

Diabetes prevention and management in South Asia: A call for action

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Abstract

Background: Globally, the number of people living with Diabetes Mellitus (DM) has increased by four-folds since 1980. South Asia houses one-fifth of the world's population living with diabetes and it was the 8th leading cause of deaths in 2013 for South Asians. **Aim:** To review and discuss the context of diabetes in South Asia with a particular focus on a) contributing factors and impact; b) national health policies around non-communicable diseases in the region and; c) to offer recommendations for prevention and management of diabetes. **Method:** We assessed relevant publications using PubMed, Scopus and OvidSP. Similarly, the World Health Organization (WHO) and relevant ministries of each South Asian country were searched for reports and policy documents. **Results:** Emerging evidence supports that the prevalence of diabetes (ranges from 3.3% in Nepal up to 8.7% in India) in South Asia follows the global trend over the past decades. Urban populations in the region demonstrate a higher prevalence of diabetes although it is also a public health concern for rural areas. Changes in the pattern and types of diet along with increasingly sedentary lifestyles are major causes for diabetes. Overall agenda of health promotion to prevent diabetes has not yet been established in the region and majority of the countries in the region are inadequately prepared for the therapeutic services for diabetes. **Conclusion:** The early onset of the diabetes, longevity of morbidity and early mortality may have a significant impact on people's health expenditure and health system as well as on the region's demographic composition. There is an urgent need to reduce the diabetes prevalence in the region through evidence-based interventions ranging from prevention and early detection to appropriate treatment and care. We suggest that a multi-sectorial collaboration across all stakeholders is necessary to raise awareness about diabetes, its prevention, treatment and care in the region.

Key words: Diabetes Mellitus, South Asia, Low and Middle Income Countries, Non-Communicable Diseases

Introduction

Diabetes Mellitus affects a huge number of people globally with approximately two-folds increase in the global age-standardised prevalence from 4.3% in 1980 to 9.0% in 2014 among men, and 5.0% to 7.9% among women (NCD Risk Factor Collaboration, 2016). As a consequence of population growth and ageing the number of people living with diabetes in the world has increased four-folds from 108 million in 1980 to 432 million in 2014 (NCD Risk Factor Collaboration, 2016). Additionally, approximately 193 million people with diabetes remain undiagnosed (International Diabetes Federation, 2015) and a high proportion (83%) of the undiagnosed diabetes burden is in LMICs (Beagley et al., 2014).

Diabetes Mellitus can lead to short-term complications (e.g. hypoglycaemia, ketoacidosis) and long-term macrovascular complications (e.g. coronary heart disease) and microvascular complications (e.g. blindness, amputation) (Nefs et al., 2012, Hippisley-Cox and Coupland, 2015, Marshall and Flyvbjerg, 2006). It accounts for more than 2 million deaths every year (Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration, 2014). The 2010 Global Burden of Diseases (GBD) study reported that diabetes-related deaths have increased by 93% over the two decades and proportion of diabetes related deaths in LMICs is also very high (Lozano et al., 2013). For example, in 2013, most deaths due to the diabetes (81%) occurred in LMICs (Global Burden of Disease Study, 2016). In the context of South Asia where all countries in the region are categorised as LMICs, it is already the 8th leading cause of deaths in 2013 followed by road accidents (9th) (Global Burden of Disease Study, 2016). Thus diabetes will have a significant impact on mortality, morbidity and health system cost worldwide.

In 2015, a global target as part of the 17 sustainable development goals (SDGs) was set to reduce the increase in non-communicable diseases (NCDs) including diabetes (United Nations, 2015). The third goal of the SDG focussed on the theme 'Ensure healthy lives & promote well-being for all at all ages' with an aim to reduce premature mortality from NCDs including diabetes by a third. However, the recent estimation indicates that if the rise in diabetes prevalence continues at post-2000 rates, the probability of achieving the target is extremely low (NCD Risk Factor

Collaboration, 2016). This calls for an urgent action including evidence-based multiple interventions, detection, prevention, treatment and care. In this paper, we discuss the context of contributing factors to and the impact of diabetes in South Asia. We offer suggestions to help improve health policies in the region while tackling NCDs, particularly diabetes. Finally, we also offer a few recommendations for diabetes prevention, care and treatment in the region. In this paper, South Asia refers to eight countries of the Asian continent namely Nepal, India, Pakistan, Bangladesh, Bhutan, Sri Lanka, Afghanistan and Maldives. These countries are also known as SAARC (South Asian Association for Regional Cooperation) countries.

For this narrative review, we searched PubMed, Scopus and OvidSP (MEDLINE and EMBASE) for English-language articles published after 2000 using key words such as ‘diabetes’ combined with ‘South Asia’ or the name of each of the eight South Asian countries listed above. We did not limit our search outcomes by study types. Included paper was initially screened by publication title followed by scanning the abstracts. Similarly, we thoroughly searched websites of the World Health Organization (WHO) and the ministry of health, population, welfare, gender of the South Asian countries for national policy documents and publications around NCDs included diabetes. Due to the narrative nature of this review, we did not appraise papers for quality or produce a flow diagram of the selected /publications.

Diabetes in South Asia: Contributors and Impacts

South Asia houses a quarter of the world’s population (Moran and Vedanthan, 2013) and the increase in diabetes morbidity and mortality in the region follows the global trends. For example, recent estimates by the International Diabetes Federation (IDF) reported country level diabetes prevalence in South Asia that ranges from 3.3% in Nepal up to 8.7% in India (India: 8.7%; Sri Lanka: 8.5%; Bhutan 7.8%, Bangladesh: 7.4%; Maldives 7.5%; Pakistan: 6.9%, Nepal: 3.3%)(International Diabetes Federation, 2015). Globally, India and Pakistan are ranked 2nd (was 2nd in 1980) and 6th (ranked in 13th in 1980) respectively in 2014 in terms of the number of people living with diabetes(NCD Risk Factor Collaboration, 2016). A recent meta-analysis estimates the prevalence of type 2 diabetes in Nepal at 8.4% (Gyawali et al., 2015), over two-folds higher than the IDF estimates. The GBD study estimates for South Asia (Afghanistan,

Bhutan, Bangladesh, India, Nepal and Pakistan) suggest that the diabetes death rates have increased by 33% and that actual deaths have doubled between 1990 and 2013. In the year 2013, deaths due to diabetes in the above six countries was around 31% of all diabetes-related deaths reported from the LMICs (Global Burden of Disease Study, 2016). During the same period, in Sri Lanka alone, diabetes death rates increased by 250% (from 13.6 to 47.7 per 100,000) which accounts for 10% of all deaths in 2013. Diabetes is also recognised as one of the principle risk factor associated with increase in premature heart attack and deaths among South Asian. For example, mortality data from the GBD study showed that Cardiovascular Diseases (CVD) deaths in South Asia increased by 97% (1.7 million more deaths in 2013 than 1990)(Roth et al., 2015).

The escalating prevalence of diabetes in South Asia observed in the last few decades can be attributed mostly to the change in lifestyles in urban areas as a result of rapid socioeconomic changes. Diabetes prevalence in urban areas (e.g. Nepal: 8.1(Gyawali et al., 2015), India: 13.9% (Ramachandran et al., 2001), Sri Lanka: 16.4% (Katulanda et al., 2008), Pakistan: 22% (Hussain and Ali, 2016) is higher than the national averages. Along with the epidemiological transition, the behavioural patterns of the young population have been rapidly altered and predilection towards lifestyle increasing rates of obesity and diabetes in the region (Aryal and Wasti, 2015). A large proportion of daily energy intake in South Asian diets comes from refined carbohydrates (e.g. white rice) and energy obtained from sugar has considerably increased in recent times. For example, in Nepal, it increased from 4 g/capita/day in 1970 to 57 g/capita/day in 2010 (Subedi YP, 2015). There is also a high prevalence of smoking and heavy alcohol use which are all linked to increased risk of diabetes(Hu, 2011). Air pollution, an emerging public health issue in South Asia, may have also increased the risk of insulin resistance and diabetes(Pearson et al., 2010). Likewise, South Asians also have a strong genetic predisposition for diabetes. A case control study, for example, found protective factors for diabetes were lower in South Asian controls than in controls from other countries (moderate or high intensity exercise, 6.1 % vs. 21.6%; daily intake of fruits and vegetables, 26.5% vs. 45.2% (Joshi et al., 2007). South Asians have an increased intra-abdominal fat accumulation which may be related with insulin resistance and consequently diabetes (Misra and Vikram, 2004).

Although diabetes is often related to lifestyle behaviours commonly associated with urbanisation, physical inactivity and long sedentary periods (International Diabetes Federation, 2015), a growing body of evidence signals that diabetes is also a significant public health concern for rural areas of a region where the majority of people are farmers. For example, studies conducted in rural areas of India and Pakistan reported a prevalence of diabetes ranging from 11 to 17% (Amin et al., 2015, Little et al., 2016, Hussain and Ali, 2016). Likewise, the number of children (0-14 years old) with Type 1 diabetes in India is second to the United States (70,000 versus 84,000) (International Diabetes Federation, 2015) suggesting wide spread of diabetes across all age groups. The higher prevalence of diabetes has also been reported among South Asians in high income countries (Zaninotto et al., 2007) suggesting possibility of genetic linkages. Moreover, studies also have found a genetic link among south Asians which sets off diabetes five to ten years earlier than other ethnic groups. For example, South Asian migrants in the UK (6.2% vs 1.7%) (Diabetes UK, 2015) and USA (20% vs 10%) (Thomas and Ashcraft, 2013) have higher diabetes prevalence and experience poorer health outcomes when compared to the overall general population (Garduño-Díaz and Khokhar, 2012). This highlights the need for health intervention among this ethnic group worldwide as the economic burden of diabetes and its complications among South Asian descent is a global issue due to the spread of its large population across other regions.

As in many LMICs, diabetes in South Asia is a significant challenge for healthcare systems and an obstacle to sustainable economic development. For most of South Asia the cost of diabetes accounts for 5% to 20% of total health expenditure (International Diabetes Federation, 2015). Furthermore, large inequality within countries means that the economic burden is higher for individuals with lower income and they are likely to spend from 25% up to 34% of their income on diabetes care (Ramachandran et al., 2007), leaving little income to spend on other essentials such as proper nutrition and education. An earlier estimate reported the annual mean direct cost for each person with diabetes to be \$197 in Pakistan (Khowaja et al., 2007) and \$628.30 in South India (Akari et al., 2013). This substantial expenditure incurred to people with diabetes in South Asia could be reduced significantly by adopting prevention, earlier detection and a reduction in diabetes co-morbidities and complications through improved diabetes care.

South Asian Health Policies on Non-Communicable Diseases

Unlike other South Asian countries, the Government of Sri Lanka had prioritised prevention and control of NCDs since 1992 (Ministry of Health Care and Nutrition, 2009). In 2009, recognising its rapidly increasing burden of NCDs, Sri Lanka developed the National Policy & Strategic Framework for Prevention and Control of Chronic NCDs, particularly related to CVDs, diabetes mellitus, chronic respiratory diseases and chronic renal disease. Other countries have started revisiting their National Health Policies (NHPs) to incorporate NCD issues. For example, although the first NHP of India was launched in 1983 only the most recent NHP 2015 recognised hypertension and diabetes as major NCDs (Ministry of Health and Family Welfare, 2002, Ministry of Health and Family Welfare, 2014). The NHP 2014 of Nepal, prioritised NCDs including diabetes as a major national public health problem (Ministry of Health and Population, 2014). Prevention of NCDs has also been included in the Health Master Plan of Maldives (2006-2015) which focuses on prevention of CVDs, diabetes, renal diseases, COPD (Chronic Obstructive Pulmonary Disease) and selected cancers (Ministry of Health and Gender, 2014). Bhutan recognised NCDs as important disease in its NHP (2011) aiming to prevent and control NCDs through comprehensive interventions that will include risk surveillance, health promotion, and strengthening of health care services (Ministry of Health, 2011).

The implementation of the strategies/actions mentioned in NHPs for the control of NCDs has not been robust across South Asian countries. For instance, despite Bangladesh acknowledging NCDs as a priority in its NHP 2008, the World Bank reported that implementation has been slow due to lack of finance and competing priorities (World Bank, 2011). Although the second NHP of Pakistan gave special attention to NCDs particularly, cancer and diabetes (Ministry of Health, 1997), however, its third NHP, just four years after the second NHP, totally neglected NCDs (Ministry of Health, 2001). A recent draft of NHP had recognized NCDs as a major public health challenges of Pakistan, but still NCDs are completely neglected in the policy's objectives and actions (Ministry of Health, 2009). In Afghanistan's current NHP (2005-2009) NCDs are not covered. This is largely because this post-conflict country is mostly focused on improving

maternal and child health, reducing communicable diseases and malnutrition (Ministry of Public Health, 2005). Health services, care services and human resources in most of these countries heavily focussed on addressing the very high burden of maternal, child mortality and infectious diseases in the past. The overall agenda of health promotion has not yet been established at grassroots levels and not all countries in the region are well prepared for the therapeutic services for all NCDs including diabetes.

Diabetes Prevention, Treatment and Care: A Way Forward

In light of the increasing rates of diabetes in South Asia, it is important for clinical and public health communities to focus on NCDs including diabetes. There is a need for wider implementation of cost-effective interventions in prevention and control of diabetes as well as a need for a united arrangement among South Asian Association for Regional Cooperation (SAARC) countries to develop common strategies, standards and guidelines to form joint action on chronic diseases (JA-CHRODIS) in line with the EU Joint Action on Chronic Diseases (European Union, n.d.). A SAARC meeting of health ministers highlighted the urgent need for a comprehensive response to NCDs (Ministry of Health and Family Welfare, 2015). The World Health Organization's South East Asia Region (WHO SEARO) should also play a key role with its 'Regional action plan and targets for prevention and control of non-communicable diseases (2013–2020)' (World Health Organization, 2013). Governments in the region should create and financially support designated places for physical activities (e.g. walking and cycling routes, leisure centres), such interventions can be funded through imposing higher tax on products such as tobacco, sweetened drinks, foods high in sugar, fat and salt, and junk food. It is well documented that relatively modest changes in diet and physical activity can reduce the incidence of Type 2 diabetes by >50% for people with impaired glucose regulation (Gillies et al., 2007). This is especially important as more than 80% cases of all Type 2 diabetes cases can be ascribed to obesity (Foody, 2007). Early identification of individuals at risk and appropriate intervention for weight reduction, healthy dietary habits and increased physical activity could greatly help to prevent, or at least delay, the onset of diabetes among South Asians.

It is critical for individuals to adopt a healthy lifestyles (e.g. doing regular physical activity, weight management) and eating healthy diets (e.g. fruits and vegetables, avoiding tobacco and reducing alcohol use) from an early age to prevent diabetes later in life. The provision of affordable healthy food in schools, including healthy beverages, fresh fruits and vegetables, a supportive and safe environment for physical activity, specialized health educational curriculum, and restricting access to tobacco and alcohol products near school premises can be effective in promoting healthy diets and physical activity (Branca et al., 2007, Cecchini et al., 2010, World Health Organization, 2008). Consumer-friendly nutrition labelling along with health messages has the potential to change the food consumption pattern and can help prevent diabetes(Cecchini et al., 2010, World Health Organization, 2014). Effective consumer awareness of food labelling can be achieved through sustained media and educational campaigns. However, understanding food labels also relies on consumers' general education levels and low literacy rates are still a serious problem in large parts of rural South Asia.

Complications of diabetes can be avoided or delayed by maintaining good glycaemic control, which is achievable through self-management and medication where necessary. People with diabetes should be provided with knowledge and skills to manage their condition effectively on a daily basis, and should be empowered to seek out information or support as required and diabetes education and personalised care planning support should be integrated into diabetes care services. Counselling on eating healthy diet and regular physical activity can change behaviours related to diabetes (World Health Organization, 2010). In South Asia, community health workers who are in close connection with the community, would be appropriate for lifestyle changes related to diabetes if trained to conduct counselling or health promotion activities (Mishra et al., 2015). These interventions not only increase knowledge and skills to manage diabetes but also motivate people to manage diabetes effectively.

Diabetes treatment which focuses on lowering blood glucose levels requires lifelong care and management and oral medication or insulin, or both are needed to control blood glucose levels. Early detection by screening for diabetic retinopathy and foot ulcers, easy access to health-care services for early diagnosis using inexpensive technologies, availability of essential anti-diabetic medications at affordable price, access to insulin, are needed for treatment and management of

diabetes and its complications. However, the available health workforce in the region is largely urban centred and specialized health service providers in the region is inadequate. For example, Nepal has only one endocrinologist per 1000000 populations and one ophthalmologist for every 200000 people. Moreover, appropriate referrals and consultations are not commonly practised and there is a lack of national guidelines for diabetes care (Upreti et al., 2016). The cost-effective interventions for treatment and care of diabetes such as the WHO Package of Essential NCDs Interventions (PEN) should be implemented in the primary health care centers in the region. The WHO PEN empowers primary care physicians as well as allied health workers to contribute to NCD care and has the potential to be delivered to an acceptable quality of care, even in resource-poor settings (World Health Organization, 2010).

With a focus on evidence based prevention, treatment and care for diabetes, South Asian countries should initiate implementing comprehensive strategies for diabetes. A vigilant system to track down the periodic progress may contribute to the effective implementation. To move this forward, governments in the region should co-ordinate and bring along all other relevant stakeholders in society such as civil society, private sector, educational institutions, media, Non-Governmental Organizations (NGOs), community organizations, donor agencies, researchers, families, and individuals where appropriate. Accurate national data are still unavailable in most South Asian countries, making it more difficult to defining needs and prioritising decisions, and highlights the need for better disease surveillance system in the region. We have a notion that the target of SDG to reduce premature mortality by one-third from non-communicable diseases will greatly depend on the concerted efforts on prevention, health services and health policies. It is thus high time for all stakeholders, especially development partners, to play a crucial role in halting diabetes prevalence in South Asian people with technical and financial necessary support.

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References:

- AKARI, S., MATETI, U. V. & KUNDURU, B. R. 2013. Health-care cost of diabetes in South India: A cost of illness study. *Journal of research in pharmacy practice*, 2, 114.
- AMIN, F., FATIMA, S. S., ISLAM, N. & GILANI, A. H. 2015. Prevalence of obesity and overweight, its clinical markers and associated factors in a high risk South-Asian population. *BMC obesity*, 2, 1.
- ARYAL, N. & WASTI, S. P. 2015. The prevalence of metabolic syndrome in South Asia: a systematic review. *International Journal of Diabetes in Developing Countries*, 1-8.
- BEAGLEY, J., GUARIGUATA, L., WEIL, C. & MOTALA, A. A. 2014. Global estimates of undiagnosed diabetes in adults. *Diabetes research and clinical practice*, 103, 150-160.
- BRANCA, F., NIKOGOSIAN, H. & LOBSTEIN, T. 2007. *The challenge of obesity in the WHO European Region and the strategies for response: summary*, World Health Organization.
- CECCHINI, M., SASSI, F., LAUER, J. A., LEE, Y. Y., GUAJARDO-BARRON, V. & CHISHOLM, D. 2010. Tackling of unhealthy diets, physical inactivity, and obesity: health effects and cost-effectiveness. *The Lancet*, 376, 1775-1784.
- DIABETES UK 2015. Diabetes: Fact and Stats. UK: Diabetes UK.
- EUROPEAN UNION n.d. Joint Action on Chronic Diseases and Promoting Healthy Ageing across the Life Cycle.
- FOODY, J. A. M. 2007. *Preventive Cardiology: Insights into the prevention and treatment of Cardiovascular disease*, Springer Science & Business Media.
- GARDUÑO-DIAZ, S. D. & KHOKHAR, S. 2012. Prevalence, risk factors and complications associated with type 2 diabetes in migrant South Asians. *Diabetes/metabolism research and reviews*, 28, 6-24.
- GILLIES, C. L., ABRAMS, K. R., LAMBERT, P. C., COOPER, N. J., SUTTON, A. J., HSU, R. T. & KHUNTI, K. 2007. Pharmacological and lifestyle interventions to prevent or delay type 2 diabetes in people with impaired glucose tolerance: systematic review and meta-analysis. *Bmj*, 334, 299.
- GLOBAL BURDEN OF DISEASE STUDY 2016. GBD Compare - Viz Hub. Washington DC: Institute of Health Metrics and Evaluation, University of Washington.
- GLOBAL BURDEN OF METABOLIC RISK FACTORS FOR CHRONIC DISEASES COLLABORATION 2014. Cardiovascular disease, chronic kidney disease, and diabetes mortality burden of cardiometabolic risk factors from 1980 to 2010: a comparative risk assessment. *Lancet Diabetes Endocrinol*, 634-47.
- GYAWALI, B., SHARMA, R., NEUPANE, D., MISHRA, S. R., VAN TEIJLINGEN, E. & KALLESTRUP, P. 2015. Prevalence of type 2 diabetes in Nepal: a systematic review and meta-analysis from 2000 to 2014. *Global health action*, 8.
- HIPPISLEY-COX, J. & COUPLAND, C. 2015. Development and validation of risk prediction equations to estimate future risk of blindness and lower limb amputation in patients with diabetes: cohort study. *BMJ*, 351, h5441.
- HU, F. B. 2011. Globalization of Diabetes The role of diet, lifestyle, and genes. *Diabetes care*, 34, 1249-1257.
- HUSSAIN, A. & ALI, I. 2016. Diabetes mellitus in Pakistan: A major public health concern. *Archives of Pharmacy Practice*, 7, 30.
- INTERNATIONAL DIABETES FEDERATION 2015. IDF Diabetes Atlas 2015 Seventh Edition. 7th.

- JOSHI, P., ISLAM, S., PAIS, P., REDDY, S., DORAIRAJ, P., KAZMI, K., PANDEY, M. R., HAQUE, S., MENDIS, S. & RANGARAJAN, S. 2007. Risk factors for early myocardial infarction in South Asians compared with individuals in other countries. *Jama*, 297, 286-294.
- KATULANDA, P., CONSTANTINE, G., MAHESH, J., SHERIFF, R., SENEVIRATNE, R., WIJERATNE, S., WIJESURIYA, M., MCCARTHY, M., ADLER, A. & MATTHEWS, D. 2008. Prevalence and projections of diabetes and pre-diabetes in adults in Sri Lanka—Sri Lanka Diabetes, Cardiovascular Study (SLDCS). *Diabetic Medicine*, 25, 1062-1069.
- KHOWAJA, L. A., KHUWAJA, A. K. & COSGROVE, P. 2007. Cost of diabetes care in outpatient clinics of Karachi, Pakistan. *BMC health services research*, 7, 1.
- LITTLE, M., HUMPHRIES, S., PATEL, K., DODD, W. & DEWEY, C. 2016. Factors associated with glucose tolerance, pre-diabetes, and type 2 diabetes in a rural community of south India: a cross-sectional study. *Diabetology & metabolic syndrome*, 8, 1.
- LOZANO, R., NAGHAVI, M., FOREMAN, K., LIM, S., SHIBUYA, K., ABOYANS, V., ABRAHAM, J., ADAIR, T., AGGARWAL, R. & AHN, S. Y. 2013. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet*, 380, 2095-2128.
- MARSHALL, S. M. & FLYVBJERG, A. 2006. Clinical review-Prevention and early detection of vascular complications of diabetes. *BMJ-British Medical Journal-International Edition*, 333, 475-480.
- MINISTRY OF HEALTH 1997. National Health Policy 1997. Islamabad: Ministry of Health.
- MINISTRY OF HEALTH 2001. National Health Policy 2001-the way forward. Islamabad: Ministry of Health.
- MINISTRY OF HEALTH 2009. National Health Policy 2009-Final Draft. Islamabad: Ministry of Health, Government of Pakistan.
- MINISTRY OF HEALTH 2011. National Health Policy.
- MINISTRY OF HEALTH AND FAMILY WELFARE 2002. National Health Policy 2002. New Delhi: Ministry of Health and Family Welfare.
- MINISTRY OF HEALTH AND FAMILY WELFARE 2014. National Health Policy 2015 Draft. New Delhi: Ministry of Health and Family Welfare.
- MINISTRY OF HEALTH AND FAMILY WELFARE. 2015. Meeting of Health Ministers of SAARC Countries
- MINISTRY OF HEALTH AND GENDER 2014. Maldives Health Profile 2014.
- MINISTRY OF HEALTH AND POPULATION 2014. National Health Policy 2014. Kathmandu: Ministry of Health and Population.
- MINISTRY OF HEALTH CARE AND NUTRITION 2009. The National Policy for Prevention and Control of Chronic Non-Communicable Diseases. Sri Lanka: Ministry of Health Care and Nutrition.
- MINISTRY OF PUBLIC HEALTH 2005. National Health Policy 2005–2009 and National Health Strategy 2005–2006. Kabul: Ministry of Public Health.
- MISHRA, S. R., NEUPANE, D., PREEN, D., KALLESTRUP, P. & PERRY, H. B. 2015. Mitigation of non-communicable diseases in developing countries with community health workers. *Globalization and health*, 11, 1.
- MISRA, A. & VIKRAM, N. K. 2004. Insulin resistance syndrome (metabolic syndrome) and obesity in Asian Indians: evidence and implications. *Nutrition*, 20, 482-491.

- MORAN, A. & VEDANTHAN, R. 2013. Cardiovascular Disease Prevention in South Asia Gathering the Evidence. *Global heart*, 8, 139.
- NCD RISK FACTOR COLLABORATION 2016. Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4#4 million participants. *The Lancet*, 387, 1513-1530.
- NEFS, G., BOT, M., BROWNE, J. L., SPEIGHT, J. & POUWER, F. 2012. Diabetes MILES– The Netherlands: rationale, design and sample characteristics of a national survey examining the psychosocial aspects of living with diabetes in Dutch adults. *BMC public health*, 12, 1.
- PEARSON, J. F., BACHIREDDY, C., SHYAMPRASAD, S., GOLDFINE, A. B. & BROWNSTEIN, J. S. 2010. Association between fine particulate matter and diabetes prevalence in the US. *Diabetes care*, 33, 2196-2201.
- RAMACHANDRAN, A., RAMACHANDRAN, S., SNEHALATHA, C., AUGUSTINE, C., MURUGESAN, N., VISWANATHAN, V., KAPUR, A. & WILLIAMS, R. 2007. Increasing expenditure on health care incurred by diabetic subjects in a developing country A study from India. *Diabetes care*, 30, 252-256.
- RAMACHANDRAN, A., SNEHALATHA, C., KAPUR, A., VIJAY, V., MOHAN, V., DAS, A., RAO, P., YAJNIK, C., KUMAR, K. P. & NAIR, J. D. 2001. High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia*, 44, 1094-1101.
- ROTH, G. A., FOROUZANFAR, M. H., MORAN, A. E., BARBER, R., NGUYEN, G., FEIGIN, V. L., NAGHAVI, M., MENSAH, G. A. & MURRAY, C. J. L. 2015. Demographic and epidemiologic drivers of global cardiovascular mortality. *New England Journal of Medicine*, 372, 1333-1341.
- SUBEDI YP, M. D., NEULANDS D. 2015. Where is Nepal in the nutrition transition? . *Asia Pac J Clin Nutr*.
- THOMAS, A. & ASHCRAFT, A. 2013. Type 2 diabetes risk among Asian Indians in the US: A pilot study. *Nursing research and practice*, 2013.
- UNITED NATIONS 2015. Transforming our world: The 2030 agenda for sustainable developme. New York: United Nations.
- UPRETI, S. R., LOHANI, G. R., MAGTYMOVA, A. & DIXIT, L. P. 2016. Strengthening policy and governance to address the growing burden of diabetes in Nepal. *WHO*, 40.
- WORLD BANK 2011. NCDs Policy Brief - Bangladesh.
- WORLD HEALTH ORGANIZATION 2008. School policy framework: implementation of the WHO global strategy on diet, physical activity and health.
- WORLD HEALTH ORGANIZATION 2010. Package of essential noncommunicable (PEN) disease interventions for primary health care in low-resource settings.
- WORLD HEALTH ORGANIZATION 2013. *Regional action plan and targets for prevention and control of non-communicable diseases (2013–2020). Resolution of the WHO Regional Committee for South-East Asia*, India, WHO.
- WORLD HEALTH ORGANIZATION 2014. Global status report on noncommunicable diseases 2014. Geneva: World Health Organization.
- ZANINOTTO, P., MINDELL, J. & HIRANI, V. 2007. Prevalence of cardiovascular risk factors among ethnic groups: results from the Health Surveys for England. *Atherosclerosis*, 195, e48-e57.

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