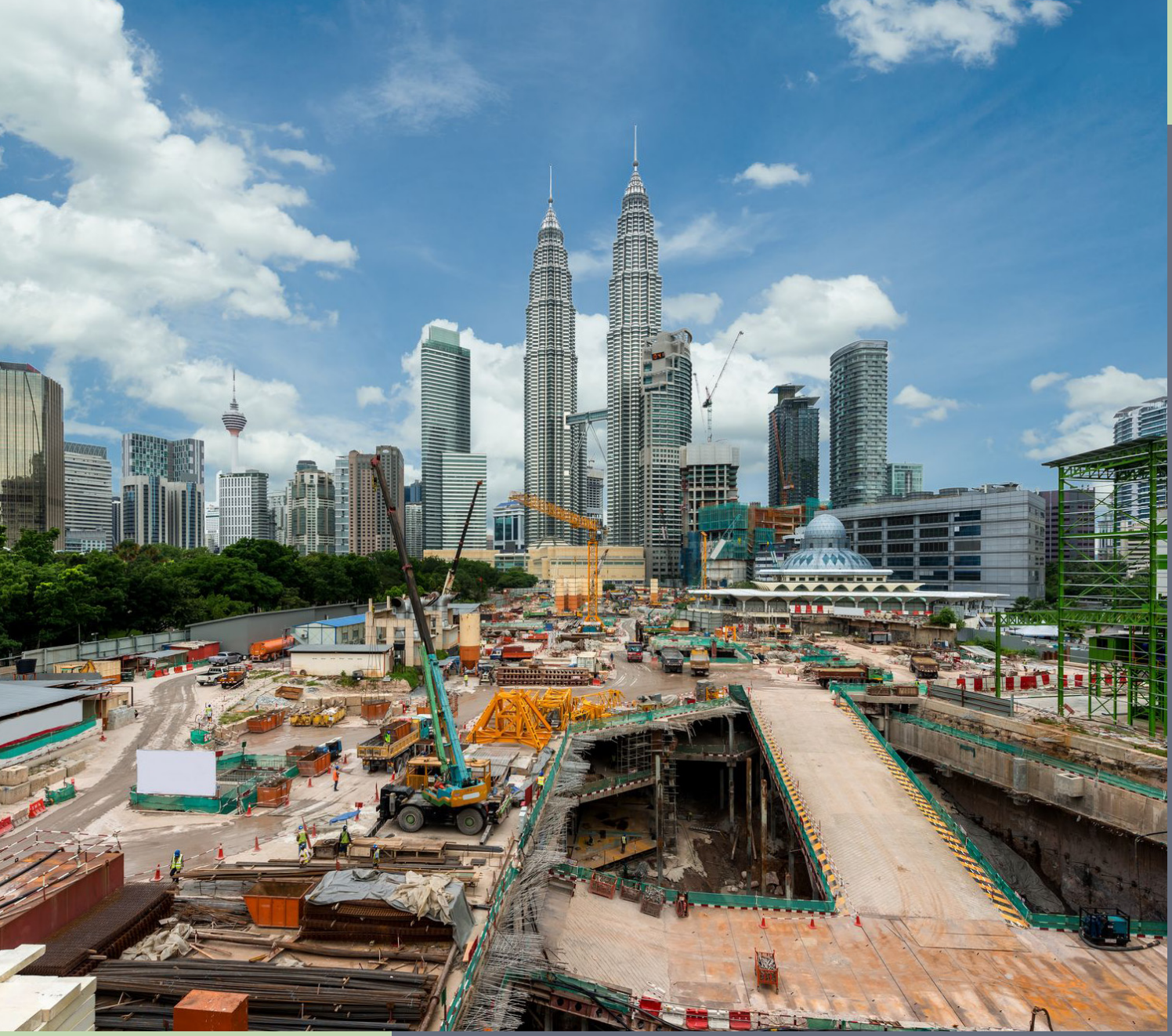

THE IMPACT OF NONCOMMUNICABLE DISEASES AND THEIR RISK FACTORS ON MALAYSIA'S GROSS DOMESTIC PRODUCT

Ministry of Health Malaysia

World Health Organization
Representative Office
for Malaysia, Brunei Darussalam,
and Singapore

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ABBREVIATIONS

CVD	cardiovascular disease
DALY	disability-adjusted life year
GBD	Global Burden of Disease
GDP	gross domestic product
IHME	Institute for Health Metrics and Evaluation
LMIC	low- and middle-income country
NCD	noncommunicable disease
NHMS	National Health and Morbidity Survey
PV	present value
RM	Malaysian ringgit
WHO	World Health Organization
YLD	years lived with disability
YLL	years of life lost

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EXECUTIVE SUMMARY

Noncommunicable diseases (NCDs) and their complications pose a real and significant threat to Malaysia. The results of the National Health and Morbidity Survey (NHMS) in 2015 estimated that 3.5 million (17.5%) adult Malaysians were living with diabetes, 6.1 million (30.3%) with hypertension, 9.6 million (47.7%) with hypercholesterolaemia and 3.3 million (17.7%) with obesity.

Poorly controlled NCDs will result in an increase of people with disabilities who possess a limited capacity to produce goods and services. From a macroeconomic point of view, the increasing prevalence of NCDs contributes to economic loss because of reduced labour productivity and rising health care costs to treat NCD patients.

This report quantifies the productivity losses and burden of disease costs that stem from the three largest NCD categories in Malaysia. The estimated costs are those incurred as a result of NCDs in the 2017 Malaysian population. The three NCD categories – namely cardiovascular disease, diabetes and cancer – are estimated to have cost the Malaysian economy RM 12.88 billion (high estimate) in terms of productivity losses arising from absenteeism, presenteeism or premature death in persons of working age. The estimated burden of disease cost is considerably higher at RM 100.79 billion (low estimate) or RM 302.37 billion (high estimate). These intangible costs relate to the value placed by individuals on the loss of life or loss of healthy life, whereas the financial costs arising from lost productivity entail tangible costs to the economy (to individuals, industry and government). We have elected to report the two types of costs separately and not add them together.

This study estimates the current burden pertaining to the 2017 population, and no projections of the future burden were undertaken. However, it can be reasonably expected that the cost burden will grow over time as the Malaysian population grows and ages. Also, these two cost estimates provide only a partial picture of the total economic burden of NCDs in Malaysia.

This report did not take into account direct health care costs associated with the NCDs (e.g. inpatient admissions, outpatient visits, allied health, medications, laboratory tests, preventive care), carer costs, welfare payments or taxes foregone. The inclusion of health care costs would make for a complete picture of the economic burden of NCDs in Malaysia.

1. INTRODUCTION

The World Health Organization (WHO) estimated that noncommunicable diseases (NCDs) were responsible for 41 million deaths, equivalent to 71% of global deaths, in 2016. The NCD-related deaths were attributed to cardiovascular diseases (CVDs – 17.9 million deaths – accounting for 44% of global NCD-related deaths), followed by cancers (9 million; 22%), chronic respiratory diseases (3.8 million; 9%) and diabetes (1.6 million; 4%) *(1).*

WHO has been committed to addressing this substantial burden of NCDs, as specified in the *Global Action Plan for the Prevention and Control of NCDs 2013–2020,* which aims at a 25% relative reduction in premature mortality from the four aforementioned NCDs as one of nine global targets *(2).*

NCDs disproportionately affect low- and middle- income countries (LMICs), where 78% of total NCD-related deaths and 85% of NCD-related premature (i.e. 30–69 years of age) deaths occurred. Malaysia is also severely impacted by the global NCD crisis. In 2016, it was estimated that 113 400 out of 154 000 deaths were NCD-related *(1).* The National Health and Morbidity Survey (NHMS) in 2015 revealed that the prevalence of NCD risk factors continued to rise. NHMS estimated that there were 3.5 million (17.5%) adult Malaysians living with diabetes, 6.1 million (30.3%) with hypertension, 9.6 million (47.7%) with hypercholesterolaemia and 3.3 million (17.7%) with obesity *(3).* The Ministry of Health Malaysia has designated the prevention and control of NCDs as a high priority, which was demonstrated in the *National Strategic Plan for NCD 2016–2025* and its complementary national strategies to control risk factors associated with NCDs *(4).* Malaysia also launched the *Skim Peduli Kesihatan untuk Kumpulan B40 (PeKa B40)* to promote screening of NCDs for the population with income below 40%, but efforts need to be further strengthened *(5).*

NCDs are characterized by their socio-economic impact in addition to direct health needs to screen, diagnose and treat them. The prolonged disability associated with NCDs causes reduced productivity and the ability to earn, which may trap people living with NCDs into poverty *(6).* This may eventually distress countries through stagnant economic growth and rising spending on welfare. A previous study estimated that the economic cost due to four NCDs (i.e. CVD, cancer, respiratory diseases and diabetes) in LMICs exceeded US$ 7 trillion between 2011 and 2025. The annualized economic loss was about US$ 500 billion, which on average accounted for 4% of gross domestic product (GDP) of LMICs in 2010 *(7).* Realizing the benefit of investing in the prevention and control of NCDs is crucial to pursue sustainable economic growth, particularly for countries like Malaysia aspiring to achieve high-income status in the near future.

The Ministry of Health Malaysia has concerns that the high prevalence of NCDs is associated with a huge cost burden to the Malaysian economy, but there is limited evidence from research to quantify the economic implication of NCDs in the country. As such, the Ministry has sought the support of the WHO Representative Office for Malaysia, Brunei Darussalam and Singapore to build a strong, evidence-informed advocacy case for investment in NCD prevention and control in Malaysia.

To this end, this submission by Deakin Health Economics, Deakin University, Australia, responds to a request from the Ministry of Health Malaysia and WHO to undertake a

macroeconomic analysis of the impact of NCDs and NCD risk factors on Malaysia's GDP, with a focus on:

a) the economic cost of NCDs arising from productivity losses due to absenteeism, presenteeism and early retirement; and

b) the total economic cost of NCDs based on the disease burden as measured by disability-adjusted life years (DALYs) or years of life lost (YLL) and years lived with disability (YLD) as estimated by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington, United States of America.

The report explicitly mentions three categories of NCDs (i.e. CVD, diabetes and cancer) and four shared NCD risk factors (i.e. tobacco use, unhealthy diet, physical inactivity and harmful use of alcohol).

2. LOST PRODUCTIVITY **DUE TO NCDs**

There is strong evidence demonstrating the substantial long-term macroeconomic impacts of NCDs on a country's labour supply, and in turn, on its productivity and economic growth (6). NCDs may result in reduced workforce participation through illness and early retirement, thereby affecting both the size and the quality of the labour force and its output. Lost productivity may occur as a result of workers with NCDs spending days absent from work, being at work but not being fully productive, or dying prematurely while still of working age. This chapter sets out to quantify the potential productivity losses occurring in Malaysia as a direct consequence of the selected NCDs.

2.1 Lost productivity due to premature deaths from NCDs

The lost productivity that stems from the premature deaths of persons of working age is commonly estimated using two different approaches.

2.1.1 Human capital approach

METHODS

The human capital approach counts all future potential income of an individual who is lost from the workforce due to death prior to their normal retirement age *(8).* The annual loss of income resulting from the death of a worker was estimated based on the number of working years lost from the age of death to the age when the employee would have reached the Malaysian retirement age of 60 *(9).* Deaths by disease group and classified by five-year age and gender groups for Malaysia were extracted from the Global Burden of Disease (GBD) data for 2017 *(10).*

Labour force participation rates (by age and gender) were based on data drawn from the *Labour Force Survey Report Malaysia 2017 (11).* Calculations of lost working years were based on the median age of death for each five-year age bracket. A worker's lost productivity as a consequence of their death was expressed in terms of their lost wages. The lost wages resulting from each disease were calculated as the product of the number of working years lost in each age and gender bracket multiplied by monthly mean wage (RM 2954 for males, and RM 2772 for females), and the workforce participation rate for each age and gender group *(12).* Unemployment rates were factored into the calculations.

However, no account was taken of full- versus part-time employment or informal sector employment given the absence of data by age and gender groups. The losses were valued in constant Malaysian ringgit (RM) for the reference year 2017, taking no account of inflation or wage growth.

LOST PRODUCTIVITY USES TWO DIFFERENT APPROACHES: THE HUMAN CAPITAL AND THE FRICTION COST ONES.

Discounting reduces the value of future costs to present values (PVs). For all the productivity loss estimates that extend beyond one year, the July 2017 discount rate for Malaysia of 3.1% was applied, using the formula $\mathrm{PV} = \mathrm{cost}/(1+\mathrm{r})^{\mathrm{n}}$, where PV = present value, r = discount rate, n = number of years into the future *(13)*. The estimates are also reported with 0% discounting.

In calculating these losses, reliance was placed on official estimates of both the working population and of deaths. Malaysia supports a large migrant worker population, and it is unclear as to whether they are included in official labour force or mortality statistics. If they are excluded, this would potentially result in an underestimation of the disease burden and productivity losses arising from NCDs.

The human capital approach has some limitations that should be acknowledged. It does not take into consideration the costs of unpaid labour or the substitution of paid labour by mechanization. Furthermore, our use of monthly mean wage in the calculations may distort the estimates as mortality rates tend to be disproportionately higher among lower socioeconomic groups.

RESULTS

In 2017, there were an estimated 20 786 deaths of persons of working age in Malaysia as a result of the three NCD categories. An estimated total of 201 185 working years would be lost due to the deaths of these persons who would otherwise be employed. Based on the human capital approach, the lost productivity costs total RM 4.11 billion (or RM 7.02 billion not discounted).

Table 1 provides a breakdown of the total losses resulting from premature deaths for each disease based on the human capital approach; the losses were combined for males and females. CVD accounted for RM 2.54 billion or 61.72% of this lost production due to premature deaths, followed by cancer at RM 1.5 billion or 36.11%.

Table 1. Lost productivity due to deaths of workers from selected NCDs, Malaysia, 2017

NCD category	Total deaths of workers	Total working years lost	Human capital approach				Friction cost approach	
			Total cost discounted 3.1% (RM)	Total cost (in %)	Total cost not discounted (RM)	Total cost (in %)	Total cost (RM)	Total cost (in %)
Cardio-vascular disease	13 023	122 083	2.536 B	61.72	4.281 B	60.68	87.84 M	62.92
Diabetes	471	4 273	0.089 B	2.17	0.148 B	2.12	3.14 M	2.25
Cancer	7 291	74 830	1.484 B	36.11	2.590 B	37.19	48.615 M	34.82
Total	20 786	201 185	4.111 B	100.00	7.019 B	100.00	139.60 M	100.00

B: billion; M: million; NCD: noncommunicable disease; RM: Malaysian ringgit

2.1.2 Friction cost approach

METHODS

The friction cost approach takes into account the period of time that it takes an organization to restore its level of production and the time and cost of organizing a replacement worker *(14)*. This approach is very dependent on the characteristics and fluidity of the market for both local and foreign workers. In the absence of country-specific data, a frictional period of 10 weeks' loss was assumed (comprising an average of eight weeks to recruit a new employee, plus a further two weeks of productivity loss to account for the time and cost associated with organizing and training the replacement). The friction period length will vary between organizations, sectors and occupations. A period of 10 weeks is quite optimistic. While Erdogan et al. *(15)* found that the average friction period across a number of European countries ranged between 60 and 95 days, van den Hout *(8)* recommended a timeline of six months. The frictional loss was calculated as the product of the number of deaths in each five-year age group multiplied by the age-specific workforce participation rate by 10 times the average weekly wage. No discounting was applied as the losses were incurred in less than one year.

The friction cost approach shares a common limitation with the human capital approach in that it takes into account only market-valued benefits. It does not consider unpaid labour.

RESULTS

The productivity costs calculated using the frictional cost approach stemming from the three selected NCD categories amounted to RM 139.60 million in 2017 (Table 1). CVD accounted for RM 87.84 million or 62.92% of total frictional costs, followed by cancer RM 48.61 million (34.82%) and diabetes RM 3.14 million (2.25%).

The two costing approaches – human capital and friction cost – produce markedly different estimates of lost GDP. The frictional loss represents just RM 139.60 million, or only 3.40% of the discounted human capital loss of RM 4.11 billion. In this report, these two different results were used to produce low- and high-cost estimates of the productivity costs of NCDs in Malaysia.

The actual productivity losses due to premature death would probably fall somewhere between the two estimates.

2.2 Lost productivity due to premature deaths from NCDs attributable to specific risk factors

METHODS

Using risk factor data drawn from the GBD dataset, calculations were made of the productivity losses arising from premature deaths from the three NCD categories that were attributable to the four risk factors specified in the project brief *(10).* The risk factors were tobacco use, unhealthy diet, low physical activity and alcohol use. Deaths by disease and by risk factor were extracted by five-year age- and gender-specific groups.

It is common for people to be exposed to more than one of these four risk factors at the same time. Furthermore, many people have comorbidities, where they experience two or more NCD conditions simultaneously. It is also known that diseases such as stroke, ischaemic heart disease and cancers can be attributed independently to several of the risk factors of interest in this study. Given the absence of data, no correction has been made for joint effects. For these reasons, the results presented by risk factor cannot be summed.

RESULTS

FOUR RISK FACTORS ARE UNDER STUDY: LOW PHYSICAL ACTIVITY AND TOBACCO, DIET OR ALCOHOL USE.

Two thirds (68.9%) of the costs of lost productivity due to premature deaths from CVD were attributable to unhealthy diets, while tobacco use contributed to more than one third of deaths (36.9%) (Table 2). The same risk factors featured for the costs of lost productivity due to premature deaths from diabetes, although the attributable percentages were considerably smaller (26.6% and 12.8%, respectively). Of the four risk factors under study, tobacco consumption attributed to the highest proportion of the productivity losses due to premature deaths from cancer (15%). Low physical activity was not prominent as a risk factor across any of the three NCD categories, while alcohol use was a minor contributor to productivity losses due to mortality from CVD and cancer.

Table 2. Lost productivity due to deaths of workers from selected NCDs attributable to specific risk factors, Malaysia, 2017

NCD risk factor	Cardiovascular disease		Diabetes		Cancer	
	RM	%	RM	%	RM	%
Tobacco use	935.9 M	36.9	11.41 M	12.8	222.7 M	15.0
Unhealthy diet	1.75 B	68.9	23.74 M	26.6	99.3 M	6.7
Low physical activity	136.7 M	5.4	1.61 M	1.8	6.7 M	0.5
Alcohol use	145.9 M	5.8	1.57 M	1.8	106.9 M	7.2

B, billion; M, million; NCD, noncommunicable disease; RM, Malaysian ringgit

2.3 Lost productivity due to absenteeism

METHODS

Absenteeism refers to lost productivity when employees are absent from work due to illness. The costs of absenteeism to the Malaysian economy as a consequence of the selected NCDs were estimated based on lost wages. The cost of work loss attributable to absenteeism in the 2017 reference year was the product of the estimated lost working days multiplied by the gender-specific mean daily wages *(12)*.

It is acknowledged that the cost to a business of a worker's absence is likely to exceed the worker's wage. We have elected to apply an average wage "multiplier" of 1.28, as suggested by Nicholson et al. *(16),* based on data from a survey of 800 managers in 12 industries. The wage multiplier takes into account the additional costs to an employer of an absence over and above a worker's salary, including recruitment costs, training, office equipment, and any employers' contribution. Consequently, the cost of an absence for many jobs is considerably higher than the daily wage of the worker. We chose to conservatively use the median multiplier (1.28) rather than the higher mean of 1.61 *(16)*. This approach was adopted in the belief that employer costs (over and above wages) are likely to be lower in Malaysia.

The first step in estimating the productivity lost due to absenteeism was to determine the number of lost working days; this required estimation of the expected number of people living and working with each the selected NCDs. Age- and gender-specific disease prevalence data for 2017 was obtained from the GBD data for 2017 *(10)*.

Age- and gender-specific workforce participation rates were then applied to the surviving cases to estimate the number of persons with each disease who were likely to be working. The expected annual number of days taken off work was calculated by multiplying the number of surviving cases in the labour force by the average number of days of absence caused by each disease based on evidence from published literature. Anesotti-Rothermel and Sambamoorthi *(17)* used cross-sectional data from the US Medical Expenditure Panel Survey to examine absenteeism by disease.

It should be noted that the average days absent by disease (Table 3) are not incremental over and above the average days absent of persons with no disease. Given the differences in average days absent, separate calculations were made for the CVD categories of heart disease, hypertension and stroke, and then were added to obtain a total number of days absent for CVD. The limited resources available to the current project did not permit access to comprehensive data to validate the applicability of these average annual days of absenteeism by disease for Malaysia.

ABSENTEEISM DUE TO NCDs TRANSLATED INTO AN ESTIMATED LOSS OF RM 2.6 BILLION TO THE MALAYSIAN ECONOMY.

Table 3. Average annual days of absenteeism by disease

Disease category	Days off work per year
Heart disease	7.89
Hypertension	6.39
Stroke	17.94
Diabetes	7.25
Cancer	9.98

Source: Ansetti-Rothermel and Sambamoorthi *(17)*.

RESULTS

An estimated total of 15.3 million working days were likely lost in Malaysia in 2017 due to the three major NCD categories (Table 4). This amounted to a productivity loss to the Malaysian economy of RM 2.61 billion. Diabetes was the largest contributor to the working days lost, accounting for an estimated 7.9 million lost working days, or 51.5% of the total, amounting to a cost of RM 1.35 billion. CVD was a very close second, accounting for 6.7 million lost working days and 44.1% of the productivity loss (RM 1.15 billion).

Table 4. Lost productivity due to absenteeism by disease, Malaysia, 2017

NCD category	Annual days absent from work	Productivity loss (RM) due to absenteeism	Total absenteeism costs (in %)
Cardiovascular disease	6 770 001	1 152 685 033	44.10
Diabetes	7 890 782	1 346 546 711	51.52
Cancer	685 731	114 637 665	4.39
Total for selected NCDs	15 346 514	2 613 869 409	100.00

NCD: noncommunicable disease; RM: Malaysian ringgit

2.4 Lost productivity due to presenteeism

METHODS

Presenteeism refers to the cost of lost productivity resulting from people who are present at work but not working at full capacity. Productivity losses due to presenteeism are difficult to measure; it is further problematic to determine the extent to which presenteeism losses are attributable to a worker's disease. In the absence of country-specific data, lost productivity due to presenteeism was estimated based on findings from a study by Goetzel et al. *(18),* which reported the average number of productive hours per day lost due to various NCDs (Table 5). Goetzel et al. combined cost estimates from a large US medical/absence database with findings from several published productivity surveys *(18).* The methods used in each of these surveys to measure presenteeism varied, but the authors combined the results to produce their best estimates of time lost at work due to specific conditions. While the hours of work lost daily seem high, it should be noted that most of the surveys did allow for the individual employee respondent to indicate that they had one of the given conditions but that it did not affect their productivity at work.

The mean working hours per week by age group and gender were obtained from the *Labour Force Survey Report Malaysia 2017 (11).* The hourly wage rate by age group and gender was calculated by dividing the monthly mean wage by the weekly mean working hours. The daily working hours lost were multiplied by the hourly rate to estimate the total productivity loss in Malaysia as a result of presenteeism due to each NCD. The total loss was then multiplied by the number of days worked (allowing for days absent) by the daily mean wage *(12),* multiplied by the wage multiplier of 1.28 *(16).* The working hours lost were calculated separately for hypertension and heart disease.

The application of these daily working hours lost to Malaysia provides a crude estimate of the impact of the three categories of NCDs on presenteeism in the workforce. The only way to obtain a truer picture of this impact would be to conduct an in-country study with interviews of employers and employees from a range of industries, using accepted methods for measuring presenteeism.

PRESENTEEISM DUE TO NCDs AMOUNTED TO AN ESTIMATED LOSS OF RM 6.2 BILLION.

Table 5. Average number of productive hours lost per day by NCD category

NCD category	Working hours lost per day
Heart disease	0.5
Hypertension	0.6
Diabetes	0.9
Cancer	0.7

NCD: noncommunicable disease – *Source:* Goetzel et al *(18).*

RESULTS

Losses due to presenteeism for the three NCD categories amounted to an estimated RM 6.2 billion (Table 6). Diabetes was the biggest contributor to presenteeism losses, accounting for RM 4.31 billion or 70.00% of the total losses. CVD accounted for a further 26.57% of presenteeism losses (RM 1.6 billion).

Table 6. Lost productivity due to presenteeism, Malaysia, 2017

NCD category	Productivity loss (RM) due to presenteeism	Total presenteeism costs (in %)
Cardiovascular disease	1 634 936 969	26.57
Diabetes	4 308 059 689	70.00
Cancer	211 414 485	3.44
Total for selected NCDs	6 154 411 143	100.00

NCD: noncommunicable disease; RM: Malaysian ringgit

2.5 Summary – Lost productivity due to NCDs

Table 7 summarizes the estimated productivity losses due to the three categories of NCDs incurred by the 2017 cohort of persons of working age in Malaysia. The estimates comprise losses due to absenteeism and presenteeism in the year 2017, in addition to the years of potential productive life lost due to workers who died in 2017.

Both high- and low-cost estimates are provided based on the use of the two different approaches for estimating productivity losses resulting from premature deaths. These two estimates (RM 12.88 billion and RM 8.91 billion) should be viewed as the upper and lower bounds of the likely productivity losses.

Under the high-cost scenario, CVD and diabetes each account for more than 40% of productivity losses. However, the make-up of these losses varies. In the case of CVD, the losses are spread across the three categories of losses due to deaths, absenteeism and presenteeism, whereas for diabetes, the losses are predominantly a result of presenteeism. Under the low-cost scenario, 63.51% of the losses arise from diabetes, followed by CVD at 32.28%.

CVD AND DIABETES EACH ACCOUNT FOR MORE THAN 40% OF PRODUCTIVITY LOSSES.

Table 7. Lost productivity due to selected NCDs, Malaysia, 2017

NCD risk factor	Productivity losses (RM) due to...				
	Deaths	Absenteeism	Presenteeism	Total	Total (in %)
High estimate (using human capital approach for productivity losses due to deaths)					
Cardiovascular disease	2 536 849 286	1 152 685 033	1 634 936 969	5 324 471 289	41.3
Diabetes	89 401 437	1 346 546 711	4 308 059 689	5 744 007 837	44.6
Cancer	1 484 332 103	114 637 665	211 414 485	1 810 384 253	14.1
Total for selected NCDs	4 110 582 826	2 613 869 409	6 154 411 143	12 878 863 378	100.0
Low estimate (using human capital approach for productivity losses due to deaths)					
Cardiovascular disease	87 840 150	1 152 685 033	1 634 936 969	2 875 462 152	32.3
Diabetes	3 144 453	1 346 546 711	4 308 059 689	5 657 750 853	63.5
Cancer	48 614 200	114 637 665	211 414 485	374 666 350	4.2
Total for selected NCDs	139 598 803	2 613 869 409	6 154 411 143	8 907 879 355	100.0

NCD: noncommunicable disease; RM: Malaysian ringgit

3. BURDEN OF **DISEASE**

In addition to the impact of NCDs on the health care system and on economic growth through lost production, there is a health burden incurred by individuals as a result of loss of healthy life years. Individuals and societies value health.

We can estimate the health burden of NCDs by placing a monetary value on a DALY, which is a summary measure of the health burden resulting from disability and lost years of life associated with specific diseases. The burden of ill health associated with NCDs apply to persons of all ages (including young children and older adults).

The GBD study establishes the disability weights that can be used to calculate DALYs and the burden of disease costs (for the selected NCDs). These costs are different to productivity costs that relate to losses to the economy of lost engagement in the workforce.

The suggestion that the inclusion of such burden-of-disease costs in the estimates of NCD costs will inevitably entail a measure of double counting appears unfounded because the health states and lay descriptions used in the GBD study to establish the disability weights make no reference to a person's ability to work or maintain a job *(19)*.

3.1 Methods

DALYs (DISABILITY-ADJUSTED LIFE YEARS) ARE VALUED AT ONE TO THREE TIMES A COUNTRY'S GDP.

DALYs provide a measure of overall disease burden and are expressed as the sum of years of potential life lost due to premature mortality (years of life lost [YLL]) and the years of life lost due to disability (years lived with disability [YLD]). DALY data specific to Malaysia were based on mean values extracted from the GBD Results Tool *(10)*. The data were analysed separately for each of the three NCD categories for the 2017 reference year by age group and gender.

In 2001, the WHO Commission on Macro-economics and Health recommended valuing DALYs at between one and three times a country's GDP per capita *(19)*. For the purposes of this study, a conservative approach was adopted and the lower end of this approximation (one times GDP per capita) was used. For Malaysia, in 2017, this equated to RM 42 834 per DALY *(20)*.

We acknowledge that this method of monetizing the disease burden through the application of a constant value for a DALY has been subject to recent criticism. However, the literature is not yet well-enough developed to support an approach that adjusts the value to reflect the characteristics of the health effect (such as severity and duration) or of the population affected, or to support a valuation function specific to LMICs, or more specifically, Malaysia *(21)*.

3.2 Noncommunicable diseases

DALYs due to ill health in the 2017 Malaysian population totalled an estimated 7 124 793. (57.78% males and 42.22% females) (Table 8).

NCDs accounted for nearly three fourths of DALYs (72.4%), and the three major categories of NCDs under consideration in this study accounted for one third of all DALYs (33.03%). Some 2 353 023 DALYs were estimated as lost to CVD, diabetes and cancer. These DALY losses from the three NCD categories incurred by the 2017 Malaysia population totalled RM 100.79 billion when valued conservatively at one time GDP per capita. A high estimate based on three times GDP per capita would equal RM 302.37 billion. Hereafter in this section, all values are based on the low estimate.

DALY losses for the NCDs under study were highest among males (RM 59.71 billion) compared to females (RM 41.08 billion). Nearly half (46.88%) of these DALY losses were incurred among people in the 50–69 years age group.

DALY LOSSES DUE TO CVD, DIABETES AND CANCER TOTALLED RM 100.79 BILLION (CONSERVATIVE ESTIMATE).

Table 8. DALYs and cost of DALYs by gender, Malaysia, 2017

Disease category	DALYs	Cost of DALYs (RM)		Total DALY burden (in %)
		Low estimate (valued at GDP per capita)	High estimate (valued at 3 times GDP per capita)	
Males				
Three selected NCD categories[1]	1 394 035	59 712 087 600	179 136 262 800	33.87
Other NCDs[2]	1 436 446	61 528 734 811	184 586 204 432	34.90
Other causes[3]	1 285 962	55 082 903 938	165 248 711 814	31.24
Total[4]	4 116 443	176 323 726 349	528 971 179 046	100.00
Females				
Three selected NCD categories	958 988	41 077 308 688	123 231 926 065	31.88
Other NCDs	1 369 394	58 656 619 694	175 969 859 082	45.52
Other causes	679 967	29 125 709 693	87 377 129 078	22.60
Total	3 008 349	128 859 638 075	386 578 914 226	100.00
All persons				
Three selected NCD categories	2 353 023	100 789 396 288	302 368 188 865	33.03
Other NCDs	2 805 840	120 185 354 505	360 556 063 514	39.38
Other causes	1 965 929	84 208 613 631	252 625 840 892	27.59
Total	7 124 793	305 183 364 424	915 550 093 272	100.00

1. Includes cardiovascular disease, cancer and diabetes.
2. Includes all other noncommunicable diseases – cirrhosis, chronic respiratory disease, digestive diseases, neurological disorders, mental and substance use disorders, urogenital, blood and endocrine diseases, musculoskeletal disorders, congenital anomalies, skin and subcutaneous diseases, sense order diseases and oral disorders.
3. Includes all communicable, maternal, neonatal and nutritional diseases, plus injuries.
4. Includes all causes of disease.

DALY: disability-adjusted life year; GDP: gross domestic product; NCD: noncommunicable disease; RM: Malaysian ringgit

Source: Data extracted from Global Burden of Disease Results Tool *(10)*.

The vast majority of the DALY losses were due to premature deaths (Table 9). The three selected NCD categories were responsible for 2 million YLL resulting in a cost of RM 85.43 billion. This equated to 84.8% of the value of DALY health burden. YLD totalled 358 580, at a cost of RM 15.36 billion (15.2% of total DALY burden). While males experienced more of the YLL (60.9%), YLD were marginally higher for females.

Table 9. Three selected NCD categories – YLL and YLD by gender, Malaysia, 2017

Gender	Years of life lost		Years lived with disability	
	Number	Cost (RM)	Number	Cost (RM)
Males	1 216 385	52 102 654 070	177 649	7 609 433 530
Females	778 057	33 327 306 131	180 931	7 750 002 558
All persons	1 994 443	85 429 960 201	358 580	15 359 436 088

RM: Malaysian ringgit
Source: Data extracted from the Global Burden of Disease Results Tool *(10)*.

Nearly two thirds (62.1%) of the burden of disease losses from CVD were attributable to unhealthy diets, while tobacco use contributed to one quarter of the losses (24.8%) (Table 10). The same risk factors featured for the burden of disease losses from diabetes, although the attributable percentages were considerably smaller (39.7% and 18.5%, respectively). Of the four risk factors under study, tobacco consumption attributed to the highest proportion of premature deaths from cancer (18.0%). Low physical activity and alcohol use were not prominent as risk factors across any of the three NCD categories.

Table 10. Burden of disease due to selected NCDs attributable to specific risk factors, 2017[1]

NCD risk factor	Cardiovascular disease		Diabetes		Cancer	
	RM	%	RM	%	RM	%
Tobacco use	14 866 293 053	24.84	1 889 311 493	18.50	5 533 682 096	18.01
Unhealthy diet	37 153 563 659	62.08	4 050 469 382	39.67	2 558 752 662	8.33
Low physical activity	4 117 703 246	6.88	323 988 410	3.17	182 012 534	0.59
Alcohol use	566 479 520	4.01	228 293 622	2.24	1 617 719 279	5.27

1. Percentages by disease are not additive, as joint effects of different risk factors have not been taken into account.
RM: Malaysian ringgit

3.3 Cardiovascular disease

CVD refers to all diseases and conditions of the heart and blood vessels. DALYs due to CVD in the 2017 Malaysian population totalled an estimated 1 397 311 (63.2% males and 36.8% females) (Table 11). CVD accounted for nearly three fifths of the DALYs (59.4%) arising from three major categories of NCDs under consideration in this study. DALY losses from CVD totalled RM 59.85 billion. The greatest proportion of the burden of CVD occurs between the ages of 50 and 80 years. This age group accounts for 67.4% of the CVD burden.

The specific diseases and conditions included within CVD are shown in Table 12. Two categories together account for 84.81% of the total disease burden arising from CVDs. Some 54.3% of the DALY burden from CVD is attributable to ischaemic heart disease (RM 32.48 billion), and 30.6% to stroke (RM 18.29 billion). A greater proportion of the CVD burden in males (59.2%) was due to ischaemic heart disease than in females (45.8%); on the other hand, stroke caused a higher share of the CVD burden in females (36.6%) than in males (27.1%).

DALY LOSSES FROM CVD TOTALLED RM 59.85 BILLION.

Table 11. Lost productivity due to absenteeism by disease, Malaysia, 2017

Age group (years)	Males	Females	Persons	Total (in %)
DALYs				
0–9	4 753	3 835	8 588	0.61
10–19	9 732	6 753	16 484	1.18
20–29	30 616	13 108	43 724	3.13
30–39	70 888	23 239	94 127	6.74
40–49	116 958	44 780	161 738	11.57
50–59	203 898	88 450	292 349	20.92
60–69	234 588	130 287	364 875	26.11
70–79	154 709	129 619	284 328	20.35
≥ 80	57 155	73 943	131 097	9.38
Total	883 297	514 014	1 397 311	100.00
DALY cost burden (RM)				
0–9	203 587 432	164 286 167	367 873 599	0.61
10–19	416 839 525	289 245 955	706 085 480	1.18
20–29	1 311 411 011	561 463 585	1 872 874 597	3.13
30–39	3 036 425 002	995 417 780	4 031 842 783	6.74
40–49	5 009 776 228	1 918 118 212	6 927 894 440	11.57
50–59	8 733 781 697	3 788 688 337	12 522 470 034	20.92
60–69	10 048 349 140	5 580 724 720	15 629 073 860	26.11
70–79	6 626 820 910	5 552 079 047	12 178 899 957	20.35
≥ 80	2 448 163 714	3 167 256 900	5 615 420 614	9.38
Total	37 835 154 660	22 017 280 704	59 852 435 364	100.00

DALY: disability-adjusted life year; RM: Malaysian ringgit
Source: Data extracted from Global Burden of Disease Results Tool *(10)*.

Most of the DALY burden arising from CVD (89.8%) stems from the years of life lost due to premature death (Table 12). Ischaemic heart disease accounted for the largest share (58.5%) of the mortality burden from CVD, while stroke was more significant in terms of YLD (morbidity burden) (44.0%).

Table 12. CVD by type – YLL and YLD cost burden, Malaysia, 2017

Disease category	Years of life lost		Years lived with disability	
	RM	%	RM	%
Rheumatic heart disease	470 957 849	0.88	533 915 128	8.70
Ischaemic heart disease	31 440 352 328	58.53	1 034 972 939	16.87
Stroke	15 585 249 154	29.01	2 700 776 097	44.01
Hypertensive heart disease	494 786 619	0.92	86 667 662	1.41
Cardiomyopathy and myocarditis	1 109 614 950	2.07	86 369 853	1.41
Atrial fibrillation and flutter	359 563 736	0.67	310 687 390	5.06
Aortic aneurysm	681 507 737	1.27	0	0.00
Peripheral vascular disease	25 878 572	0.05	89 167 586	1.45
Endocarditis	1 310 459 526	2.44	25 789 430	0.42
Non-rheumatic valvular heart disease	185 242 019	0.34	28 323 540	0.46
Other CVDs and circulatory diseases	2 052 628 356	3.82	1 239 524 892	20.20
Total CVDs - persons	53 716 240 847	100.00	6 136 194 517	100.00

CVD: cardiovascular disease; RM: Malaysian ringgit
Source: Data extracted from Global Burden of Disease Results Tool *(10)*.

3.4 Diabetes

DALYs due to diabetes mellitus in the 2017 Malaysian population totalled an estimated 238 394 with a reasonably even split between males (121 586 or 51.0%) and females (116 808 or 49.0%). Diabetes mellitus accounted for one in every 10 of the total DALYs (10.1%) arising from the three major categories of NCDs under consideration in this study. DALY losses from diabetes mellitus totalled RM 10.21 billion.

The greatest proportion of the burden from diabetes occurs between the ages of 50 and 69 years, which accounts for 42.8% of the attributable costs (Table 13); however, the burden of disease costs of diabetes start to rapidly rise from the age of 30 years.

DALY LOSSES FROM DIABETES TOTALLED RM 10.21 BILLION.

The vast majority of the DALY burden arising from diabetes mellitus occurred as a result of YLD. Some 194 072 YLD accounted for 81.4% (RM 8.31 billion) of the total DALY cost burden stemming from diabetes. The remaining 18.6% of the cost burden (RM 1.9 billion) resulted from 44 322 YLL as a consequence of diabetes (Table 14). The bulk of the DALY burden stemmed from type 2 diabetes (94.3%).

Table 13. Diabetes – DALYs and DALY cost burden by age and gender, Malaysia, 2017

Age group (years)	Males	Females	Persons	Total (in %)
DALYs				
0–9	115	101	215	0.09
10–19	1 909	1 615	3 524	1.48
20–29	10 458	7 805	18 263	7.66
30–39	19 162	14 301	33 464	14.04
40–49	22 931	19 935	42 866	17.98
50–59	26 843	26 985	53 828	22.58
60–69	23 032	25 241	48 273	20.25
70–79	12 480	14 595	27 075	11.36
≥ 80	4 657	6 230	10 887	4.57
Total	121 586	116 808	238 394	100.00
DALY cost burden (RM)				
0–9	4 905 498	4 314 777	9 220 275	0.09
10–19	81 778 075	69 157 090	150 935 165	1.48
20–29	447 955 403	334 312 661	782 268 065	7.66
30–39	820 798 531	612 580 474	1 433 379 005	14.04
40–49	982 227 628	853 904 930	1 836 132 558	17.98
50–59	1 149 780 038	1 155 886 323	2 305 666 361	22.58
60–69	986 536 875	1 081 174 224	2 067 711 099	20.25
70–79	534 564 233	625 159 215	1 159 723 448	11.36
≥ 80	199 466 436	266 863 051	466 329 488	4.57
Total	5 208 012 716	5 003 352 747	10 211 365 464	100.00

DALY: disability-adjusted life year; RM: Malaysian ringgit
Source: Data extracted from Global Burden of Disease Results Tool *(10)*.

Table 14. Diabetes by type - YLL and YLD cost burden, Malaysia, 2017

Disease category	Years of life lost		Years lived with disability	
	RM	%	RM	%
Type 1 diabetes mellitus	507 969 880	26.76	70 813 745	0.85
Type 2 diabetes mellitus	1 390 530 728	73.24	8 242 051 110	99.15
Total diabetes	1 898 500 609	100.00	8 312 864 855	100.00

RM: Malaysian ringgit
Source: Data extracted from Global Burden of Disease Results Tool *(10)*.

3.5 Cancer

Neoplasms or cancer accounted for 717 318 DALYs in the 2017 Malaysian population (54.3% males and 45.7% females) (Table 15). Cancer accounted for 30.5% of the DALYs arising from the three major categories of NCDs under consideration in this study. DALY losses from cancer totalled RM 30.73 billion. The DALY burden from cancer occurs primarily in the 50–69 years age group, which accounts for nearly one half (47.9%) of the attributable burden of disease costs.

The cancer burden is spread across a long list of types of cancer (29 specified in total) (Table 16). The largest burden of disease losses stem from trachea, bronchus and lung cancer, which accounts for 15% of the total DALY burden from neoplasms and primarily affects males. The next largest cancer categories were breast cancer and cancer of the colon and rectum, each of which accounts for approximately 11.5% of the total DALY burden. Breast cancer, however, is responsible for one quarter of the female burden (25.2%).

DALY LOSSES FROM CANCER TOTALLED RM 30.73 BILLION.

Table 15. Cancer – DALYs and DALY cost burden by age and gender, Malaysia, 2017

Age group (years)	Males	Females	Persons	Total (in %)
DALYs				
0–9	8688	5720	14 408	2.01
10–19	14 736	7948	22 683	3.16
20–29	19 207	10 876	30 083	4.19
30–39	28 343	26 911	55 254	7.70
40–49	44 263	55 071	99 334	13.85
50–59	81 811	84 205	166 017	23.14
60–69	103 563	74 114	177 678	24.77
70–79	66 738	45 319	112 057	15.62
≥ 80	21 802	18 003	39 806	5.55
Total	389 152	328 166	717 318	100.00
DALY cost burden (RM)				
0–9	372 131 464	245 012 394	617 143 858	2.01
10–19	631 191 665	340 428 255	971 619 920	3.16
20–29	822 709 483	465 849 532	1 288 559 016	4.19
30–39	1 214 050 463	1 152 685 168	2 366 735 631	7.70
40–49	1 895 969 038	2 358 909 746	4 254 878 784	13.85
50–59	3 504 301 803	3 606 852 402	7 111 154 205	23.14
60–69	4 436 036 951	3,174 603 047	7 610 639 998	24.77
70–79	2 858 649 840	1 941 178 830	4 799 828 670	15.62
≥ 80	933 879 516	771 155 863	1 705 035 379	5.55
Total	16 668 920 224	14 056 675 237	30 725 595 461	100.00

DALY: disability-adjusted life year; RM: Malaysian ringgit
Source: Data extracted from Global Burden of Disease Results Tool *(10)*.

Nearly all of the DALY burden (97.0%) arising from cancer stems from the YLL due to premature death (RM 29.8 billion) (Table 16). Only 3.0% of the total DALY burden from cancer was due to YLD (at a cost of RM 0.9 billion). The three cancers specified in the previous paragraph accounted for nearly two in every five years lost (38.2%).

Table 16. Cancer – YLL and YLD cost burden by cancer type, Malaysia, 2017

Disease category	Years of life lost		Years lived with disability	
	RM	%	RM	%
Oesophageal cancer	647 079 183	2.17	7 672 792	0.84
Stomach cancer	1 507 365 051	5.06	18 676 161	2.05
Liver cancer	1 819 193 177	6.10	16 382 016	1.80
Larynx cancer	306 977 016	1.03	12 496 945	1.37
Tracheal, bronchus and lung cancer	4 587 466 534	15.39	44 386 204	4.88
Breast cancer	3 311 531 509	11.11	228 976 062	25.15
Cervical cancer	1 170 948 681	3.93	50 908 164	5.59
Uterine cancer	296 220 622	0.99	27 908 279	3.07
Prostate cancer	603 528 422	2.02	59 569 973	6.54
Colon and rectum cancer	3 447 888 561	11.56	129 219 896	14.19
Lip and oral cavity cancer	583 426 372	1.96	23 864 853	2.62
Nasopharynx cancer	1 213 036 683	4.07	32 974 244	3.62
Other pharynx cancer	239 355 780	0.80	4 712 653	0.52
Gallbladder and biliary tract cancer	267 108 193	0.90	3 072 108	0.34
Pancreatic cancer	799 893 551	2.68	7 175 744	0.79
Malignant skin melanoma	107 184 616	0.36	3 232 132	0.36
Non-melanoma skin cancer	180 853 992	0.61	387 379	0.04
Ovarian cancer	684 386 154	2.30	33 024 968	3.63
Testicular cancer	75 617 808	0.25	7 957 907	0.87
Kidney cancer	310 948 868	1.04	13 821 170	1.52
Bladder cancer	403 061 295	1.35	29 684 363	3.26
Brain and nervous system cancer	921 982 375	3.09	13 069 129	1.44
Thyroid cancer	213 655 185	0.72	32 895 216	3.61
Mesothelioma	56 057 782	0.19	1 090 487	0.12
Hodgkin lymphoma	134 269 388	0.45	5 272 472	0.58
Non-Hodgkin lymphoma	1 128 125 115	3.78	22 525 675	2.47
Multiple myeloma	226 366 661	0.76	6 813 528	0.75
Leukaemia	2 285 293 518	7.66	33 058 502	3.63
Other malignant neoplasms	1 374 849 773	4.61	38 573 522	4.24
Other neoplasms	911 546 879	3.06	974 171	0.11
Total neoplasms	29 815 218 745	100.00	910 376 716	100.00

RM: Malaysian ringgit

Source: Data extracted from Global Burden of Disease Results Tool *(10)*.

4. CONCLUSION

In this paper, the economic costs attributed to NCDs in Malaysia for the year 2017 were estimated. Table 17 summarizes key findings from both parts of the analysis.

Table 17. Summary of economic costs attributed to selected NCDs, Malaysia, 2017

Characteristics	Cost (RM million)	Percentage
Nominal GDP (2017)		
	1 371 648	100.00
Productivity losses due to selected NCDs[1]		
High estimate[2]	12 879	0.94
Low estimate[3]	8 908	0.65
Cost of disease burden due to selected NCDs[1]		
High estimate[4]	302 368	22.04
Low estimate[5]	100 789	7.35

1. Includes cardiovascular disease, cancer and diabetes.
2. Applied human capital approach.
3. Applied friction cost approach.
4. Valued at three times GDP per capita.
5. Valued at GDP per capita.

GDP: gross domestic product; NCD: noncommunicable disease; RM: Malaysian ringgit

The first part of this report aimed to estimate the NCD-related productivity losses due to absenteeism, presenteeism and early retirement due to premature deaths. The analysis revealed that CVD, diabetes and cancer cost RM 12.88 billion (high estimate) or RM 8.91 billion (low estimate) in lost productivity, which accounted for 0.94% or 0.65% of Malaysia's GDP in 2017, respectively.

The second part of this paper aimed to estimate the monetary value of the NCD-related disease burden as measured by DALYs, YLL and YLD. The research evaluated the cost of the three NCD categories at RM 302.37 billion (high estimate) or RM 100.79 billion (low estimate), which accounted for 22.04% or 7.35% of GDP in 2017, respectively. The higher estimated costs of NCDs in the second part of this paper are contributed by intangible costs, including the value of individuals on the loss of life or loss of healthy life. In contrast, the financial costs arising from productivity losses entail tangible costs to the economy.

There are various limitations to the methodologies used and these were stated in each section of the report. We also did not incorporate any projections of future economic costs associated with NCDs as well as the estimation of health-care costs to prevent, screen, diagnose and treat NCDs.

The latest NHMS 2019 results also revealed the increasing trends in the prevalence of NCDs, which implies that both direct and indirect costs for NCDs may further increase in the future. The Ministry of Health Malaysia and WHO will continue discussing the necessary subsequent steps to move forward.

We also believe this report can serve as a basis for further detailed exploration of costs.

To sum up, the results of this report reaffirmed the significance and necessity to further strengthen the prevention and control of NCDs in Malaysia from an economic viewpoint.

REFERENCES

1. Noncommunicable diseases country profiles 2018. Geneva: World Health Organization; 2018 [cited 2020 Jun 7]. Available from: https://apps.who.int/iris/handle/10665/274512
2. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. Geneva: World Health Organization; 2013 [cited 2020 Jun 7]. Available from: https://www.who.int/nmh/publications/ncd-action-plan/en
3. Institute for Public Health. Non-communicable diseases, risk factors & other health problems. In: National Health and Morbidity Survey 2015. Kuala Lumpur: Ministry of Health Malaysia; 2015. Available from: https://www.moh.gov.my/moh/resources/nhmsreport2015vol2.pdf
4. National Strategic Plan for Non-Communicable Disease (NSP-NCD) 2016-2025. Putrajaya: Ministry of Health Malaysia; 2016. Available from: https://www.moh.gov.my/moh/resources/Penerbitan/Rujukan/NCD/National%20Strategic%20Plan/FINAL_NSPNCD.pdf
5. ProtectHealth Corporation Sdn Bhd. PeKa B40 [website]. Cyberjaya; 2020 [cited 2020 May 28]. Available from: https://www.pekab40.com.my/eng
6. Jaspers L, Colpani V, Chaker L, van der Lee SJ, Muka T, Imo D, et al. The global impact of non-communicable diseases on households and impoverishment: a systematic review. Eur J Epidemiol. 2015 Mar;30(3):163–88.
7. World Economic Forum, World Health Organization. From burden to "best buys": Reducing the economic impact of non-communicable diseases in low- and middle-income countries. Geneva: World Economic Forum; 2011. Available from: https://www.who.int/nmh/publications/best_buys_summary.pdf
8. Van den Hout W. The value of productivity: human-capital versus friction-cost method. Ann Rheum Dis. 2010;69(Suppl 1):i89–91.
9. Department of Labour. Minimum Retirement Age Act 2012, Laws of Malaysia. Act 753 2012. Available from: http://www.federalgazette.agc.gov.my/outputaktap/20120816_AKTA%20753_BI_JW002810%20BI-MINIMUM%20RETIREMENT%20AGE%20ACT%202012.pdf
10. Institute for Health Metrics and Evaluation. Global Health Data Exchange: GBD Results Tool [website]. Seattle (WA): University of Washington; 2017. Available from: http://ghdx.healthdata.org/gbd-results-tool
11. Labour Force Survey Report, Malaysia 2017. Putrajaya: Department of Statistics Malaysia; 2017. Available from: https://www.dosm.gov.my
12. Principal statistics of salaries & wages for citizens, Malaysia, 2017. Putrajaya: Department of Statistics Malaysia; 2018. Available from: https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=157&bul_id=NzFoZURoenJHeFBhdCt0bXJFOWY3dz09&menu_id=U3VPMldoYUxzVzFaYmNkWXZteGduZz09
13. CEIC Data. Malaysia discount rates [website]. New York (NY); 2018. Available from: https://www.ceicdata.com/en/malaysia/discount-rates
14. Koopmanschap MA, Rutten FFH, van Ineveld BM, Van Roijen L. The friction cost method for measuring indirect costs of disease. J Health Econ. 1995;14(2):171–89.

15. Erdogan-Ciftci E, Koopmanschap MA. Estimation of productivity costs using the friction cost method: new evidence using national data. Value Health. 2011;14(7):A235–6.

16. Nicholson S, Pauly MV, Polsky D, Sharda C, Szrek H, Berger ML. Measuring the effects of work loss on productivity with team production. Health Econ. 2006;15(2):111–23.

17. Anesetti-Rothermel A, Sambamoorthi U. Physical and mental illness burden: disability days among working adults. Popul Health Manag. 2011;14(5):223–30.

18. Goetzel RZ, Long SR, Ozminkowski RJ, Hawkins K, Wang S, Lynch W. Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting US employers. J Occup Environ Med. 2004;46(4):398–412.

19. WHO Commission on Macroeconomics and Health. Macroeconomics and health: investing in health for economic development: report of the Commission on Macroeconomics and Health. Geneva: World Health Organization; 2001. Available from: https://apps.who.int/iris/handle/10665/42435

20. State Socioeconomic Report 2018. Putrajaya: Department of Statistics Malaysia; 2019 Jul. Available from: https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=102&bul_id=a0c3UGM3MzRHK1N1WGU5T3pQNTB3Zz09&menu_id=TE5CRUZCblh4ZTZMODZIbmk2aWRRQT09

21. Robinson LA, Hammitt JK, Cecchini M, Chalkidou K, Claxton K, Cropper M, et al. Reference case guidelines for benefit-cost analysis in global health and development. Boston (MA): Harvard T.H. Chan School of Public Health; 2019 May [cited 2020 Jun 9]. Available from: https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2447/2019/05/BCA-Guidelines-May-2019.pdf

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