Review on Cardiovascular Disease Risk Factors Among Selected Countries in Asia

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Abstract Cardiovascular disease is known as the principal cause of death worldwide. Among all the diseases related to cardiovascular disease, myocardial infarction and stroke are the most common contributors to the increased death rate. This paper aims to study the risk factors affecting cardiovascular disease, especially in the region of Asia. This paper reviews past studies regarding cardiovascular disease to investigate the contributing risk factors for this disease. This study found that most of the cardiovascular disease risk factors are related to unhealthy lifestyles. Blood pressure level, smoking status, body mass index, cholesterol level and blood glucose level are among the most significant risk factors for cardiovascular disease. Promoting a healthy lifestyle towards all citizens is necessary to reduce the mortality rate due to cardiovascular disease. A comprehensive prevention plan by the government is essential to reduce the risk and the mortality rate of cardiovascular disease.

Keywords Cardiovascular disease · Myocardial infarction · Stroke · Risk factors

1 Introduction

The heart is an organ in the human body, which ensures continuous blood flow in the blood vessel without any stop. Heart functions to pump the blood to the entire human body. This process is vital to ensure an adequate supply of oxygen to cells throughout the body. The process of blood circulation begins with oxygenated blood cells, which are blood cells that carry oxygen from the lung to the heart. Then, the heart will pump the oxygenated blood cell to the entire body. The oxygenated blood cells will supply the body's tissue with the oxygen needed by the body. Lastly, after the exchange of oxygen and carbon dioxide at the body tissue, the deoxygenated blood cell, which

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carries carbon dioxide, will be transported to the heart before being pump back to the lung. This process will continuously occur until the human dies. The blood in the human body does not only carries oxygen and carbon dioxide, but it also carries nutrients, hormones, waste materials, and interstitial fluid that are needed by the body [1]. Approximately, there are 72 heartbeats per minute. The human heart weight was estimated at around 300–350 g for men and 250–300 g for women [2]. Like other organs in the human body, the heart also requires oxygen to function continuously. The artery that provides the blood to the heart is called the coronary artery [1].

Humans' routine changed from being active and focused on farming for food to being inactive with high consumption of fast food in the last decades due to advancing technology. Besides that, a worldwide increase in cigarette consumption increases the risk of cardiovascular disease (CVD). CVD is a phrase used to describe diseases related to heart and blood vessels. CVD occurs when a blood vessel has narrowed or blocked, disturbing the oxygen supply to the organ's tissue [3]. This condition is known as atherosclerosis, a condition when plaques from fats, cholesterol and other substances developed at the artery's inner wall and disturb the blood circulation system. The plaques' development starts with the formation of tiny cholesterols crystals inside the intima and its underlying smooth muscle. The plaque will then expand with the development of fibrous tissues and its surrounding smooth muscle. The plaque will bend within the arteries and lower the flow of blood. Fibroblast connective tissue development and calcium accumulation in the lesion will cause the arteries to harden. The arteries' irregular surface results in the growth of clots and thrombosis, leading the blood flow being suddenly obstructed [4].

There are two types of CVD, which describes the diseases of the heart and blood circulation. The most common cause for the heart disease is myocardial infarction (MI) or heart attack, and the most common cause for the disease of the circulation is cerebrovascular accident or stroke [2].

Ischaemic Heart Disease (IHD) is a disease due to blockage of the blood flow in the coronary artery. MI is the results of IHD. MI is the condition when there is a blood clot that blocks the coronary artery from delivering blood, which supplies the heart muscle with oxygen. MI also refers to the condition when the myocardial cell dies due to shortage of oxygen [5]. Based on the MI definition, not all MI cases would be due to the presence of a blood clot. The oxygen supply to the heart muscle must be equal to the oxygen demand by the heart muscle. Any imbalance ratio of supply and demand will lead to a rapid heart rate or increased blood pressure. This condition can lead to MI without the existence of blood clot [6].

Stroke is also the most frequent cause of death for patients with CVD. A stroke occurs when there is a sudden decrease in blood flow to the brain and causes brain functions loss due to lack of oxygen and nutrients supply to the brain. A stroke usually presents the symptoms of hemiparesis, vomiting, drowsiness, and loss of consciousness. The most common type of stroke is the ischemic stroke due to blockage of blood vessel towards the brain, while haemorrhagic stroke is due to the spontaneous rupture of blood vessel [7].

CVD was the principal factor of mortality and morbidity worldwide. The total number of deaths due to CVD had increased universally from 14.4 million death

in 1990 to 17.5 million death in 2012. In 2012, 31% of worldwide deaths were caused by CVD, and it has been the largest single contributor to global mortality and was projected to maintain its dominance of the world mortality trends in the future [8]. CVD had also contributed to more than 30% of all deaths worldwide, and 82% of CVD deaths happen in low and middle-income countries. It is also predicted around 23.6 million people would die annually due to CVD during 2030, and the most significant rise of CVD deaths would be in South East Asia countries [3]. CVD treatment is the most expensive, with 11% or 5.4 billion dollars of the total expenditure on health was from CVD cases in 2000–2001. Other than that, CVD survivors were mostly disabled and are not able to work. These had become a tremendous financial burden for the patients [3].

Many risk factors can contribute to the trends of CVD cases. This paper aims to review the trend of risk factors on CVD among selected countries in Asia: China, India, Indonesia, Japan, Malaysia, Singapore, and Thailand. Section 2 will review the distribution of CVD among selected countries. Following this, Sect. 3 will discuss the prevalence of the risk factors for CVD among selected countries and the relationship between each country's death trend. Section 4 will discuss the prevention of CVD. Section 5 will discuss the review's findings, and Sect. 6 will conclude all the finding in the research.

2 Distribution of Cardiovascular Disease Among Selected Countries

Type of CVD that are fatal differs among countries. China, Cambodia, North Korea, South Korea, Vietnam, Bangladesh, and Myanmar have a higher mortality rate due to stroke than MI, while in all the other Asian countries the mortality rate due to MI is higher than mortality resulted from stroke [9]. Figure 1 shows the proportion of MI and stroke deaths among the selected countries and shows Malaysia, India, and China to have the highest mortality due to MI in 2016. Other than that, these three countries show an increasing rate of MI mortality in the 16 years. Figure 2 shows that stroke mortality is highest in China and has an increasing trend in China, Indonesia, and India.

Studying the mortality rate of CVD will allow a glance at the mortality rate of MI and stroke since most CVD were due to MI and stroke. Among all CVD cases, MI and stroke comprise 87.8% of all CVD deaths worldwide [9]. Figure 3 shows the CVD mortality rate of the selected countries. Based on the figure, China had the highest CVD mortality rate compared to other countries. China has also shown a 10% increase in CVD mortality rate from 2000 to 2016. Many studies reported a decline in physical activity among individuals in China. During 2002, the Chinese National Nutrition and Health Survey had proved that only 34% of adults in a large city and 45% adults in the small and medium cities have an active lifestyle. Only 18.7% of Chinese adults have regular physical activity. The study believes that the

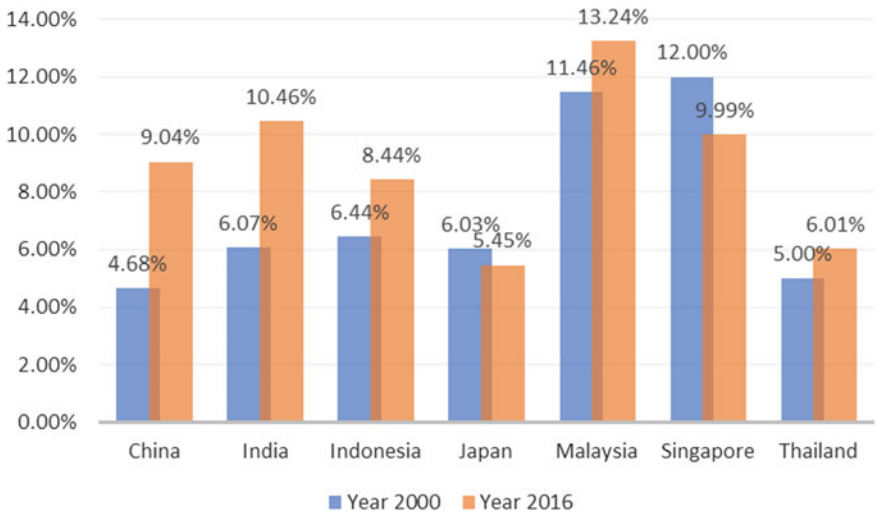

Fig. 1 Percentage of myocardial infarction death in selected countries [9]

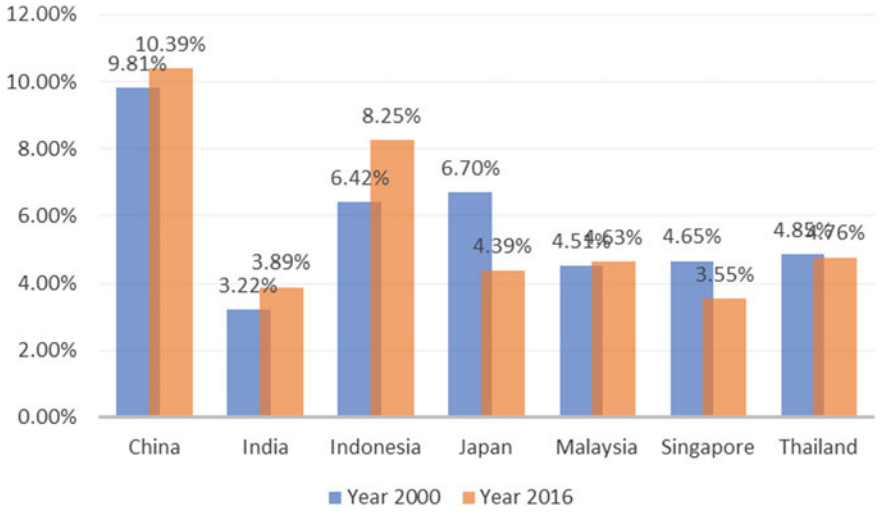

Fig. 2 Percentage of stroke death in selected countries [9]

decline in the number of active Chinese adults will contribute to China's rising cases of CVD deaths [10].

The graph also shows that Japan and Singapore have a declining trend in CVD's mortality from 2000 to 2016. Another study discovered that Japan also reported the lowest MI death worldwide, with 47 deaths per 100,000 populations [11]. Although there was a declining in the statistics of CVD death in Singapore, CVD is still the main

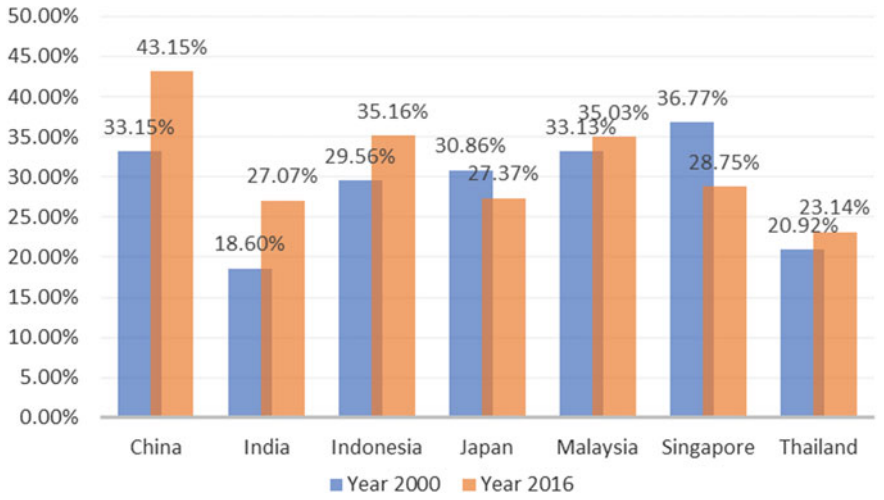

Fig. 3 Percentage of cardiovascular disease death in selected countries [9]

contributor to Singapore's total death because its population was moving towards the ageing population [12]. The graph also shows that China, India, Indonesia, Malaysia, and Thailand have an increased CVD mortality rate. The risk factors which contribute to the different CVD trends would be discussed further in the next section.

3 Prevalence of Risk Factors Among Selected Countries

Many risk factors contribute to CVD. There are two types of risk factors: controllable risk factors and uncontrollable risk factors. The uncontrollable risk factors are the risk factors that could not be modified or avoided. Family history, age, ethnicity, and gender are among the uncontrollable risk factors of CVD. Whereas the controllable risk factors were the risk factors that could be modified or avoided. Dyslipidaemia, hypertension, hyperglycaemia, low physical activities, low nutrition consumption, smoking habits and BMI were the controllable CVD risk factors [13]. A study reported that current smoking behaviour, psychosocial factors, diabetes mellitus, hypertension history, abdominal obesity, alcoholic drinks consumption, reduced regular activities and low daily consumption of fruits and vegetables are the significant CVD risk factors [14]. Another study discovered that diabetes mellitus, hypertension, CVD family history, renal disease, Percutaneous Coronary Intervention (PCI), Killip class and age were the main contributing CVD risk factors [15]. National Health and Morbidity Survey 2019 reported hypertension, diabetes, and high cholesterol as the main risk factors of CVD in Malaysia. 1.7 million people in Malaysia have these three risk factors, while 3.4 million people have two of these three risk factors [16]. Based on a lot of research, it can be concluded that blood

pressure, BMI, smoking status, cholesterol level and blood glucose level were the main CVD risk factors. This paper will discuss in detail these CVD's risk factors.

3.1 Blood Pressure

High blood pressure or hypertension was the number one risk factors for CVD. According to Malaysian clinical practice guideline, the patients would be classified as having hypertension if the reading of blood pressure were 140/90 mmHg or higher [17]. Hypertension has contributed to more than 15% of deaths worldwide. Hypertension also contributed to 62% of all strokes and 49% of MI cases [18]. Based on Fig. 4, all countries had more than 10% of raised blood pressure. Among all these seven countries, India, Indonesia, Malaysia, and Thailand, have the highest percentage of raised blood pressure. It is comparable to the previous graph that shows that India, Indonesia, Malaysia, and Thailand have an increasing trend of CVD mortality. This finding concludes that hypertension has a high impact on CVD mortality.

Hypertension is a disease which is related to the increase in age. Increasing age would increase the risk of having hypertension. It was approximated that 60% of people aged 60 years and above have hypertension. Since the global population is moving towards an ageing population, it is predictable that most of the worldwide population aged 60 years and above would develop hypertension by 2030 [19]. One of the factors that contribute to the increasing rate of hypertension cases was excessive salt consumption. Current salt consumption in the world population is alarming. Although sodium has many benefits for the human body, consuming too much sodium

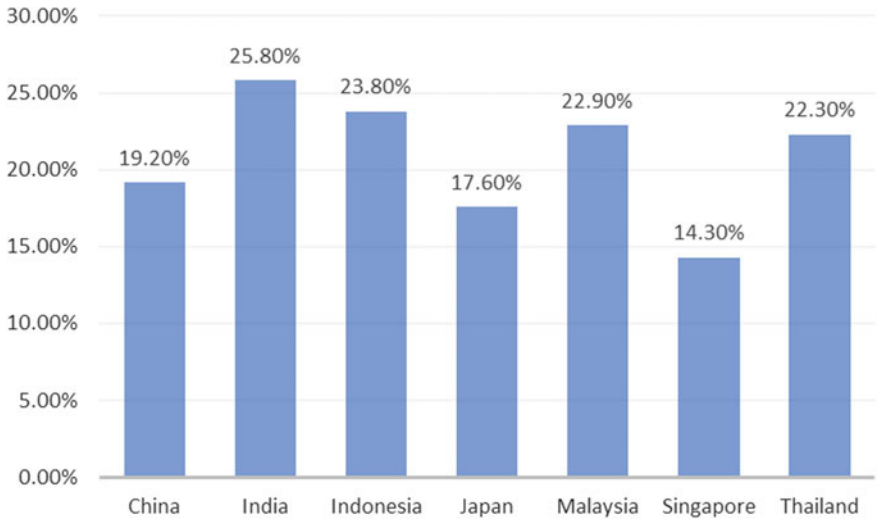

Fig. 4 Percentage of raised blood pressure in selected countries [9]

than what is needed by the body would overload the metabolic system. The overload would increase blood pressure and cause millions of deaths, mostly related to CVD [18].

3.2 *Smoking Status*

Cigarette smoking was found to be the largest risk factor for premature death among developing countries. Premature death is a condition when a person dies before the average age of the country. It was estimated that approximately 3 million deaths were reported per year worldwide due to smoking-related diseases, and 10 million deaths were forecasted to occur due to smoking-related diseases [20]. Smoking was the second leading risk factor for CVD after high blood pressure. According to the World Health Organization (WHO), more than 1 billion smokers exist worldwide, and the statistics keep increasing [21].

Figure 5 shows the percentage of smokers amongst the selected countries. By analyzing the graph, most of the countries have nearly half of their population that were smokers. India and Singapore recorded the smallest number of smokers' percentage. Indonesia, China, and Malaysia recorded the highest number of smokers in these countries. These countries showed the highest statistics for CVD mortality during 2016. This finding proves that smoking has a high impact on CVD mortality trends.

There are many reasons for the youths to be involved in smoking, such as peer pressure, desire to look mature, kill boredom, and to help relax and release stress.

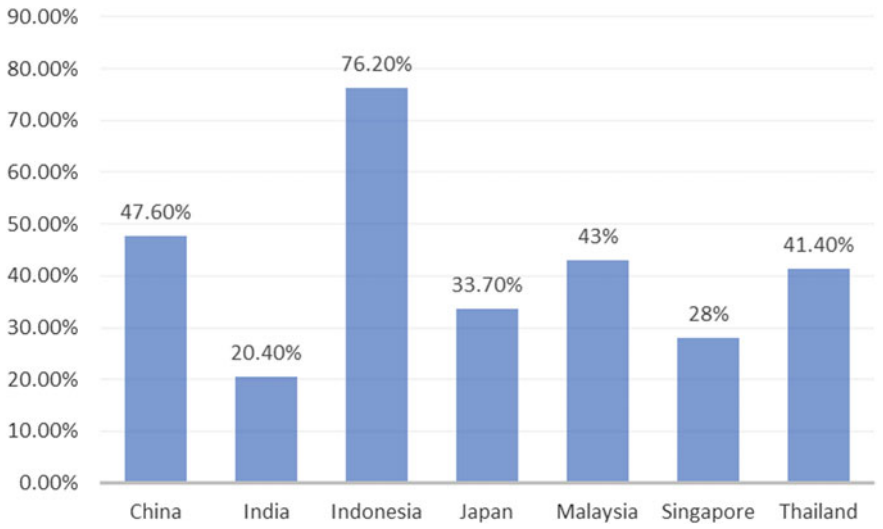

Fig. 5 Percentage of smokers in selected countries [9]

Usually, this would be learned from their friends, influenced by family members who are also smokers or tried by themselves because of curiosity [22]. There are many reasons for people to start smoking either due to the environment or genetic factors. Many smokers would try to stop smoking or reduce their cigarette consumption, but many tend to fail due to strong nicotine addiction. Since majority of smokers are men, it is found that men are two to five times at greater chance of developing CVD [21].

3.3 Body Mass Index

BMI is another significant risk factor for the development of MI and stroke. In Malaysian clinical practice guideline, individuals with BMI reading between 18.5 and 22.9 kg/m^2 were classified as normal. Individuals being above these values are considered obese [23]. Some studies reported that BMI does not directly affect CVD, but it has a second-order CVD effect. High BMI value would increase the risk of developing hypertension, diabetes and hypercholesterolaemia. Smoking had a little impact on BMI. Quitting smoking could raise the BMI level while continuing to smoke cigarette could reduce the BMI level. Studies have proved that reducing BMI would result in the reduction of CVD occurrence risk [24].

Figure 6 demonstrates that most of the countries showed an increase in the BMI average from the year 2000–2016. As for overweight individuals, their BMI values would be in the range of 25–40. Individuals passing the value of 40 would be classed as being obese. Most countries were nearly approaching the average BMI range of

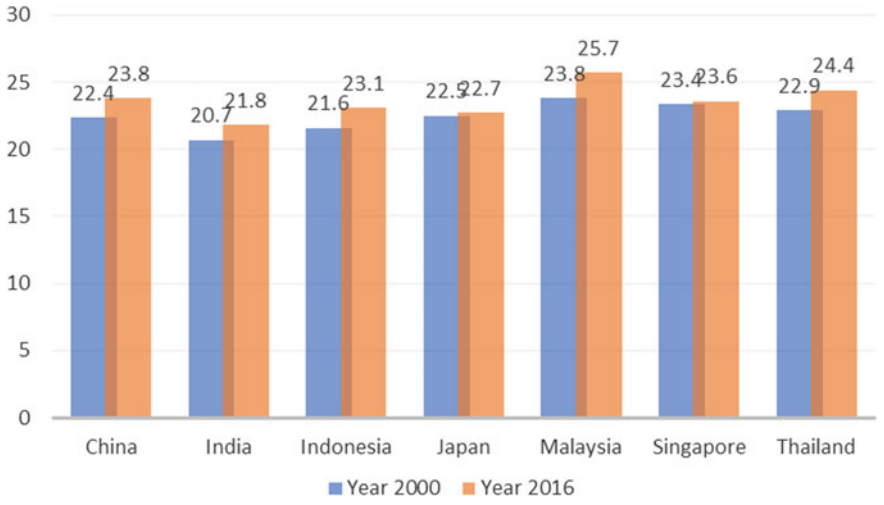

Fig. 6 Average body mass index in selected countries [9]

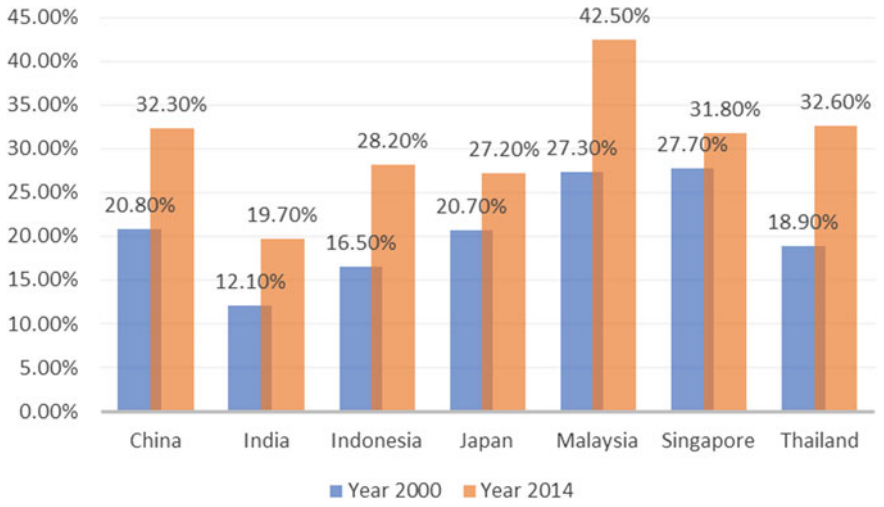

Fig. 7 Percentage of overweight citizens in selected countries [9]

overweight while Malaysia had already passed this range. This finding shows that most of the countries are moving towards the average BMI of being overweight.

Figure 7 also exposed that Malaysia has 42.5% of individuals categorised as being overweight. The graph also shows that the percentage of overweight individuals in all countries has increased from 2000 to 2016. This finding is alarming since the increase in BMI could trigger other CVD risk factors.

Physical inactiveness is the main factor for the increase in BMI level, which can lead to obesity. Increase in BMI would also increase the risk of CVD. Individuals with high physical activity or fitness have the potential to counter the risk of mortality caused by obesity [25].

3.4 Cholesterol

Dyslipidaemia is the condition in which the blood lipid or cholesterol levels are increased. Increase in the blood cholesterol level could cause ischemia or blood vessel blockage in the heart [26]. According to clinical practice guideline in Malaysia, patient with a total cholesterol level higher than 5.2 mmol/L would be diagnosed with dyslipidaemia [27]. Figure 8 shows that Japan, Malaysia, Singapore, and Thailand have more than 50% of the individuals with raised total cholesterol level. Although China and Indonesia recorded the highest CVD deaths, the percentage of individuals with raised total cholesterol is lower. The effect of blood cholesterol level towards CVD is antagonistic in this study, suggesting that the cholesterol level may not have a high impact on CVD risk in these countries.

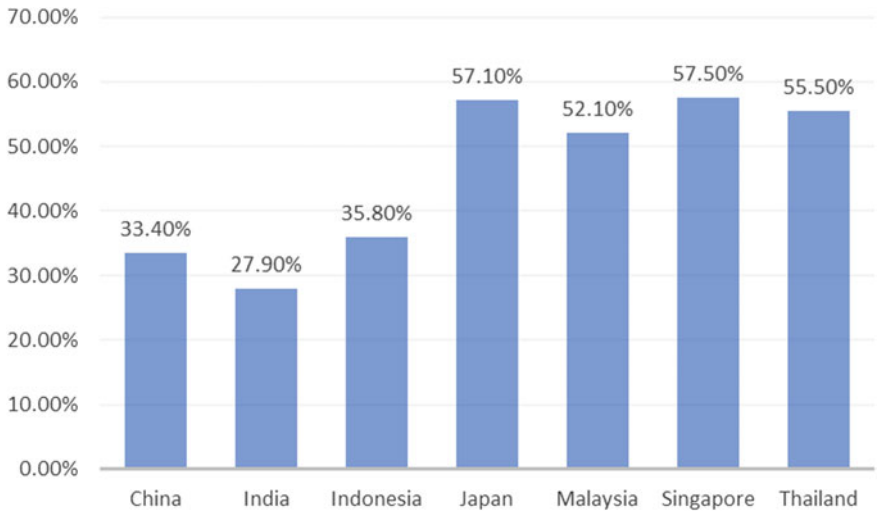

Fig. 8 Percentage of raised total cholesterol in selected countries [9]

Increased cholesterol level would increase the CVD risk, and a decrease in cholesterol level would reduce CVD risk. There are many strategies to reduce the blood cholesterol level, which in turn would reduce the risk of CVD, such as by consuming statins [28].

3.5 Blood Glucose Level

Blood glucose level has a significant positive effect on CVD risk. Increase in blood glucose level would increase the risk of CVD [23, 24]. For diabetic patients, the clinical practice guideline in Malaysia had set the reading for venous plasma glucose would be higher than 7.0 mmol/L for fasting patient and 11.1 mmol/L for non-fasting patients [29]. Figure 9 shows that Malaysia has the highest percentage of raised blood glucose, and Japan has the lowest percentage. Findings for other countries varied among each other. The impact of blood glucose level on CVD mortality may not be high, since the percentage of raised blood glucose level is lower than other CVD risk factors that had been discussed.

Diabetes is a well-recognized risk factor for CVD. Diabetic patients who consume insulin should monitor their blood glucose level routinely to assure their diabetes is controlled with the correct diet, exercise, and medication. Taking good care of blood glucose level would reduce the risk of CVD [30].

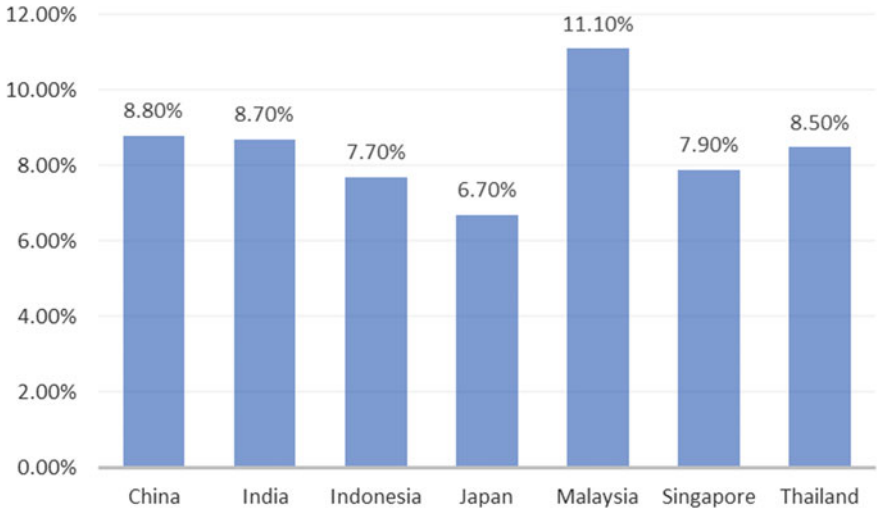

Fig. 9 Percentage of raised fasting blood glucose in selected countries [9]

4 Methods of Preventing the Risk of Suffering from Cardiovascular Disease

Based on the risk factors mentioned above, most of the risk factors mentioned were related to an unhealthy lifestyle. Replacing the bad habit of lifestyles with better habits would reduce the CVD risk, especially for developing MI and stroke. There are many ways to reduce the risk of MI and stroke. Quitting or reducing smoking, having a healthy diet, and being active physically by playing sports and jogging could help reduce this risk. Implementing a healthy lifestyle would lead to cessation of deaths related to MI and stroke [14]. According to the National Health and Morbidity survey 2019, CVD was considered a non-communicable disease. Some ways to help reduce the risk of having the non-communicable disease are by controlling the blood pressure to be below 140/90 mmHg, practicing a healthy diet, maintaining a healthy weight, having regular exercises, stop smoking and reducing the consumption of alcohol [16].

Lessening salt intake would assist to lower the high blood pressure Reducing the number of individuals having high blood pressure may lead to excellent health gain. WHO had recommended reducing the consumption of salt to 5 g per day [18]. Other than that, quitting smoking could also be beneficial for CVD risk reduction. About 40% of smokers try to quit smoking, but only 4–6% would be successful. This failure is due to high nicotine addiction and lack of motivation. Having great motivation would influence someone to stop smoking and having a better life [31]. Having an active lifestyle would reduce the risk of being overweight and obese. People who are obese but have an active lifestyle tend to have a lower risk of CVD than those with an inactive lifestyle. People who are active in sports also less likely to

be smokers [25]. Taking statin may result in reducing blood cholesterol or lipid levels. With the exception for individuals with extreme cholesterol panel, controlling diet or dietary therapy may help reduce the risk of developing hyperlipidaemia. Having a balanced diet, proper exercise, consuming fruits and vegetables, and fish oil may reduce the blood cholesterol level [32]. Reducing sugar consumption would reduce the risk of diabetes development [33].

4.1 Prevention of the Cardiovascular Disease Risk from an Islamic Perspective

Islam encourages individuals to take care of their health. Having a good health condition not only prevents individuals from developing dangerous diseases, but it also helps them to focus on their worship to Allah. Allah SWT had said in the Quran:

One of the two women said, "O my father, take him as a hired man (shepherd of sheep), surely the best person you choose is the one who is strong and trustworthy" (Al-Qasas: 26).

From Abi Hurairah RA, Rasulullah SAW said: "A strong believer is better and more favoured by Allah than a weak believer. Even when both are good. Do your utmost to obey Allah and seek His help and do not be discouraged. If you are hit by disaster, do not say 'if I had not done that', but say 'Allah had destined it and what Allah desires would surely happen.' Indeed, the word 'if' could open the door to the devil" (Sahih Muslim).

Both verses from Al-Quran and Al-Hadith explain that it is essential to be strong since Allah love strong believers. 'Strong' means having a healthy life. Healthy people tend to have more energy to work efficiently and perform worship to Allah calmly. Allah SWT also Said in the Quran:

And We say: "Eat of the good things which We have given to you and do not cross the limit because who are over the limit would face My anger and whoever faces My anger would certainly perish" (Taha: 81).

This verse explains that Allah has permitted us to eat all the good foods provided on the earth, but do not consume excessively until the limit is crossed. Anything that is over the limit would usually bring disaster. For example, consuming too much salt would increase the chance of developing high blood pressure, and too much sugar would lead to diabetes. Hence, we need to be balanced and not crossover the limit. Rasulullah SAW had said:

> And indeed, every human body has lumps of blood that if it is good then the body would be good, and if it is damaged the body would be damaged. You know, it is Al-Qalb. (Sahih Bukhari)

From this verse, it can be understood that to have a healthy body, not only having an intense physical activity is required, but the spiritual needs should also be complete. Having a good spiritual condition may help individuals to overcome stress

and tension, hence avoiding them from harming themselves by taking dangerous substances to calm themselves, such as by smoking.

Therefore, it can be concluded that Islam encourages individuals to take care of themselves to maintain physical and mental health. Having a balanced physical and spiritual activities would reduce the risk of being unhealthy. Eating from good sources and not consuming over the limit, would provide sufficient nutrients to maintain a healthy body, thus reducing the risk of developing MI, stroke, and other diseases.

5 Discussion

Based on the study above, only China had a lower rate of MI deaths compared to stroke. This previous study also reported that China's stroke mortality was lower than MI, with 157 deaths related to stroke per 100,000 individuals, while MI contributed to 63 deaths per 100,000 individuals [34]. This study also discovered that Japan and Singapore showed a declining mortality rate related to both MI and stroke. A study reported that Singapore's CVD mortality rate had declined from 99 deaths per 100,000 population in 1976 to 59 deaths per 100,000 population in 1994 [34]. They reported that Japan mortality rate due to stroke had decreased from 974 deaths per 100,000 in 1964–1971 to 231 deaths per 100,000 in 1996–2003. The study also found that there is no change in MI mortality rate in Akita, Hiroshima, and Nagasaki from 1960 to 1990. It is estimated that the trend of stroke mortality events in Singapore decreases 3–5% annually. Japan showed a 70% decrease in stroke-related deaths from the year 1960–1990 [35]. There was also a study that discovered a different result from the previous discussion. The study reported that Japan's MI mortality rate had increased by 7.4 deaths per 100,000 individuals in 1979 to 27.0 deaths per 100,000 in 2008 due to the increase in Japan's ageing population. The results were contradictory and could be due to many factors, such as the different analysis method used [36].

Many risk factors were contributing to the trends of CVD mortality rate. Each risk factors have a different level of impact on the death rate of CVD. Blood pressure is the most significant risk factors of CVD, especially for MI and stroke. It was reported that 54% of stroke and MI cases were contributed by high blood pressure. In the Asia Pacific region, hypertension contributes 665 CVD cases. Reduction in blood pressure will give a consistent effect on CVD reduction [37].

Smoking is also an important risk factor for CVD, strongly related to the increase in morbidity and mortality of CVD patients. Smoking cessation would result in declining CVD mortality rates [38]. People who are smokers have 3.436 times more chances to develop MI and 2.158 more chances to develop stroke, compared to those who never smoke. Smoking also increases the chance of developing other risk factors such as diabetes, hypertension and hypercholesterolaemia. Smokers who suffered MI and stroke were 1.766 times more likely to die than people who never smoked. Reducing the number of cigarette smokes could increase the BMI of the individual while resuming smoking could decrease the BMI level [39].

Increase in BMI was directly related to developing MI. Being overweight and obese would affect the health and other independent risk factors of MI [40]. Some studies argued that BMI not an important risk factor of MI and stroke but has a second-order effect since BMI is an important risk factor for hypertension, hypercholesterolaemia and diabetes [24].

Dyslipidaemia is another significant risk factor of CVD. Many patients of dyslipidaemia developed MI. High level of total cholesterol increases the chance of having CVD. Improving blood cholesterol level to manage dyslipidaemia better could reduce the risk of developing MI [40]. Dyslipidaemia in Asian countries is generally than lower than the United States of America and other western countries. Among Asian countries, Singapore recorded with the highest dyslipidaemia cases [41].

Diabetic patients have a higher probability of developing CVD. More than 70% of patients with type 2 diabetes died from CVD [37]. People with type 2 diabetes have a higher probability of injury and death due to CVD. Diabetes raises the risk of CVD by 2 to 4 times. Individuals with diabetes' life expectancy are reduced almost by eight years since the chance of mortality increases. Diabetes also increases the probability of developing MI because diabetes increases the rate of atherosclerotic progression and mitigate the formation of atherosclerotic plaque [40].

6 Conclusion

CVD is the number one cause of mortality in the world. Among all the disease in CVD, MI and stroke are the most common contributor to CVD-related deaths worldwide. There are many risk factors that contribute to the high number of deaths due to CVD. There are controllable and uncontrollable risk factors. Some of the uncontrollable risk factors are family history with CVD, increase in age, ethnicity, and being a male. High blood pressure and smoking are the most important risk factors since it can be reflected in the rate of death in selected countries. The BMI, cholesterol and blood glucose are also significant risk factors for CVD; even when it does not reflect too much on the CVD mortality trends of the selected countries. There are many ways to reduce the risk of CVD such as by quitting or reducing smoking, having healthy food with consistent intake of fruits and vegetables, and having active physicals activities such as sport and jogging. Islam also encourages individuals to have a healthy physical and spiritual and taking sufficient nutrient to have a healthy body.

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References

1. Weinhausr, A.J., Roberts, K.P.: Anatomy of the human heart. In: Iaizzo, P.A. (ed.) Handbook of Cardiac Anatomy, Physiology, and Devices, 2nd edn., pp. 51–79. Springer, US (2009)
2. Gaze, D.C.: Introduction to ischemic heart disease. In: Gaze, D.C. (ed.) Ischemic Heart Disease, pp. 1–13. IntechOpen (2013)
3. Biglu, M., Ghavami, M., Biglu, S.: Cardiovascular diseases in the mirror of science. Tabriz Univ. Med. Sci. **8**(4), 158–163 (2016). https://doi.org/10.15171/jcvtr.2016.32
4. Rafieian-kopaei, M., Setorki, M., Doudi, M., Baradaran, A., Nasri, H.: Atherosclerosis: process, indicators, risk factors and new hopes. Int. J. Prev. Med. **5**(8), 927–946 (2020)
5. Mendis, S., et al.: World health organization definition of myocardial infarction: 2008–09 revision. Int. J. Epidemiol. **40**(1), 139–146 (2011). https://doi.org/10.1093/ije/dyq165
6. Saleh, M., Ambrose, J.A.: Understanding myocardial infarction [version 1; referees: 2 approved]. F1000 Res. **7**(0), 1–8 (2018). https://doi.org/10.12688/f1000research.15096.1
7. Wittenauer, R., Smith, L.: Ischaemic and Haemorrhagic Stroke, Dec 2012
8. Ahmad, M.H., Nishi, N., Mohd Yusoff, M.F., Aris, T.: Cardiovascular disease risk and its association with body mass index in Malaysians based on the world health organization/international society of hypertension risk prediction chart. Heal. Sci. J. **12**(1), 1–7 (2018). https://doi.org/10.21767/1791-809x.1000550
9. OECD/WHO, Health at a Glance: Asia/Pacific 2018: Measuring Progress Towards Universal Health Coverage. OECD Publishing (2018)
10. Wu, Y., Benjamin, E.J., MacMahon, S.: Prevention and control of cardiovascular disease in the rapidly changing economy of China. Circulation **133**(24), 2545–2560 (2016). https://doi.org/10.1161/CIRCULATIONAHA.115.008728
11. Seong, A.C., Chb, M.B., Kok, C., John, M., Cth, F.: A Review of Coronary Artery Disease Research in Malaysia, vol. 71, pp. 42–57 (2016)
12. S. Epidemiology & Disease Control Division, Ministry of Health: The Burden of Disease in Singapore, 1990–2017: An Overview of the Global Burden of Disease Study 2017 Results. Institute for Health Metrics and Evaluation (2017)
13. Mucheru, D., Hanlon, M.C., Campbell, L.E., McEvoy, M., MacDonald-Wicks, L.: Cardiovascular disease lifestyle risk factors in people with psychosis: a cross-sectional study. BMC Public Health **18**(1), 1–14 (2018). https://doi.org/10.1186/s12889-018-5649-5
14. Oliveira, G.B.F., Avezum, A., Roever, L.: Cardiovascular disease burden: evolving knowledge of risk factors in myocardial infarction and stroke through population-based research and perspectives in global prevention. Front. Cardiovasc. Med. **2**, 1–4 (2015). https://doi.org/10.3389/fcvm.2015.00032
15. Juhan, N., Khalid, Z.M., Zubairi, Y.Z., Syadi, A., Zuhdi, M.: Risk Factors of Cardiovascular Disease Infarction Male Patients in Malaysia. J. Teknol. Sci. Eng. **81**(3), 145–150 (2019). https://doi.org/10.11113/jt.v81.12194
16. National Health and Morbidity Survey: Non-communicable Diseases: Risk Factors and Other Health Problems, vol. 1. National Institutes of Health (NIH), Ministry of Health Malaysia (2019)
17. Clinical Practice Guidelines: Management of Hypertension, 5th edn (2018). https://doi.org/10.1080/00325481.1947.11691709
18. Abreu, D., Sousa, P., Matias-Dias, C., Pinto, F.J.: Cardiovascular disease and high blood pressure trend analyses from 2002 to 2016: after the implementation of a salt reduction strategy. BMC Publ. Health **18**(1), 1–9 (2018). https://doi.org/10.1186/s12889-018-5634-z
19. Wu, C.Y., Hu, H.Y., Chou, Y.J., Huang, N., Chou, Y.C., Li, C.P.: High blood pressure and all-cause and cardiovascular disease mortalities in community-dwelling older adults. Med. (United States) **94**(47), e2160 (2015). https://doi.org/10.1097/MD.0000000000002160
20. Lim, K.H., Teh, C.H., Pan, S., Ling, M.Y., Yusoff, M.F.M., Sumarni, M.: Prevalence and factors associated with smoking among adults in Malaysia: findings from the National Health and Morbidity Survey (NHMS) 2015. EUEP Eur. Publ. Behalf Int. Soc. Prev. Tob. Induc. Dis. **16**, 1–12 (2018). https://doi.org/10.18332/tid/82190

21. Keto, J., et al.: Cardiovascular disease risk factors in relation to smoking behaviour and history: a population-based cohort study. Open Hear. **3**, e000358 (2016). https://doi.org/10.1136/openhrt-2015-000358
22. Azad, S.M.N., Hossain, M.M., Parveen, R.: Impacts of smoking habit by young generation in our society impacts of smoking habit by young generation in our society. AIUB J. Bus. Econ. **10**(Jan 2011), 45–66 (2014)
23. Clinical Practice Guidelines: Management of Obesity (2004)
24. Chatterjee, T., Macdonald, A.S., Waters, H.R.: A model for ischaemic heart disease and stroke II: modelling obesity. Ann. Actuar. Sci. **3**(1–2), 83–103 (2008). https://doi.org/10.1017/s1748499500000464
25. Hamer, M., Stamatakis, E.: Low-dose physical activity attenuates cardiovascular disease mortality in men and women with clustered metabolic risk factors. Circ. Cardiovasc. Qual. Outcomes **5**(4), 494–499 (2012). https://doi.org/10.1161/CIRCOUTCOMES.112.965434
26. Ariyanti, R., Besral, B.: Dyslipidemia associated with hypertension increases the risks for coronary heart disease: a case-control study in Harapan Kita Hospital, National Cardiovascular Center, Jakarta. J. Lipids 6 (2019) [Online]. Available: https://doi.org/10.1155/2019/2517013
27. Clinical Practice Guidelines: Management of Dyslipidaemia, vol. 5. Ministry of Health Malaysia, Academy of Medicine Malaysia, National Heart Association of Malaysia (2017)
28. Jeong, S.M., et al.: Effect of change in total cholesterol levels on cardiovascular disease among young adults. J. Am. Heart Assoc. **7**(12) (2018). https://doi.org/10.1161/JAHA.118.008819
29. Clinical Practice Guidelines: Management of Type 2 Diabetes Mellitus, 5th edn (2015)
30. Frankum, S., Ogden, J.: Estimation of blood glucose levels by people with diabetes: a cross-sectional study. Br. J. Gen. Pract. **55**(521), 944–948 (2005)
31. Hughes, J.R.: Motivating and helping smokers to stop smoking. J. Gen. Intern. Med. **18**(12), 1053–1057 (2003). https://doi.org/10.1111/j.1525-1497.2003.20640.x
32. Rosenthal, R.L.: Effectiveness of altering serum cholesterol levels without drugs. Baylor Univ. Med. Cent. Proc. **13**(4), 351–355 (2000). https://doi.org/10.1080/08998280.2000.11927704
33. Park, C., et al.: Fasting glucose level and the risk of incident atherosclerotic cardiovascular diseases. Diab. Care **36**(7), 1988–1993 (2013). https://doi.org/10.2337/dc12-1577
34. Ohira, T., Iso, H.: Cardiovascular disease epidemiology in Asia—an overview. Circ. J. **77**(7), 1646–1652 (2013). https://doi.org/10.1253/circj.CJ-13-0702
35. Khor, G.L.: Cardiovascular epidemiology in the Asia–Pacific region. J. Clin. Nutr. **10**(2), 76–80 (2001). https://doi.org/10.1111/j.1440-6047.2001.00230.x
36. Takii, T., et al.: Trends in acute myocardial infarction incidence and mortality over 30 years in Japan: Report from the MIYAGI-AMI registry study. Circ. J. **74**(1), 93–100 (2010). https://doi.org/10.1253/circj.CJ-09-0619
37. Ministry of Health: Primary and Secondary Prevention of Cardiovascular Disease 2017 (2017)
38. Hasdai, D., Garratt, K.N., Grill, D.E., Leman, A., Holmes, D.R.: Effect of smoking status on the long-term outcome after successful percutaneous coronary revascularization. N. Engl. J. Med. **336**(11), 755–761 (1997)
39. Chatterjee, T., Macdonald, A.S., Waters, H.R.: A model for ischaemic heart disease and stroke III: applications. Ann. Actuar. Sci. **3**(1–2), 105–119 (2008). https://doi.org/10.1017/s1748499500000476
40. Rathore, V., Singh, N., Mahat, R.K.: Risk factors for acute myocardial infarction: a review. Eur. J. Med. Investig. **2**(1), 1–7 (2018). https://doi.org/10.14744/ejmi.2018.76486
41. Ueshima, H., et al.: Cardiovascular disease and risk factors in Asia: a selected review. Circulation **118**(25), 2702–2709 (2008). https://doi.org/10.1161/CIRCULATIONAHA.108.790048. Cardiovascular