RESEARCH ARTICLE

# Measuring Diabetes Complications, Risk Factors and Capacity for Managing Diabetes: An Initial Step to Improve Diabetes Care at The Primary Health Centre in Tonga

**Veisinia Matoto[1], Si Thu Win Tin[2]\*, Elisiva Na'ati[2], Sione Tomiki[1], Molimoli Ofahulu[1], Ane Fangalua[1], Vasitai Toli[1]**

[1] Ministry of Health, Tonga
[2] The Pacific Community (SPC), Fiji

\* Corresponding Author: sithuw@spc.int

ABSTRACT

*Background:* The small Pacific Island nation like Tonga has faced a crisis for decades due to premature loss of lives and disabilities due to diabetes. However, there is limited peer-reviewed literatures on the rates of diabetes complications and capacity for providing quality diabetes care in Tonga. The lack of adequate information in local context triggers significant challenges to make informed decision, proper planning, and effective implementation to improve diabetes care.

*Aim:* This study aims to determine the prevalence of diabetes complications and associated risk factors among people with diabetes, and the capacity for managing diabetes as an initial step towards strengthening diabetes care at the primary health care setting in Tonga.

*Methods:* This cross-sectional study was conducted on a sample of 207 people with diabetes from the primary health care centre in Tonga. People with diabetes were screened by qualified health professional using a standardised protocol, and the capacity of diabetes care was assessed by a standardised assessment form.

*Results:* Of the 207 people with diabetes aged between 20 and 80 years screened for diabetes related complications, 135 (74%) had family history of diabetes, 57 (28%) female subjects had history of gestational diabetes, and 28 (14%) subjects were current smokers. The prevalence of overweight was 51%, obese was 38% and hypertension was 44%. The percentage of subjects with high cholesterol was 42%. HbA1c was measured and subjects with good, poor, and very poor blood glucose control were 15%, 49% and 36% respectively. The percentage of people with diabetes who had retinopathy was 18% and who were at risk of developing diabetic foot ulcer was 14%. This study also found that people with diabetes did not attend regular follow-up visits at the health care centre and the capacity to provide quality diabetes care services is limited.

*Conclusion:* This study highlighted the urgent need to improve the quality and accessibility of diabetes care to reduce diabetes complications. The findings also provided a timely reminder to government and development partners to invest additional resources to effectively manage diabetes at the primary health care level. Tonga will require to strengthen a resilient health system to improve screening for early detecting of diabetes complications and enhance management services at the primary health care setting.

**Keywords:** Diabetes, complications, risk factors, capacity, primary health care

## Introduction

Diabetes is a major health and development issue that has reached alarming level with over half a billion people are living with diabetes worldwide.[1] The Western Pacific Region has the third highest prevalence of diabetes in the world with approximately 12% in adult population, and it is projected that the prevalence will continue to increase to reach 14.4% by 2045.[2] Particularly, the small island developing nations in the Western Pacific Region are among the top ten with the highest rates of diabetes in the world with more than one third of the adult population are living with diabetes in some countries.[3] Several population based survey also reported the high prevalence of diabetes in the Pacific island countries, for example, approximately 30-50% of adult population in American Samoa, Tokelau, Niue, Kiribati and Marshall Islands have diabetes.[4-6] This imposes an enormous social and economic burden on governments and families and impede to achieve Sustainable Development Goals (SDG)[7] due to the substantially high health expenditures for managing diabetes and treating its complications.[1]

There are proven measures to best manage diabetes to prevent or delay complications. Regular follow-up, effective medications, lifestyle management and screening for early detection of diabetes complications prevent the development and progressing of complications and can lead long and healthy lives.[8-10] In addition. , there has been emerging evidence that remission of type 2 diabetes may be possible with effective management at early onset of diabetes.[11] Despite proven effective measures, diabetes and its complications remain a major concern given approximately 6.7 million died worldwide as a result of diabetes complications.[1]

More importantly, there are mounting evidence on the comorbidity of diabetes and emerging infectious diseases such as the Corona Virus Diseases 2019 (COVID-19).[12-13] The COVID-19 pandemic has further proven that health care systems in most countries are fragile particularly when they face crisis due to emerging diseases and resulted in disruption of essential health care services to the people with diabetes.[14] Recent high level meeting declarations, including the Small Island Developing States (SIDS) Ministerial Level Meeting in 2023,[15] highlighted the importance of the decentralisation of health services and urging countries to strengthen diabetes care at the primary health care setting. However, the capacity and capability to transform global and regional commitments to national actions have been a challenge particularly in the low-resourced and geographically isolated island nations such as Tonga[16] where the prevalence of diabetes was 15% among adult population aged 20-79 years which is much higher than the global average 10.5%.[1]

While many countries from different parts of the world have examined the prevalence of diabetes complications, there is limited literatures published for the small island countries in the Pacific region.[17] A few island countries including Nauru, the Solomon Islands and Vanuatu reported that up to 69% among people with diabetes had retinopathy and 71% had microalbuminuria.[18] Despite anecdotal reports on the high prevalence of diabetes complications in Tonga, there is limited recent peer-reviewed literatures on the rates of diabetes complications and capacity for providing quality diabetes care particularly in the remote settings. The lack of adequate information in local context triggers significant challenges to make informed decision, proper planning, and effective implementation to improve diabetes care. Consequently, this study aimed to determine the prevalence of diabetes complications and associated risk factors among people with type 2 diabetes, and the capacity for managing diabetes as an initial step towards strengthening diabetes care at the primary health care setting in Tonga.

## Methods

This cross-sectional study was conducted in 2022 on a convenience sample of 207 of people with known type 2 diabetes from the Kolonga community health centre which is located in the eastern site of the main Island of Tongatapu and providing health services to eight villages with a total population of approximately 3800.[19]

People with diabetes attending the health centre were screened by qualified medical doctors and nurses using a standardised assessment form and protocol. Demographic data such as age; gender; family history of diabetes; history of gestational diabetes, smoking, ischemic health diseases and cerebrovascular accident; and existing treatment for diabetes were assessed.

Physical assessment such as height and weight were measured for calculation of BMI, and resting blood pressure was measured using the digital blood pressure monitor. Overweight was defined as a BMI≥25, obese as a BMI≥30, and hypertension as a systolic blood pressure ≥140mmHg and/or diastolic blood pressure ≥90 mmHg or taking anti-hypertensive medications.

Biochemical assessment such as HbA1c was measured using a MultiCare HbA1c Testing Kit and

total cholesterol was measured using LDX analyser. Good glycaemic control was defined as a HbA1c≤ 7%, poor glycaemic control as a HbA1c between 7.1% and 9.9%, and very poor glycaemic control as a HbA1c≥10%. High total cholesterol was defined as a total cholesterol >5mmol/L.

Diabetes complications such as retinopathy and foot ulcers were assessed using the retinal screening test and the diabetes foot assessment protocol respectively and diagnosed by the qualified medical doctors and nurses. Total number of follow-up appointments made, and actual visits made by the people with diabetes within a four-months period (June to September 2022) were assessed using registration records.

The medical doctor in-charge of the community health centre was interviewed using a structured questionnaire to assess the capacity and resources for managing diabetes. Data such as the number and type of health professionals; and the availability of diabetes management guidelines and referral system, professional development training program for health professionals, equipment to assess routine physical and biochemical profiles and essential diabetes medications were collected.

The data were compiled and analysed using Microsoft Office Excel 2016 version. Where relevant, data were reported as numbers and percentages. This study was approved by the Research Ethics Committee of Tonga.

## Results

Of the 207 people with diabetes aged between 20 and 80 years screened for diabetes related complications, 144 (68%) were female, 114 (55%) were aged between 50 and 69 years (mean age 59 years), 135 (74%) had family history of diabetes and 57 (28%) female subjects had history of gestational diabetes. Twenty-eight (14%) subjects were current smokers, 2 (1%) had history of ischemic health disease and 5 (2%) had history of cerebrovascular accident. The prevalence of overweight was 51%, obese was 38% and hypertension was 44%. The percentage of subjects with high cholesterol was 42% (Fig. 1).

The percentage of people with diabetes treated with insulin was 15% and the remainder were treated with oral anti-diabetic agents with lifestyle management or lifestyle managing only. HbA1c was measured and subjects with good, poor and very poor blood glucose control were 15%, 49% and 36% respectively (Fig. 2). Diabetes complications were assessed and the percentage of people with diabetes who had retinopathy was 18% and who were at risk of developing diabetic foot ulcer was 14%.

**Fig. 1 – Profile of people with diabetes**
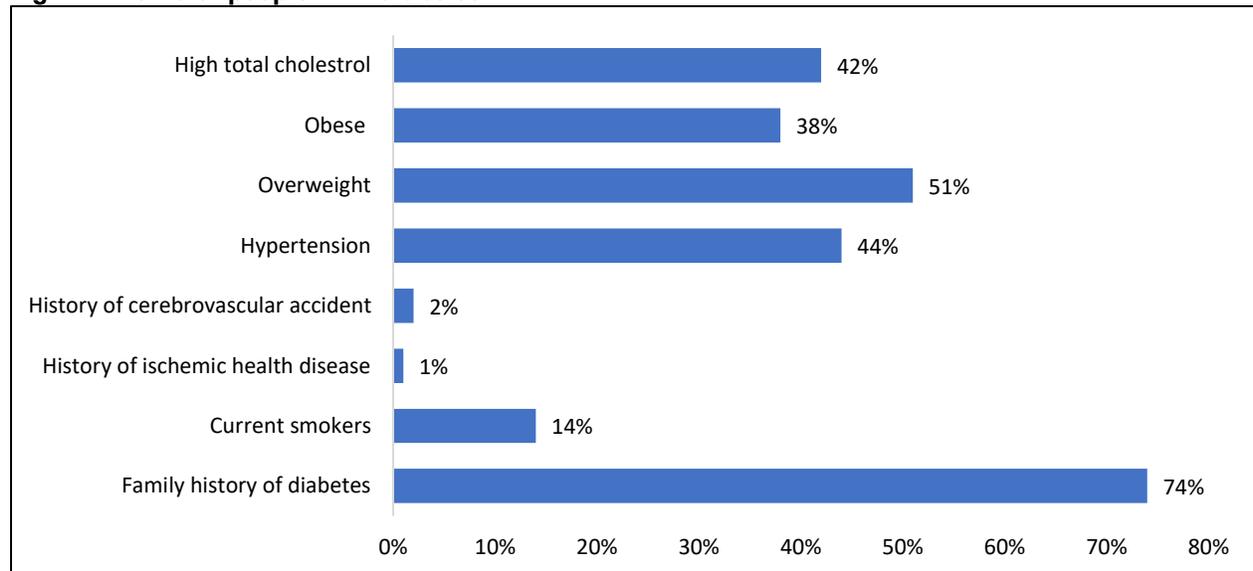
**Fig. 2 – Blood glucose control**
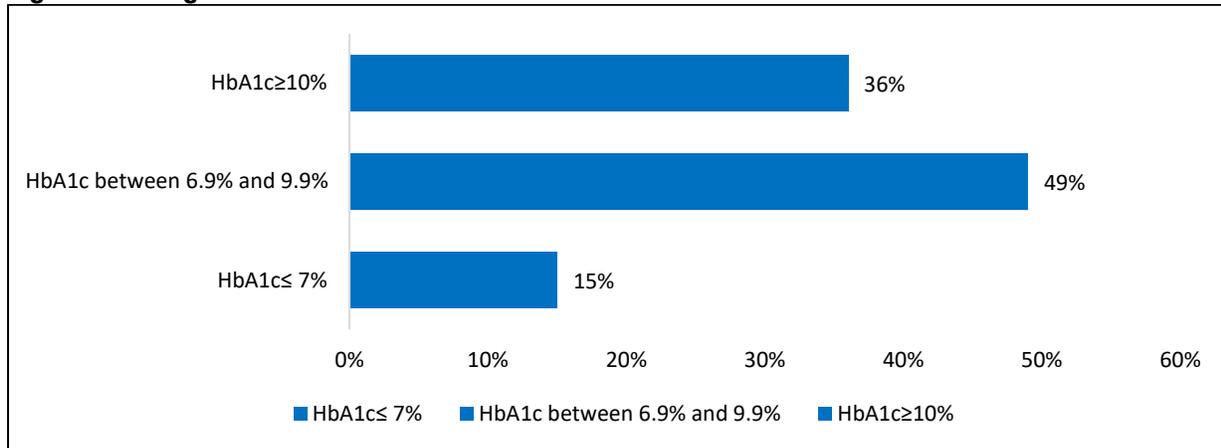


With regards to the number of follow up visits, of the 610 follow-up appointments made at the health centres within the four-months period, however, only 422 visits (69%) were made by the people with diabetes.

There were a nurse and one health officer who provide routine care for people with diabetes at the health centre. There were digital based diabetes registry and referral protocol, visiting specialist physician however no multidisciplinary diabetes care team. Professional development program for staff was not consistent. There was limited availability of equipment and consumables to assess biochemical measures such as HbA1c, microalbuminuria and blood lipids. Supplies of oral diabetes medications, insulin and lipid lowering medications and laboratory testing reagents were insufficient. The availability of resources for diabetes education and awareness was limited.

## Discussion

This study showed a high prevalence of diabetes complications and their associated risk factors among people with type 2 diabetes, and limited resources to effectively manage diabetes at the primary health care centre in Tonga. This highlighted the need to improve the capacity of diabetes care to enhance early detection of diabetes complications and strengthen diabetes care to improve quality of life.

The prevalence of retinopathy among people with diabetes found in this study was 18% which is within the rage of the prevalence of diabetic retinopathy found in Asian countries (10-43%)[20] and European country (6.5-25.2 % in Ireland),[21] slightly higher than the study found in low- and middle- income countries (6-15%),[22] and lower than the neighbouring Pacific Island countries (Nauru 69%, Solomon Islands 40% and Vanuatu 42%).[18]

Likewise, the percentage of people who were at risk of developing diabetic foot ulcer (neuropathy) found in this study was 14% which is within the rage of the rates identified in the low- and middle-income countries (10-25%)[22] and in Ireland (3.2–32.0%),[21] and slightly lower than the prevalence found in Nauru, Solomon Islands and Vanuatu (19-30%).[18] However, given that there were high prevalence of poor glycaemic control (49%) and very poor glycaemic control (36%) among people with diabetes found in this study population, if left unscreened for diabetes complications and left untreated the existing complications, the condition of retinopathy and neuropathy will get worse and lead to blindness and amputation. This will further challenge on national productivity due to disability and will increase social and economic burden to the government and family.

Evidence has shown that complications of diabetes can be prevented and delayed through effective and sustained interventions,[8-10] and there are several recommendations to improve diabetes care. For example, treatment for diabetes should be timely, focused on people centred integrated and self-management approach for better health outcomes,[23-24] and implementing a locally relevant and sustainable model of diabetes care focusing on capacity building in the small island states demonstrated improvement in diabetes services, metabolic and glycaemic control.[25] However, our study found a high prevalence of poor glycaemic control, high blood pressure and overweight and obese among people with diabetes, and irregular follow-up visits. This was most likely due to the lack of knowledge and awareness on diabetes complications, and disruption of diabetes management services resulting from COVID-19 pandemic and natural disasters affecting Tonga in recent years. This demonstrates the need to strengthen actions to improve system of diabetes

care including self-health care and follow-up visits in the communities of Tonga.

Literatures have clearly demonstrated that diabetes care outcomes are better in primary care settings that use a patient-centred approach,[26] however this study reported suboptimal capacity to manage diabetes at the primary health care level which compromise the delivery of timely and quality diabetes care in Tonga. While secondary and tertiary care are important, it is also critical to reorient health system to focus more on primary health care as the foundation of universal health access and coverage. Increase government financing on building capacity and sustainable model to scale up diabetes care at the primary health care settings is urgently needed. The evidence is clear that the investment in primary health care improves equity, and health outcomes, and lower overall national health care expenditure. Recognising the high prevalence of diabetes complications and associated risk factors found in this study, Tonga has initiated to scale up actions to improve diabetes primary health care services in the Kolonga community health centre and other remote settings. These include building up capacity of health centres to improve quality, accessibility, and effectiveness of diabetes care. These efforts have centred on increasing the resources, skills, awareness, capabilities, support, and referral systems to enable the health workforce, health centres and communities to detect and appropriately manage diabetes in a timely manner that prevents and delays the onset of diabetes complications. The system of diabetes care has been based on recommended standard of care taking into consideration of local context and engagement of the local and national health authority and community leaders thereby contributing to long term sustainability.

Furthermore, at the national level, Tonga has taken active steps to ensure that non-communicable diseases particularly diabetes is prioritised in the national sustainable development agenda to increase investment in primary health care capacity. The Tonga national non-communicable diseases strategy[27] focuses on a systems-based approach and addresses not only the clinical management services but also the underlying social, cultural, political, behavioural and environment factors influencing diabetes. This approach will safeguard in improving resources for early detection and management of diabetes, enacting policies that prevent type 2 diabetes, and addressing diabetes

in a whole of government and whole of society approach in Tonga.

Despite our study providing baseline information as an initial step to improve diabetes care, there are some limitations. For example, cardiovascular complications, renal complications, and other blood lipids were not screened given that resources were limited, and appropriate diagnostic investigations were not available at the health centre. Diagnostic equipment, method and criteria used for this study may be differed from studies conducted in other countries to make a comparison. Nonetheless, this study fills knowledge gap about diabetes complications and capacity at the in the low-resourced island setting as a starting point to scale up actions on prevention and control of diabetes and associated complications.

## Conclusion

To conclude, this study highlighted the urgent need to improve the quality and accessibility of diabetes care and strengthen preventive efforts to reduce diabetes complications. The findings also provided a timely reminder to government and development partners to invest additional resources to effectively manage diabetes at the primary health care level. This study not only adds information to the pool of knowledge about diabetes complications in the small island states, and it also draws attention on the need for future research related to diabetes particularly in the remote low resource setting. No doubt, Tonga will require to strengthen a resilient health system to improve screening for early detecting of diabetes complications and enhance management services. This will reduce premature mortality and disability from diabetes and to contribute to achieving the SDG. Only with a collective action and shared responsibility from health sectors, non-health sectors and communities, Tonga will ensure and make the biggest difference to improve population wellbeing moving forward.

# References

1. International Diabetes Federation. Diabetes Atlas 10th Edition, IDF 2021. Assessed August 21, 2023. https://diabetesatlas.org/idfawp/resourcefiles/2021/07/IDF_Atlas_10th_Edition_2021.pdf

2. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract,* 2022Jan;183:109119. DOI: 10.1016/j.diabres.2021.109119

3. International Diabetes Federation. Diabetes Atlas 7th Edition, IDF 2015. Assessed August 21, 2023. https://diabetesatlas.org/atlas/seventh-edition/

4. Pacific Island Health Officers Association. NCD Hybrid Survey Reports for US Affiliated Pacific Island Countries, PIHOA. Assessed September 10, 2023. https://www.pihoa.org/regional-initiatives/health-information-management-systems-surveillance-2/usapi-ncd-surveillance-data/

5. World Health Organization. Reports on the STEPwise approach to NCD risk factor surveillance, WHO. Assessed September 10, 2023. https://www.who.int/teams/noncommunicable-diseases/surveillance/data

6. Kessaram T, McKenzie J, Girin N, Roth A, Vivili P, Williams G, Hoy D. Noncommunicable diseases and risk factors in adult populations of several Pacific Islands: results from the WHO STEPwise approach to surveillance. Aust N Z J Public Health. 2015 Aug;39(4):336-43. doi: 10.1111/1753-6405.12398.

7. United Nations. Sustainable Development Goals, UN 2015. Assessed August 21, 2023. https://www.un.org/sustainabledevelopment/sustainable-development-goals/.

8. Galaviz K, Narayan V, Lobelo F, Weber Mary. Lifestyle and the prevention of type 2 diabetes: a status report. *Am J Lifestyle Med*. 2018 Jan-Feb; 12(1): 4–20. DOI: 10.1177/1559827615619159

9. American Diabetes Association. Prevention or delay of type 2 diabetes and associated comorbidities: Standards of care in diabetes 2023. *Diabetes Care* 2023 Jan 1;46(Suppl 1):S41-S48. DOI: 10.2337/dc23-S003

10. Mohammad A. The prevention and control the type 2 diabetes by changing lifestyle and dietary pattern. *J Educ Health Promot*. 2014; 3: 1. DOI: 10.4103/2277-9531.127541

11. Diabetes Australia. Position statement: type 2 diabetes remission, 2021. Assessed August 22, 2023. https://www.diabetesaustralia.com.au/wp-content/uploads/2021_Diabetes-Australia-Position-Statement_Type-2-diabetes-remission_2.pdf

12. Cariou B, Wargny M, Boureau A, Smati S, Tramunt B et al. Impact of diabetes on COVID-19 prognosis beyond comorbidity burden: the CORONADO initiative. *Diabetologia* vol 65, p1436–1449 (2022). DOI: 10.1007/s00125-022-05734-1

13. Rawshani A, Kjolhede E, Rawshani A, Sattar N, Eeg-Olofssson K et al. Severe COVID-19 in people with type 1 and type 2 diabetes in Sweden: A nationawide retrospective cohort study. *The Lancet Regional Health*, Vol 4, 100105, 2021. DOI: https://doi.org/10.1016/j.lanepe.2021.100105

14. World Health Organization. The impact of the COVID-19 pandemic on Noncommunicable Diseases resources and services: Results of a rapid assessment, WHO 2020. Assessed August 22, 2023. https://www.who.int/publications/i/item/9789240010291

15. World Health Organization. Bridgetown Declaration on NCDs and Mental Health, WHO 2023. Accessed August 21, 2023. https://cdn.who.int/media/docs/default-source/ncds/sids-event/2023-bridgetown-declaration-on-ncds-and-mental-health.pdf?sfvrsn=5feda33f_11

16. The Commonwealth Nations. The Commonwealth yearbook: Tonga national profile, 2015. Assessed August 22, 2023. https://commonwealthofnations.org/yb-pdfs/tonga_country_profile.pdf

17. Win Tin ST, Lee CM, Colagiuri R. A profile of diabetes in Pacific Island countries and territories. *Diabetes Res Clin Pract* 2015; 107: 233-246. DOI: 10.1016/j.diabres.2014.10.010

18. Win Tin ST, Kenilorea G, Gadabu E, Tassserei J, Colagiuri R. The prevalence of diabetes complications and associated risk factors in Pacific Island countries. Diabetes Res Clin Pract 2014; 103: 114-118. DOI: 10.1016/j.diabres.2013.09.017

19. Government of Tonga. Tonga population and housing census 2021. Assessed August 22, 2023. https://tongastats.gov.to/census-2/

20. Chua J, Lim C, Wong T, Sabanayagam C. Diabetic Retinopathy in the Asia-Pacific. *Asia-Pacific Journal of Ophthalmology*, Vol 7, 1, 2018. DOI: 10.22608/APO.2017511

21. Racey, M.L., Gilmartin, M., O'Neill, K. et al. Epidemiology of diabetes and complications among adults in the Republic of Ireland 1998-2015: a systematic review and meta-analysis. *BMC Public Health* 16, 132 (2015). https://doi.org/10.1186/s12889-016-2818-2

22. Aikaeli F,Tsi Njim,Stefanie Gissing,Faith Moyo,Uazman Alam,Sayoki G et al . Prevalence of microvascular and macrovascular complications of diabetes in newly diagnosed type 2 diabetes in low-and-middle-income countries: A systematic review and meta-analysis. *PLOS Global Public Health,* Open Access, June 15, 2022. https://doi.org/10.1371/journal.pgph.0000599

23. American Diabetes Association. Improving Care and Promoting Health in Populations: Standards of Medical Care in Diabetes—2022. *Diabetes Care* 2022;45:S8–S16. https://doi.org/10.2337/dc22-S001

24. American Diabetes Association. Lifestyle Management: Standards of Medical Care in Diabetes, 2019. *Diabetes Care* 2019;42(Suppl. 1):S46–S60 https://doi.org/10.2337/dc19-S005

25. Win Tin ST, Gadabu E, Laesango N, Colagiuri R. Comparing metabolic control and complications in type 2 diabetes in two Pacific Islands at baseline and following intervention. *Journal of Clinical and Transitional Epidemiology* 2016; 4:32-37. DOI: 10.1016/j.jcte.2016.03.001

26. Kevin A. Peterson, Caroline Carlin, Leif I. Solberg, Rachel Jacobsen, Toni Kriel, Milton Eder; Redesigning Primary Care to Improve Diabetes Outcomes (the UNITED Study). *Diabetes Care,*1 March 2020; 43 (3): 549–555. https://doi.org/10.2337/dc19-1140

27. Ministry of Health of Tonga and Tonga Health Promotion Foundation, TUIAKI 'I HE 'AMANAKI KI HA TONGA MO'UI LELEI, Persevering Together Through the Crisis to a Healthier Tonga, Tonga National Strategy for the Prevention and Control of Non-Communicable Diseases 2021-2025. Assessed September 27, 2023. https://www.tongahealth.org/_files/ugd/5ce0eb_c152d65e1f6d431991c65860818c15d1.pdf