
**Table 3:** Projected change of elevated blood pressure (BP) prevalence rates by sex and age segment using historical trend from 1993 to 2015 versus 2018 momentum.

Year	Number of deaths using historical trend projection	Number of deaths using 2018 momentum	Deaths prevented
2015 (Actual)	90,208	90,208	-
2020	100,080	91,160	8,920
2025	115,168	1,01,042	14,126
2030	131,701	1,10,681	21,020
2035	149,999	1,19,476	30,523
2040	169,662	1,27,488	42,174
2045	190,127	1,33,697	56,430
2050	210,272	1,37,685	72,587

**Table 4:** Number of deaths attributed to hypertension among Filipino adults using historical trend projection from years 1993 to 2015 versus using projection with 2018 prevalence rate momentum.



**Figure 2:** Projected number of deaths from various causes due to uncontrolled hypertension among adult Filipinos in 2015 (actual and projected) with 5-year interval from years 2020 to 2050.



**Figure 3:** Prevalence of elevated blood pressure (BP) among Filipino adults comparing projected historical trend from years 1993 to 2015 and the new projected using 2018 momentum.

will result to an estimated reduction of 72,587 deaths (**Table 4**).

## Discussion

In the last two decades, the prevalence of hypertension in the Asian region seem to vary with an estimate of 20% to 40%, with higher prevalence among urban dwellers regardless of socioeconomic status, conspicuously influenced by behavioral and metabolic factors such smoking, alcohol use, obesity, and history of diabetes and hypercholesterolemia [11-23]. Low to middle-income countries are struggling in addressing significant morbidity and mortality due to uncontrolled blood pressure. Regardless of economic status, remarkable contributing factors to the burden of disease were identified to low awareness of hypertension to below 40%, low percentage of population on treatment, and inadequate control of blood pressure at mere 50% and below [11-23,27,28].

In the Philippines, with the country's increasing population [3], the Filipinos with hypertension in the last two decades continued to increase from 8 million to 13 million, and it will inflate to 33.82 million by 2050. A dramatic two to six-fold increase will occur among the elderly population, aged 65 to over 80 years, at 2% to 6.80%. This finding is congruent with other Asian countries owing to the ageing population and longevity of life [2,3], foremost from India [11], China [15], and Japan [23]. With a common finding of male preponderance [8-15], our study projects an increase in the number of hypertensive individuals from 2015 to 2050 of 13.94

million to 17.81 million among males and 10.34 million to 16.01 million among females. This proportion of gender difference could be attributed to behavioral factors like smoking and alcoholic drinking which are more common among Filipino males [19,20].

Another remarkable finding in our projection study is the early development of hypertension among the younger segment of the population. As early as 20 years of age, the male gender will be affected earlier than female at 12.40% to 32.70% (20 to 49 years old) in 2015 with an average annual increase of 1.32% in 2050. Although young females will not have the same pattern, more will be affected as they age with a prevalence of 39.20% to 59.10% at age 60 to 80 years and over. Overweight, obesity, and physical inactivity are metabolic and behavioral risk factors becoming more prominent among young females, who have been reported to become more obese as they age [19,20].

Using a momentum of 4.70% decline in the prevalence of hypertension, the eventual prevalence of hypertension in the Philippines in the year 2050 will decrease to 15.6%, providing a significant total reduction of 8.30% from 2015. An additional 1.70% decrease was attained in the 2019 ENNS report resulting into a remarkable 9.00% total decrease in the prevalence of hypertension in 4-year period (2015 to 2019) [21]. Only Singapore has attained such early decline in hypertension prevalence at 7% (21.6% to 14.6%) among the Asian countries from 2000 to 2015 [5]. The other countries which showed a downward trend of hypertension prevalence were Korea [22] and Japan [23]. The

decrease in prevalence of hypertension among Filipinos, using the 2018 momentum, will be more among females (31.38%) than among males (17.00%) in 2050. Moreover, greater decline in prevalence rates was noted in extreme age groups (20's to 30's and 60's to 80's) among both genders.

The downward trend in the prevalence of hypertension has been attributed to robust programs and collaboration from both the governmental and non-governmental units of the respective country [9-26]. In the Philippines, specifically the 2012 Sin Tax Law which excised tax system on alcohol and tobacco was passed primarily to finance Universal Health Care program with a secondary objective of addressing public health issues related to alcohol and tobacco use [24]. Six years after its implementation, Austria and Pagaduan reported a significant reduction of annual cigarette consumption of households in all income brackets [29]. This finding was supported by the 2018 and 2019 ENNS reports [20,21] showing a decline in the proportion of smokers and alcohol drinkers in both genders, all age levels, and in rural and urban dwellers regardless of socioeconomic status [20,21]. Another effective health program is the 2012 Philippine Health Insurance Corporation (PhilHealth) Primary Care Benefit Package. Filipinos were able to avail of free out-patient screening for risk factors (diabetes, cholesterol, etc.) for hypertension in health units, which eventually expanded to out-patient availment of medications for hypertension [26]. This program was enhanced by the Department of Health adaptation of the WHO Package of Essential (PEN) intervention program for noncommunicable diseases to all its health units [29].

For the past 26 years, the Philippine Society of Hypertension (PSH), in collaboration with other related medical and non-medical organizations locally and internationally, has been active in its mission to address the hypertension problem from diagnosis, management, and research. For over 10 years, its partnership with the Department of Health has been successful to increase awareness through the 2009 Presidential Decree that made the month of May the "National Hypertension Awareness Month" through its established chapters all over the country. The month-long activities also highlight the World Hypertension Day (WHD) celebration of the World Health League of the International Society of Hypertension (ISH) [30]. The biggest achievement so far of PSH is the educational initiative of the society. Running on its 17th year, the Clinical Course in

Hypertension Management Program has empowered over three thousand physicians and paramedical practitioners on the basic and clinical knowledge of hypertension and over 500 physicians have been certified as hypertension specialists, now serving in the far-flung areas of the country. Through all these years, PSH sustained its collaboration with all other sectors like educators, media, lay and patients, and legislators.

Lastly, the sustenance of effective programs is, indeed, vital to achieve the targeted goal of reducing the prevalence of hypertension. All initiatives are geared towards halting the continuous increase in the morbidity and mortality due to cardiovascular adverse outcomes (ischemic heart disease, heart failure, stroke, chronic kidney disease), of which hypertension

is a leading cause [1]. It was an eye-opener in our 2050 projection study that close to one hundred thousand deaths will be prevented, and probably even more if the prevalence of hypertension will continuously decline [31].

### Call-to-Action Initiatives

From this study, all health and health-related agencies (e.g., Department of Health, health educators, researchers, media, medical and paramedical organizations, pharmaceuticals, etc.) must be vigilant of various call-to-action initiatives. These programs and priorities include placing hypertension as a national priority, strengthening and continuing hypertension awareness, bolstering educational and research programs on hypertension, and monitoring hypertension initiatives for impact and outcome. In addition, additional legislations on hypertension-related risk factors must be implemented such as those geared towards salt intake, high caloric and fat-content foods, diabetes mellitus, and obesity.

### Limitations and Strengths

Albeit the presented projection, this study has certain limitations. First, the data acquired in the study had several missing data and were only imputed using appropriate statistical approaches. Second, the utilized datasets had different frequency of census (e.g., the FNRI initially started at 5 years and became 1 year afterwards) and used different sampling techniques, potentially introducing errors in the statistical approach. Despite these weaknesses, some of the strengths of this study include the robust statistical methods utilized to project the prevalence of hypertension and the use of multiple datasets and sources for the estimation of hypertension.

### Conclusion

The prevalence of hypertension in the Philippines is projected to steadily increase in the next three decades. Similarly, as the prevalence of hypertension inflates, the disease burden proportionally increases in the next years to arrive. However, implementing legislative policies for systemic programs can potentially mitigate this projected rise in cases of Filipinos with hypertension thus, heralding the call-to-action among government and non-government agencies to address and prioritize hypertension on a national scale.

### Conflict of Interest

The authors declare no conflict of interest related to the paper's subject matter.

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