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IDF Diabetes Atlas

Diabetes in the Western Pacific Region—Past, Present and Future

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ABSTRACT

In the 2013 issue of the International Diabetes Federation (IDF) Diabetes Atlas, the prevalence of diabetes in the Western Pacific (WP) Region was reported to be 8.6% in 2013, or 138 million adults, and estimated to rise to 11.1%, or 201 million adults, in 2035. The prevalence estimates of impaired glucose tolerance in 2013 and 2035 were 6.8% and 9.0%, respectively. Over 50% of people with diabetes were undiagnosed. In 2013, 187 million deaths were attributable to diabetes, 44% of which occurred in the under the age of 60. The WP Region is home to one quarter of the world's population, and includes China with the largest number of people with diabetes as well as Pacific Islands countries with the highest prevalence rates. There is a rapid increase in diabetes prevalence in the young-to-middle aged adults, possibly driven by high rates of childhood obesity and gestational diabetes as well as rapid demographic and socio-cultural transitions. Differences in genetics, ethnicity, cultures and socioeconomic development have led to complex host-environment-lifestyle interactions with marked disease heterogeneity, further influenced by access to care and treatment. Despite these challenges, the WP Region has provided notable examples to prevent and control diabetes.

1. Introduction

The Western Pacific (WP) Region is home to more than 1.6 billion people accounting for 31% of the world population and contributing to over 34% of the global adult diabetic population. In the early 1980s, studies in the WP Region reported a prevalence of 1–2% of diabetes [1] with type 1 diabetes being very rare even in young people [2]. In the WP Region, stroke and renal disease were the leading causes of death in people with diabetes [3].

Since early 1990s, studies were conducted reporting the prevalence of diabetes using standard methodologies and found both differences and similarities in terms of risk factors,

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epidemiology and pathophysiology of diabetes in the WP Region compared to Europe and North America [1,4,5].

In this article, we summarized the latest landscape of diabetes based on estimates from the International Diabetes Federation (IDF) Diabetes Atlas [6] and discussed our current understanding of this complex disease in the WP Region and possible strategies to combat this potential public health challenge and personal disaster.

2. Methodology

The search strategy for the generation of the IDF Diabetes Atlas data has been described in detail elsewhere [7]. Briefly, a literature search was conducted for studies reporting the age-specific prevalence for diabetes, and the Analytic Hierarchy Process was used to systematically select studies to generate estimates. Estimates for countries without available source data were modeled from pooled estimates of countries that were similar in regard to geography, ethnicity, and economic development. Logistic regression was applied to generate smoothed age-specific prevalence estimates for adults 20–79 years which were then applied to population estimates for 2013 and 2035.

3. Diabetes in adults

The prevalence of diabetes in the WP Region was estimated at 8.6% in 2013, or 138 million adults, and projected to rise to 11.1% by 2035, or 201 million adults [6]. While China harbors the largest number of affected subjects, some small Pacific Islands countries, led by Tokelau, have some of the world's highest prevalences of diabetes (Tables 1–3).

Rapid development and associated increases in obesity and unhealthy lifestyle are the main drivers of increases in the diabetes epidemic in the WP Region. In 2008, 60–70% of people in Tonga, Nauru and Cook Islands were considered obese [8]. Using the Diabetes Epidemiology Collaborative analysis of Diagnostic criteria in Asia (DECODA) data, 30–50% of subjects in the WP Region had metabolic syndrome, a strong predictor for future development of diabetes [9].

In 2004, the sex-standardized diabetes prevalence was reported to be 13.0% in men and 14.4% in women in Nauru. The age-specific prevalence rose from 4.5% in the 15–24 age group to 42.7% in the 55–64 age group [10]. In the islands of Vanuatu, researchers reported close associations of economic development with increased consumption of animal proteins and simple carbohydrates, as well as increased tobacco and alcohol consumption in men in areas with high tourism [11]. In a national survey conducted in China in 2010, the authors reported a diabetes prevalence of 11.6% with number of affected people already exceeding the IDF estimates for 2013. One third of the subjects had either central or general obesity, with diabetes closely associated with other risk factors such as hypertension and dyslipidemia [12].

Table 1 – Key facts and figures about diabetes in the Western Pacific Region [6].

	2013	2035
Adult population (20–79 years, 1000s)	1,613,207.01	1,818,169.03
Diabetes in adults (20–79 years)		
Regional Prevalence (%)	8.57	11.10
Comparative Prevalence (%)	8.07	8.42
Diabetes cases (1000s)	138,194.80	201,789.37
Cases undiagnosed (1000s)	74,655.96	–
IGT in adults (20–79 years)		
Regional Prevalence (%)	6.82	9.05
Comparative Prevalence (%)	6.59	7.77
Number of people with IGT (1000s)	110,091.17	164,546.89
Type 1 diabetes in youth (0–14 years)		
Number of children with type 1 diabetes (1000s)	32.50	–
Number of newly-diagnosed (per 100,000 per year)	5.30	–
Deaths due to diabetes in adults (20–79 years)		
Total deaths due to diabetes	1,868,810.93	–
% of deaths under 60	44.3	–
Health expenditure		
Health expenditure due to diabetes (billion USD)	88.37	–

Table 2 – Top 10 countries in the Western Pacific Region in terms of number of subjects affected by diabetes [6].

Country/Territory	Number of subjects (in 1000s), 2013
China	98,407.379
Indonesia	8554.165
Japan	7203.776
Republic of Korea	3323.903
Viet Nam	3299.113
Philippines	3256.215
Thailand	3150.670
Myanmar	1988.846
Malaysia	1913.236
Taiwan	1721.062

Table 3 – Top 10 countries in the Western Pacific Region in terms of prevalence of diabetes [6].

Country/Territory	Prevalence (%), 2013
Tokelau	37.49
Federated States of Micronesia	35.03
Marshall Islands	34.89
Kiribati	28.77
Cook Islands	25.66
Vanuatu	23.97
Nauru	23.29
French Polynesia	22.41
New Caledonia	19.49
Guam	19.48

4. Undiagnosed diabetes

In the WP Region, the proportions of subjects with undiagnosed diabetes were estimated to be 63% in the low income countries, 54.1% in the middle income countries and 49.4% in the high income countries [6]. In two national surveys conducted in China in 2007 [13] and 2010 [12], only 50% and 30% of subjects respectively, were previously diagnosed, suggesting low levels of awareness and diagnosis.

5. Impaired glucose tolerance (IGT) and prediabetes

In the WP Region, the prevalence of people with IGT was estimated to increase from 6.8% in 2013 to 9.0% by 2035 [6]. In the 2010 China national survey, 50.1% of subjects had either impaired fasting glycemia and/or IGT [12]. In the 2003 Shanghai survey, the 3-year cumulative incidence of diabetes and prediabetes were 4.9% and 11.1% respectively with a 10% annual progression rate from IGT to diabetes [14]. Without prevention strategies, a large proportion of people with IGT in the WP Region will progress to type 2 diabetes.

6. Type 1 diabetes in children

Compared to Europid populations in whom the majority of people diagnosed before the age of 40 had autoimmune type 1 disease [15], less than 10% of young Asian people with diabetes have classical type 1 presentation [16]. In the WP Region, the number of children with type 1 diabetes was estimated at 32,500 with an annual incidence estimate of 5300 [6].

There is large variability in the incidence of type 1 diabetes in children across countries in the WP Region. Compared to a mean age standardized incidence of 16.5 per 100,000 person years in Western Australia [17], the annual incidence of type 1 diabetes in Japan was 1.5–2.5 per 100,000. While the majority of children diagnosed with diabetes before the age of 10 years have type 1 diabetes, after the introduction of a urine glucose screening programme in 1974, more cases of childhood type 2 diabetes were detected in Japan with a reported annual incidence of 3.0 per 100,000 [18].

Outcomes for children with type 1 diabetes in Japan have improved. Between 1965 and 1979, the mortality rate of type 1 diabetes was 12.9-fold higher than that of the general Japanese population [18]. With better medical care, the standardized mortality ratio has declined markedly over the past 30 years [19]. However, for many of the least developed communities in the WP Region, access to insulin remains limited and early death due to type 1 diabetes is not uncommon.

7. Young-onset diabetes and latent autoimmune diabetes in adults

Slowly progressive type 1 diabetes or latent autoimmune diabetes in adults (LADA) with features of both type 1 and type 2 diabetes was first reported in the WP Region [20]. In the LADA China study involving 4880 ketosis-free diabetic patients aged over 30 years, 6% were considered to have LADA defined by a glutamic acid decarboxylase antibodies (GADA) $\geq$18 units/mL. Patients with GADA positivity tended to have lower body mass index and were less likely to have the metabolic syndrome [21]. There was an inverse relationship between GADA positivity and beta cell function although the association of GADA positivity with haplotypes were less consistent compared to Western populations [21].

In contrast to developed countries in which the largest number of people with diabetes are aged 60–79 years, in developing countries, the age-group with the largest number of people with diabetes is 40–59 years [22]. In the latest survey in China, 5–8% in the 18–40 age group had diabetes and 40–50% had prediabetes [12]. Studies from the WP Region have highlighted the phenotypic and genotypic heterogeneity of these young subjects. In the early 1990s, small case series indicated that 10–20% of Asian patients diagnosed before the age of 40 had autoimmune or monogenic diabetes with predominant lean phenotypes, although with rising obesity rate, atypical presentation with features of both insulin insufficiency and resistance, so called 'double diabetes' were not uncommon [16,23,24].

On average, diabetes reduces life expectancy by 6 years [25], especially in subjects with young onset of disease. In a recent analysis of over 2000 Chinese patients diagnosed before the age of 40 years, 10% had type 1 diabetes, 60% were overweight type 2 diabetic patients, and 30% were normal-weight type 2 diabetic patients. Overweight type 2 diabetic patients had the worst metabolic profile and highest prevalence of microvascular complications with 15-fold greater hazard of progression to cardiovascular disease compared to type 1 diabetic patients who had the lowest event rates [26].

8. Health expenditures and costs

The World Health Organization (WHO) recognized diabetes, heart disease, respiratory disease and cancer as the leading non-communicable diseases (NCD) which contributed to 60% of global deaths. Diabetes frequently coexists with these NCDs and may be causal to the development of cardiovascular disease. In 2013, approximately USD 88.4 billion was spent in the WP Region on diabetes-related direct healthcare expenditures. This figure is projected to increase to USD 98.4 billion by 2035 [6].

In China, the medical costs attributable to overweight and obesity in 2003 were estimated at USD 2.7 billion. The latter accounted for 25.5% of the total medical costs attributable to diabetes, heart disease, respiratory disease and cancer, or 3.7% of national total medical costs. This figure was expected to increase to USD 4.8 billion if the epidemic of obesity continued to rise [27]. In Australia, the annual direct per person costs for people with known diabetes was A$4390 compared to A$1898 for those with normal glucose tolerance. In 2005, the total annual cost of diabetes for Australians aged $\geq$30 years was A$10.6 billion (A$4.4 billion in direct costs; A$6.2 billion in government subsidies) which represented an excess annual cost of A$4.5 billion (A$2.2 billion in direct costs; A$2.3 billion in government subsidies) associated with diabetes [28].

In Taiwan, provision of national coverage has led to more frequent annual assessments for risk factors and complications in the last decade with improved diabetes care [29]. However, government subsidies for preventive care remain minimal in many low- and middle-income countries in the WP Region, often leading to either late presentation with high hospitalization costs or out of pocket expenditures for outpatient visits [30]. In a recent analysis of inpatient spending due to type 2 diabetes in India, China, Thailand and Malaysia, the authors reported an expenditure of 11–75% of per-capita income in patients without complications, which were

increased by 6–300% in those with complications treated at the same hospital. Overall, uninsured patients had higher A1c than those insured. These figures highlighted the substantial out-of-pocket financing burdens in some areas such as India and China [31].

Despite differences in treatment costs and financing systems, in a recent systematic analysis, health economists identified interventions which were considered cost-saving or very cost-effective. These included use of renin-angiotensin system (RAS) inhibitors for renoprotection, comprehensive foot care to prevent ulcers, multi-component interventions for control of risk factors in both type 1 and type 2 diabetes, intensive lifestyle interventions to prevent progression from IGT to diabetes, intensive glycemic control in newly diagnosed diabetes, use of statins for cardiovascular protection, annual screening for diabetic retinopathy and counseling for smoking cessation [32]. To this end, several programs initiated in the WP Region have confirmed the benefits of lifestyle modification and use of metformin and alpha glucosidase inhibitors [33–35] in preventing diabetes as well as that of statins [36,37], RAS inhibitors [38] intensive glycaemic control in type 1 diabetes [39] and multifaceted care in type 2 diabetes in reducing major clinical outcomes including death [40,41].

9. Mortality

In 2013, nearly 2 million of deaths in adults in the WP Region were attributable to diabetes, 44% of which occurred under the age of 60. In the Emerging Risk Factors Collaboration which analyzed 97 international prospective studies of 820,900 people with an accrual of 123,205 deaths, diabetes reduced life expectancy by 6 years especially in young-to-middle-aged subjects. Compared to those without diabetes, people with diabetes had a 1.3–3 fold increased risk of death due to cardiovascular disease, renal failure, mental illnesses, all-site cancer, hepato-biliary disease and sepsis [25].

In the Hong Kong Diabetes Registry established in 1995, 7534 Chinese type 2 diabetic patients were censored in 2005. After a mean follow-up period of 5.5 years, 763 died with the main causes of death being neoplasms (24.5%), cardiovascular (23.5%), respiratory (15.3) and renal disease (15.3%) [42]. In Taiwan, based on various national databases, the mortality rate of diabetic patients has declined over time (men, women: 3.92%, 3.29% in 2000; 3.64%, 3.11% in 2005, and 3.12%, 2.71% in 2009) although it remained higher in men than women. In 2009, the estimated loss of life due to diabetes was 6.1 years in women and 5.3 years in men in subjects diagnosed at the age of 40. The four major causes of death were diabetes, malignancies, heart diseases, and cerebrovascular diseases [43].

10. Morbidity

10.1. *Cardiovascular-renal disease*

The diversity in risk factors and access to care has resulted in marked differences in the geographical distributions of vascular complications in the WP Region. In areas where access to medications, revascularization and renal replacement were limited, end stage renal disease and stroke were often the leading causes of death in type 2 diabetes. In the Pacific Islands, leg amputation continues to be a major cause of morbidity and mortality. In a recent survey of 85 people with diabetes and amputations in the Solomon Islands, Nauru and Vanuatu, the major reasons leading to leg amputation included delayed treatment (42%), use of traditional treatments (18%) and insufficient knowledge about foot care (11%) [44].

Several large scale surveys have indicated that 50–60% of type 2 diabetic patients from different clinic settings in the WP Region have nephropathy [45]. In prospective studies, the annual incidence of chronic kidney disease was 2–4%, driven primarily by disease duration, smoking, metabolic syndrome and glycemic control [46]. Other factors such as chronic hepatitis B infection [47] and use of over-the-counter medications including herbal medicine [48] might also contribute to this high rate of renal disease in the WP Region.

10.2. *Psycho-social distress*

The bidirectional association between depression and diabetes is increasingly recognized with emerging data from the WP Region. In the population-based Australian Diabetes Obesity and Lifestyle (AusDiab) Study, after 5 years of follow up, perceived stress independently predicted the development of abnormal glucose tolerance in women but not in men [49]. In Malaysia, 11.5%, 30.5% and 12.5% of type 2 diabetic patients attending outpatient clinics had depression, anxiety and stress symptoms respectively. Female gender, ethnicity, marital status, family history of psychiatric illness, life events, alcohol use, unemployment, high A1c, short disease duration were some of the associated risk factors [50].

In Hong Kong Chinese type 2 diabetic patients attending outpatient clinic, 8% had depression upon screening. The presence of depression was independently associated with high A1c, hypoglycemia and somatic complaints. Of note, the majority of patients with depressive symptoms had not been diagnosed [51]. In prospective analysis, severe depression independently predicted premature cardiovascular diseases notably stroke in Chinese type 2 diabetic patients [52]. Apart from depression, 20–50% of Chinese type 2 diabetic patients experienced diabetes-related distress (e.g. treatment demands, concerns about future risks of complications), which were closely correlated with obesity and A1c [53].

Other workers have reported poor quality of life in Chinese type 2 diabetic patients with microvascular and macrovascular complications. These negative attributes were associated with depression and unhealthy eating habits, with regular exercise being a protective factor [54]. In a multicenter survey involving type 2 diabetic patients from China, Korea, Malaysia, Thailand, and Taiwan, 36% reported hypoglycemic symptoms, and fear of hypoglycemia which was associated with poor quality of life [55].

11. Socioeconomic development

Given its diversity in terms of ethnicity, culture and socioeconomic development, the many faces of diabetes in the WP

Region are not unexpected. Countries and areas with established economies have reported fairly stable rates of diabetes of 4–7% during the last decade [1]. On the other hand, countries undergoing rapid economic development such as China [12], Vietnam [56], Cambodia and Mongolia [57] continued to report rising rates of diabetes and prediabetes with prevalence as high as 50% in the Pacific islands [6].

In general, people of Asian ethnicity are more likely to develop diabetes for the same level of body mass index or waist circumference, compared to their Europid counterparts, in part due to their propensity to store excessive body or visceral fat [58]. Additionally, in relatively lean subjects, Asians were more insulin resistant than non-Asians with increased concentration of free fatty acids and inflammatory markers [59]. Compared to their Europid counterparts, lean Asian subjects with normal glucose tolerance had higher glucose excursion during an OGTT with reduced rate of glucose disposal [60]. In Japanese subjects with normal glucose tolerance, small incremental increases in body mass index were associated with increased insulin resistance which was not met by proportional increase in insulin response [61,62]. Using insulin clamp studies, researchers from Thailand reported insulin deficiency as the predominant feature in lean subjects and insulin resistance in the overweight and obese subjects [63].

This 'Asian phenotype' of low body mass index but high waist circumference could be modified by genetic, environmental and lifestyle factors, resulting in considerable geographical variations in disease prevalence in the WP Region [64,65]. Recent genome wide association studies had found some of the common variants in Caucasians to be rare in Asian populations [66]. In Asian populations, novel variants implicated in beta cell biology and protein metabolism had also been discovered, highlighting the importance of ethnicity in disease predisposition [67–69].

12. Non-modifiable risk factors

12.1. *Age and gender*

Compared to Europe, where the predominant increase in diabetes prevalence is occurring in the elderly, the most rapid rate of increase occurs in the young to middle-aged group in the WP Region [22]. While all countries in the WP Region are facing a dual burden of aging and young-onset chronic disease, men appeared to be at higher risk for diabetes amongst East Asians (e.g. China, Korea, Taiwan, Japan) while women were more at risk in South East Asians (e.g. Malaysia, Philippines) and Indians, in part due to high rates of obesity [1].

12.2. *Family history*

Using family-based genetic analysis, over 50% of the variance of obesity, diabetes, and dyslipidemia is explained by heritability. Compared to age- and sex-matched controls, siblings of people with diabetes had a 2–4 fold increased risk of diabetes and obesity [70]. Using linkage analysis, several chromosomal regions linked to diabetes and related traits including obesity and dyslipidemia have also been reported in support of the strong genetic determinants of these complex traits [71–73].

13. Modifiable risk factors

13.1. *Intrauterine influences/thrifty phenotype*

Fetal programming associated with in utero exposure to maternal stress and malnutrition might alter gene expression, resulting in phenotypes that promote survival in a nutrient-poor environment but substantially increase risk of diabetes and cardiovascular-renal disease [74,75]. These 'thrifty phenotypes' might be particularly relevant to Asian populations undergoing rapid transition in lifestyle and nutrition.

In addition, Asian women have a high prevalence of gestational diabetes [76] with short stature as a major risk factor [77]. This high prevalence of gestational diabetes coupled with childhood obesity could increase the future risk of diabetes in women [78] and that of obesity in offspring [79] resulting in transgenerational diabetes with increasingly early onset of disease, thus setting up a vicious cycle of 'diabetes begetting diabetes' [80].

13.2. *Healthy lifestyle behaviors*

Studies have shown an incremental benefit to the adoption of healthy behaviors such as smoking cessation, moderate alcohol use and a healthy lifestyle in the reduction of lifetime risk of diabetes [81]. In this context, a dose-response association between smoking and diabetes has been reported in a meta-analysis of prospective studies [82]. In the WP Region, the prevalence of smoking was amongst the highest in the world, with over 50% of males smoking cigarettes in China [12] and Korea [83].

Other lifestyle factors implicated in the development of diabetes in the WP Region include television watching [84], high consumption of rice [85] and sugar sweetened beverages [86], psychosocial stress [87] and sleep hygiene [88], all of which might be particularly relevant to populations undergoing health transition.

13.3. *Socioeconomic determinants*

Although diabetes has strong genetic determinants, the 2–5 fold increased risk of diabetes in migrant populations highlights the importance of social determinants in unmasking the genetic predisposition [89]. These include poverty and low educational levels which take on particular significance in affluent societies with high levels of physical inactivity and low food deprivation. In these communities, lack of awareness, long working hours and short sleeping hours together with psychosocial stress were often accompanied by high rates of unhealthy lifestyles and obesity [90,91]. In Hong Kong, analysis of trends of self-reported diabetes between 2001 and 2008 consistently revealed low monthly household income as an independent risk factor for diabetes [92], suggesting diabetes is often a 'poor man disease' in a rich society.

Other societal determinants and emerging risk factors associated with diabetes reported in the WP Region included

endemic infections (e.g. hepatitis B) [47,93], gut microflora [94] and environmental pollutants [95]. While an efficient innate immune response might confer survival advantage and protect against autoimmunity in primitive communities, these inflammatory responses might be triggered by micronutrients to increase the risk of insulin resistance and diabetes with rapid acculturation [96]. The effects of these host-environment interactions could be further modified by lifestyle, access to care and treatments resulting in the multifaceted nature of diabetes and its complications in Asia [61].

14. Prevention, care, and management

14.1. *Current situation*

In many areas, notably low- and middle-income countries, the health care systems are not designed to manage and support the multiple health needs of a person with a lifelong disease such as diabetes. These facilities include cognitive-psychological-behavioral support, laboratory assessments, technologies, medications and hospitalizations [97].

Control of blood pressure, A1c, and LDL-cholesterol (ABC targets) has been shown to reduce cardiovascular complications and all-cause death [98–100]. However, in China, amongst the 50% of people detected to have diabetes on A1c or oral glucose tolerance test, only 30% had been diagnosed, of whom, only 26% were treated and amongst those treated, only 40% had A1c $< 7\%$ [12]. In other large scale surveys in the WP Region, only 30% of patients with diabetes ever had clinical or laboratory assessments of risk factors and complications, with only 30–40% of them attaining one of the 3 ABC targets, and only 5–10% attaining all 3 goals [101]. Similar surveys in the WP Region also revealed particularly poor control of risk factors among patients with young onset of disease [102].

Other studies examined patients' perceptions and expectations for diabetes management. In Guam, based on responses from 125 questionnaires, almost 40% of patients were not aware of the type of diabetes they had, 20% had not received diabetes self-management education and 30–60% of patients had not received nutritional counseling, advice on tobacco cessation, regular eye and foot examinations and immunization services. Over 50% of patients expressed their desire to have better quality diabetes self-management education, preventive services, enhanced access to specialists and specialized care, and more financial support to cover the costs of chronic care and medications [103].

14.2. *General health promotion*

Rapid modernization has led to changes in food technology with increased consumption of processed foods, animal fats, and sugar sweetened beverages. In a few states, there have been efforts to use large-scale programmatic and policy measures to confront these dietary challenges [104].

While it remains to be seen whether smoking cessation will reduce the rate of diabetes, it is likely that tobacco control would reduce the amplifying effects of tobacco on multiple morbidities associated with diabetes, notably, cancer and cardiovascular-renal disease. To this end, although the levels of development, systems of government and population size differed greatly among countries, there have been successful stories in tobacco control through strong political will and tough measures in the WP Region, such as New Zealand and Hong Kong [105].

15. Diabetes management

15.1. *Early prevention*

There is conclusive evidence showing that many cases of diabetes can be prevented or delayed by structured lifestyle modification [106]. In this light, most experts recommend targeted screening using known risk factors and simple risk scores [107] to identify high risk subjects for early intervention. Of particular relevance to the WP Region is targeted screening in young subjects, which is highly cost-effective due to their high lifetime risk for complications [108].

In China, 20 years after the initiation of a 6-year lifestyle modification program, subjects with IGT who received intervention continued to have lower rate of diabetes with reduced incidence of retinopathy [109]. Similar programs have been successfully translated in a primary care setting in Australia [110] while other researchers have adopted similar principles to investigate the effects of exercise prescriptions in indigenous populations in the WP Region taking into consideration their special cultural needs [111].

Despite the effectiveness of lifestyle modification, it is important to recognize that many of these subjects went on to develop diabetes despite having lifestyle modification. Early use of medications might be needed in high risk subjects to prevent deterioration of glycemic control [37,38]. Indeed, researchers in the WP Region have demonstrated the benefits of intensive glycemic control at diagnosis to produce remission of diabetes, especially in subjects with high body mass index and no complications at presentation [112].

15.2. *Prevention of childhood obesity and treatment of childhood diabetes*

In its latest action plan, the WHO has called for early prevention of diabetes using a life-course strategy that starts with maternal health. Prospective studies have indicated the high risk of metabolic syndrome and obesity in offspring of women with gestational diabetes [80], suggesting that optimal glycemic control during pregnancy may reduce long term risks of childhood obesity. Several countries such as Japan [113] and Taiwan [114] have embarked upon national urine glucose screening program which has led to detection of type 2 diabetes and other atypical forms of type 1 diabetes in children. While there is consensus on the use of intensive insulin therapy including insulin pumps to optimize glycemic control in children with type 1 diabetes, the lack of randomized clinical trial data on the efficacy of various drugs and strategies make clinical management of type 2 diabetes in children highly challenging [113].

15.3. *Treatment in adults*

People with diabetes need to be educated, empowered and engaged regarding the nature of the disease and its management. Research has shown that increased contact time between healthcare providers and people with diabetes including regular support, reinforcement, and reminders was the main determinant for initiating and maintaining behavioral changes [115]. Furthermore, 20–50% of patients with diabetes have negative emotions which might adversely affect treatment compliance and worsen clinical outcomes [116]. In these subjects, a holistic approach including motivational interview, empathetic listening and peer support might be needed to improve their metabolic control and psychological well-being [97].

Adding to these challenges are the increasing demands from payors on care providers to contain costs and add values to their services with documentation of care processes and attainment of treatment targets [117,118]. Until recently, most hospital and primary care systems, even in developed areas, are not designed to manage these patients with accumulating health information for decision making and quality assurance purposes.

More than a decade ago, several authorities and expert groups recommended improving diabetes and chronic care by (1) redesigning workflow based on best practices; (2) using information technology to manage clinical information with decision support; (3) transferring knowledge and skills to team members to coordinate care; (4) using performance and outcome measures for quality control [119,120]. In the same vein, the IDF defined the minimum, standard and comprehensive diabetes care models where empowerment, protocols, team-based care, information technology, peer support, recall and registry were key features [121]. In a recent meta-analysis, interventions targeting health care systems with team-based care and patient empowerment had the greatest effect size on reducing A1c, blood pressure and LDL-cholesterol, although other initiatives including incentives, registries and electronic medical records also had positive benefits [122].

Motivated by the marked improvement in control of risk factors and clinical outcomes in clinical trial settings characterized by the use of protocols and care coordinators with regular monitoring [123], researchers in the WP Region adopted these recommendations and demonstrated the marked benefits of these collaborative care models on clinical outcomes including death and cardiovascular-renal complications [41,124]. The efficiency of these care models can be further enhanced using information technology to incorporate inter-linking components of care protocols, risk engines, personalized reports and decision support with ongoing evaluation [125,126]. Despite the cost-effectiveness of these care models, these recommendations still remain to be implemented in many low- and middle-income countries in the WP Region.

16. The way forward

Diabetes is a major health burden with grave impacts on the society, family and person concerned, if not diagnosed, managed or controlled. There are now proven strategies to prevent the onset of diabetes and its complications, which will save lives and money in the long term. However, due to the non-acute nature of these silent conditions, these preventive strategies which have proven to be efficacious in controlled settings, are often not implemented in the real world due a lack of motivation, mandate and care coordination, as well as insufficient resources, support and incentives.

In the updated draft of the Global Plan of Action for the Prevention and Control of NCDs (2013–2020), the WHO articulated its vision of a world free of avoidable burden of

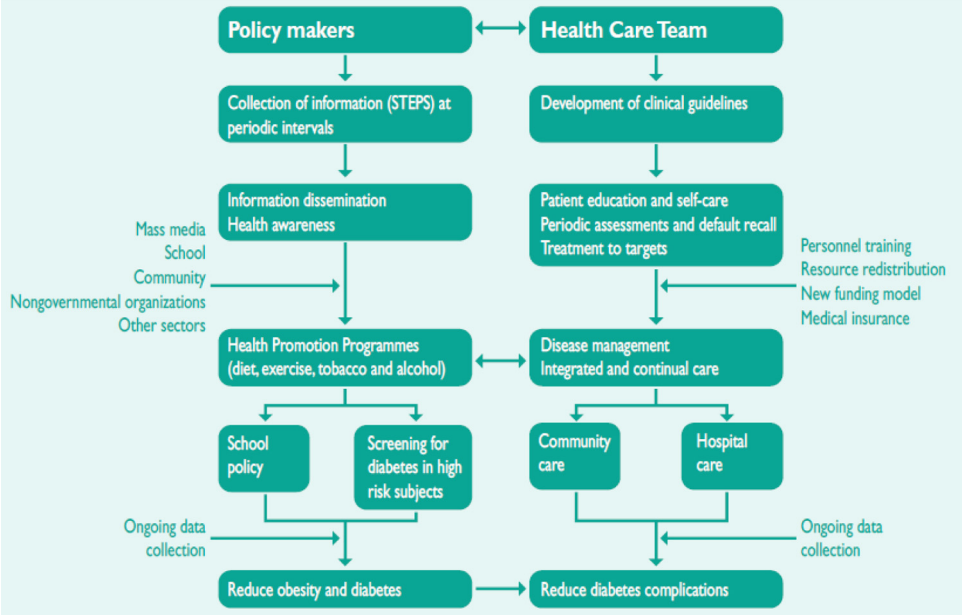

Fig. 1 – A multipronged strategy using both bottom up and top down approaches to raise awareness, detect early cases and prevent diabetes and its complications proposed by the Western Pacific Declaration on Diabetes [130].

NCD based on the overarching principles of using a life-course approach to empower people and communities and adopting an evidence-based and multisectoral strategy through partnerships [127]. Despite the challenges due to diabetes in the WP Region, researchers and care professionals had provided notable examples in early detection of diabetes [18,114] and its complications [102] through government policies as well as prevention of onset [37,38,128] and progression of diabetes [112] and its complications [39,41,125] using innovative and collaborative approaches (Fig. 1).

According to the WHO, health is defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. To this end, government leaderships, intersectoral partnerships and community empowerment will be needed to reduce poverty, health illiteracy and social disparity as well as create a health-promoting environment, encourage self-management and strengthen the health care system to reduce the burden of diabetes and make health a reality [129].

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