MINISTRY OF HEALTH

Addressing Avoidable Blindness in Samoa:

Insights from the 2024 Rapid Assessment of Avoidable Blindness and Diabetic Retinopathy (RAAB+DR) Survey

The Fred Hollows Foundation NZ

Foreword

It is with great pleasure that I present the 2024 Rapid Assessment of Avoidable Blindness and Diabetic Retinopathy (RAAB+DR) Survey Report for Samoa—a landmark study providing critical insights into the state of eye health in our country.

Conducted in collaboration with The Fred Hollows Foundation NZ and supported by regional partners, this RAAB+DR report offers the most comprehensive and up-to-date information about blindness, visual impairment, and diabetic retinopathy in Samoa. The findings are both sobering and enlightening, reaffirming that avoidable blindness and vision impairment remain significant public health challenges, limiting the independence and well-being of Samoans. It disproportionately affects the working group and our most vulnerable population, particularly the elderly and those in rural and remote areas.

The survey reveals that the majority of blindness cases in Samoa are avoidable and are primarily caused by cataracts and uncorrected refractive errors. The reasons for delayed cataract treatment highlight the need to focus efforts on primary health care to increase awareness about eye health, screening and services available for eye conditions.

Samoa has made commendable progress in cataract surgical coverage, surpassing regional and global targets. However, significant gaps remain in ensuring equitable access to high-quality cataract surgeries, refractive services, and integrated diabetes management that include systematic diabetic retinopathy screening—particularly for those in underserved areas.

This RAAB+DR Survey Report is both a call to action and a roadmap for strengthening eye health in Samoa. It provides robust evidence for government, development partners, healthcare providers, and community stakeholders to implement sustainable, integrated and effective interventions that advance the principles of Universal Health Coverage (UHC) for our peoples and communities.

The Ministry of Health is fully committed to integrating these findings into its national health strategies, particularly within the Samoa National Eye Care Plan (NECP) and the broader NCD response. Together, let us work towards a future where all Samoans have access to quality eye care services and the opportunity to see a brighter tomorrow.

On behalf of the Samoa Ministry of Health, I extend my deepest gratitude to Dr. Lucilla Ah Ching-Sefo, the Principal Investigator, and her dedicated teams in ophthalmology and other health professionals who led this vital work. I also acknowledge The Fred Hollows Foundation NZ, the Lions Clubs International Foundation, all national and regional contributors, and especially the survey participants from all participating Samoan communities for their contributions and unwavering support.

Ma le fa'aaloalo lava.

Aiono Dr. Alec Ekeroma, ONZM

DIRECTOR GENERAL OF HEALTH

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Ophthalmology staff and stakeholders involved in the RAAB survey

- Dr Lucilla Ah Ching-Sefo, Principal Investigator & co-author of this report, Head of Ophthalmology, Tupua Tamasese Meaole Hospital
- Caroline Auvaa, RAAB Coordinator, National Eye Coordinator, Tupua Tamasese Meaole Hospital
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Table of contents

List of tables

List of figures

List of abbreviations

CSC	Cataract Surgical Coverage
DALYs	Disability-Adjusted Life Years
DR	Diabetic Retinopathy
eCSC	Effective Cataract Surgical Coverage
eREC	Effective Refractive Error Coverage
EVI	Early Vision impairment
EVI+	Early Vision Impairment or worse
IAPB	International Agency for the Prevention of Blindness
IOL	Intraocular Lens
MVI	Moderate Vision Impairment
MVI+	Moderate Vision Impairment or worse
NCDs	Non-Communicable Diseases
NECP	National Eye Care Plan
PinVA	Pinhole Visual Acuity
PVA	Presenting Visual Acuity
RAAB	Rapid Assessment of Avoidable Blindness
REC	Refractive Error Coverage
RBG	Random Blood Glucose
SVI	Severe Vision Impairment
SVI+	Severe Vision impairment or worse
UCVA	Uncorrected Visual Acuity
UHC	Universal Health Coverage
VI	Visual Impairment
VA	Visual Acuity

Key definitions

Indicator	Definition
Visual acuity	The clarity of vision of an individual
Uncorrected visual acuity	Visual acuity without any corrective lenses
Pinhole visual acuity	Visual acuity with the best available refraction correction – for the purpose of this study, this is pinhole vision
Presenting visual acuity	Visual acuity with refraction correction that is available to the participant
Blindness	Visual acuity <3/60 in the better eye
Severe visual impairment	Visual acuity <6/60 to 3/60
Moderate visual impairment	Visual acuity <6/18 to 6/60
Early visual impairment	Visual acuity <6/12 to 6/18
Severe visual impairment or worse	Visual acuity <6/60
Moderate visual impairment or worse	Visual acuity <6/18
Early visual impairment or worse	Visual acuity <6/12
Bilateral visual impairment	Vision impairment in both eyes, categorized by visual acuity thresholds
Unilateral visual impairment	Vision impairment in one eye, with the other eye having PVA of 6/12
Cataract surgical coverage	(x+y) / (x+y+z) *100, where x = individuals with unilateral pseudo/aphakia, y = individuals with bilateral pseudo/aphakia, and z = individuals with bilateral operable cataract
Effective cataract surgical coverage	(a+b) / (x+y+z) *100, where a = individuals with unilateral pseudo/aphakia achieving PVA 6/18 or better, and b = individuals with bilateral pseudo/aphakia achieving PVA ≥6/18 x, y, z = as above
Refractive error coverage	(a+b+c) / (a+b+c+d) *100, where a = met need, b = history of refractive surgery, c = undermet need, and d = unmet need
Effective refractive error coverage	(a+b) / (a+b+c+d\) *100, where a = met need, b = history of refractive surgery, c = undermet need, and d = unmet need
Diabetic retinopathy	<u>Categories</u>: R0 (No DR): No visible signs of diabetic retinopathy; R1: Background DR; R2: Pre-proliferative DR; R3: Proliferative DR; M0: No maculopathy; M1: Maculopathy; P: Photocoagulation scars
Referable Diabetic Retinopathy	Defined as R2 (Pre-proliferative DR) or R3 (Proliferative DR)
Referable Maculopathy	Defined as M1 (Maculopathy)

Key messages

Methodology and Participation Rates

The 2024 national RAAB survey in Samoa utilized a cross-sectional, population-based design to assess the prevalence and causes of blindness and visual impairment among individuals aged 50 and older. The survey was conducted across all 51 districts of Samoa and achieved a participation rate of 96.2%. It included visual acuity assessments, lens examinations, and evaluations of diabetes status. Direct fundus examinations were performed on 70% of participants diagnosed or suspected of having diabetes.

National Prevalence of Blindness and Vision Impairment

In Samoa, the age- and sex-adjusted prevalence of blindness is 1.5%. Severe visual impairment (SVI) affects 2.0% of the population, while moderate visual impairment (MVI) impacts 8.1%. The prevalence of blindness is slightly higher among females at 1.7%, compared to 1.2% among males. Notably, an estimated 83.4% of blindness cases in Samoa are avoidable, highlighting the need for improved efforts to provide care for individuals living with avoidable blindness and vision impairment.

Cataracts as the Leading Cause

Cataracts are the leading cause of blindness in Samoa, accounting for 70.8% of all cases. They also represent the primary cause of severe visual impairment and contribute significantly to moderate visual impairment. This highlights the urgent need to improve access to cataract surgical services.

Cataract Surgical Coverage and Effective Cataract Surgical Coverage

The Cataract Surgical Coverage (CSC) in Samoa for severe visual impairment (PVA < 6/60) and blindness (PVA < 3/60) is 82% and 90.1%, respectively, surpassing the 80% target for Universal Health Coverage (UHC). For moderate visual impairment, the CSC is 60.2%, exceeding the median for the Western Pacific Region and other low- to middle-income countries, reflecting ongoing support efforts. Effective cataract surgical coverage (eCSC) for blindness is 67.9%, and for vision impairment below 6/18, it is 42.8%. Although these figures are better than the Western Pacific Region estimates, there remain quality gaps of 24.7% and 29%, respectively, indicating a need for improved cataract surgery outcomes in Samoa.

Visual Outcomes After Cataract Surgery

Approximately 64.4% of individuals achieved good postoperative visual outcomes, with vision levels measured at 6/12 or better. Additionally, many patients demonstrated further improvement in their visual acuity when assessed using pinhole vision. This suggests that addressing residual distance refractive errors could lead to even better outcomes in this group. In contrast, just over 10% of individuals experienced poor visual results, underscoring the importance of addressing factors that can affect vision recovery following cataract surgery.

Barriers to Cataract Surgery

The primary barriers to cataract surgery include lack of perceived need, unaware of possible treatment, limited access to services, and fear. Targeted awareness campaigns could help mitigate these barriers, encouraging more people to seek treatment.

Uncorrected Refractive Errors

Uncorrected refractive errors account for 76.2% of early visual impairment in Samoa, establishing them as a principal cause of early visual impairment. This highlights the need to strengthen refractive services to meet the high demand for vision correction.

Distance Refractive Error Coverage

The effective refractive error coverage (eREC) in Samoa is notably low at 8.1%, indicating a significant unmet need for accessible refractive correction services to address distance vision needs, particularly in rural areas.

Diabetes and Diabetic Retinopathy (DR)

Approximately 23.9% of participants who consented to a random blood sugar test were either known or suspected to have diabetes. Among these individuals, 36.7% exhibited signs of diabetic retinopathy (DR). Alarmingly, 76.5% of this group had never undergone eye screenings for DR, highlighting the urgent need for systematic screenings and improved integration of diabetic eye care and awareness.

Executive summary

Background

In 2021, the 74th World Health Assembly set global eye health targets: a 30% increase in effective Cataract Surgical Coverage (eCSC), a 40% increase in effective Refractive Error Coverage (eREC), and goals for diabetes-related eye care—ensuring 80% of people with diabetes are screened for retinopathy and 80% of those with sight-threatening diabetic retinopathy (STDR) receive timely treatment by 2030. The 2024 RAAB study in Samoa will monitor the country's progress toward these targets, providing data on blindness, visual impairment, and diabetic retinopathy among adults aged 50 and older.

Objectives

The primary objectives of the RAAB study in Samoa were:

- To estimate the prevalence and main causes of blindness and vision impairment in individuals aged 50 years and older in Samoa.
- To assess cataract surgical coverage, outcomes, and barriers to cataract service access.
- To ascertain the prevalence of diabetes and diabetic retinopathy within the target population.

Methods

The RAAB utilized a standardized, population-based survey methodology, focusing on adults aged 50 years and older across Samoa. A total of 4,616 individuals aged 50 years and older were included in the survey, with 4,440 participants successfully examined. Data collection was conducted from April to July 2024, and involved visual acuity testing, clinical eye examinations, and structured interviews to identify causes of vision impairment, cataract surgical coverage, and to assess prevalence of DR and document barriers to eye care access.

Key Findings

- **Prevalence of Vision Impairment and Blindness:** The survey determined that 1.5% of the population aged 50 years and older is blind, with a higher prevalence in females (1.7%) than males (1.2%). Severe visual impairment affects 2.0% of the population, while moderate impairment is seen in 8.1%. An estimated 83.4% of blindness in Samoa is avoidable.
- **Causes of Visual Impairment:** Cataracts account for 70.8% of blindness and are the leading cause of severe vision impairment. Refractive error is the primary cause of mild visual impairment (76.3%), with diabetic retinopathy and other posterior segment diseases also contributing significantly.
- **Cataract and Refractive Error Coverage:** Cataract Surgical Coverage (CSC) for blindness (VA <3/60) is estimated at 90.1% in Samoa, indicating a high level of coverage for individuals with severe impairments. The prevalence of refractive errors is 10.8%, with a higher incidence among older populations.
- **Diabetic Retinopathy:** Approximately 24.0% of survey participants were diagnosed or suspected to have diabetes, of whom 11.5% displayed signs of sight-threatening diabetic retinopathy, underscoring the need for comprehensive screening.
- **Barriers to Cataract Surgery:** Major barriers include, patient did not feel the need for care, lack of awareness of available treatments, and challenges related to service access and to fear limiting timely interventions for eye health.

Discussion

The findings indicate a significant burden of avoidable blindness and visual impairment in Samoa, predominantly due to untreated cataracts, untreated refractive error, pterygium, diabetic retinopathy and other posterior segment disease. The high rate of uncorrected refractive error highlights a need for expanded refractive services, while the substantial prevalence of diabetes will require robust diabetic retinopathy screenings. Limited accessibility to eye care facilities, especially in rural areas, compounded by the lack of awareness further exacerbates the challenge.

Conclusions

The RAAB survey illustrates a critical need for structured interventions to reduce avoidable blindness in Samoa. Improving access and outcomes for cataract surgery, expanding refractive error services, and expanding diabetic retinopathy screening programs are essential to improving eye health outcomes and reducing the socio-economic impact of visual impairment in the region.

Recommendations

To address the findings of this survey, it is recommended that the eye health sector in Samoa work with relevant stakeholders to:

1. **Improve Cataract Surgery Access and Outcomes**: Increase surgical services in rural facilities and initiate regular audits of surgery outcomes.
2. **Expand Refractive Error Services:** Develop supply chains which facilitate improved access to affordable spectacles, strengthen the capacity of eye care service providers to manage refractive error, and improve referral pathways from primary care to access these services.
3. **Implement Systematic DR Screening:** Integrate regular DR screening into diabetes care to detect and treat early-stage DR, with a focus on patient education.
4. **Increase Public Awareness:** Launch campaigns to promote routine eye exams and raise awareness of available eye care services.
5. **Strengthen Eye Health Infrastructure:** Build capacity in eye care through improved infrastructure, trained personnel, and stable supply chains.
6. **Promote Policy Support**: Advocate for prioritizing eye health in national policies to secure sustainable funding and international support.

Background

Blindness and Vision Impairment – Global and Western Pacific Region

Vision impairment and blindness represent significant public health challenges globally, with over 2.2 billion people affected worldwide and at least 1 billion cases either preventable or treatable (1).

The recent *Lancet Global Health* Commission on Global Eye Health (2) highlighted that vision impairment reduces mobility, affects mental well-being, exacerbates risk of dementia, increases likelihood of falls and road traffic crashes, increases need for social care, and leads to higher mortality rates. Vision loss impacts quality of life, education, and work, and if addressed through the provision of good eye health treatment, would result in productivity gains of more than US$410 billion annually (1).

Low and middle-income countries account for approximately 90% of the global burden of vision loss as a result of limited access to timely, quality eye care, higher prevalence of untreated conditions, and inadequate healthcare infrastructure (3). The World Health Organization estimates that over 90 million people in the Western Pacific Region experience visual impairment, including 10 million who are blind (4). Pacific Island nations, including Samoa, face even greater challenges due to geographic isolation, limited healthcare resources, and rising rates of non-communicable diseases like diabetes. Without targeted interventions, these conditions will continue to strain health systems, impacting economic growth and quality of life.

Samoa and Health System

Samoa is a Pacific Island country in Polynesia, in the central South Pacific Ocean. The country comprises two major volcanic islands, Savai'i and Upolu, eight smaller islands and some uninhabited islets (5). A sovereign state, Samoa is divided into 11 administrative divisions, and the capital is Apia on Upolu Island. At the 2021 Census, Samoa registered 205,557 people, with the vast majority being ethnically Samoan (96%) and about 80% live in rural areas (6). With a median age of 22 years, Samoa reflects a young demographic structure. Approximately 38.5% of the population is under 15 years old, 55.9% are aged 15–64, and 5.5% are 65 years or older. The sex ratio is balanced, with 104 males per 100 females. Life expectancy at birth is about 73 years, and the Human Development Index (HDI) in 2022 was 0.702, ranking 112 out of 193 countries (7). Non-communicable diseases (NCDs) pose significant mortality and morbidity challenges, with 24.3% of adults living with diabetes—a leading contributor to vision-threatening conditions like diabetic retinopathy.

The Samoa health system is mostly public funded and operated by the Ministry of Health (MoH) (8). It comprises two national referral hospitals that also provide secondary eye care services: *Tupua Tamasese Meaole (TTM) Hospital* on Upolu Island and *Malietoa Tanumafili II (MTII) Hospital (Tuasivi Hospital)* on Savai'i Island. (Figure 1) These are supported by ten rural health facilities, including six district hospitals providing 24-hour services daily, and four health centres (open during work hours). Rural facilities are less resourced than urban hospitals, with TTM Hospital being the most equipped. Primary eye care is available in 6 out of 10 rural health facilities, though access to advanced services remains centralized (8). The Ministry of Health (MOH) leads service delivery, integrating partnerships with NGOs, international organizations (e.g., WHO, Fred Hollows Foundation NZ), and regional training institutions like the Pacific Eye Institute. Health services prioritize primary care under the PEN Fa'aSamoa Initiative (9, 10), though challenges persist in workforce shortages and equitable resource distribution across islands.

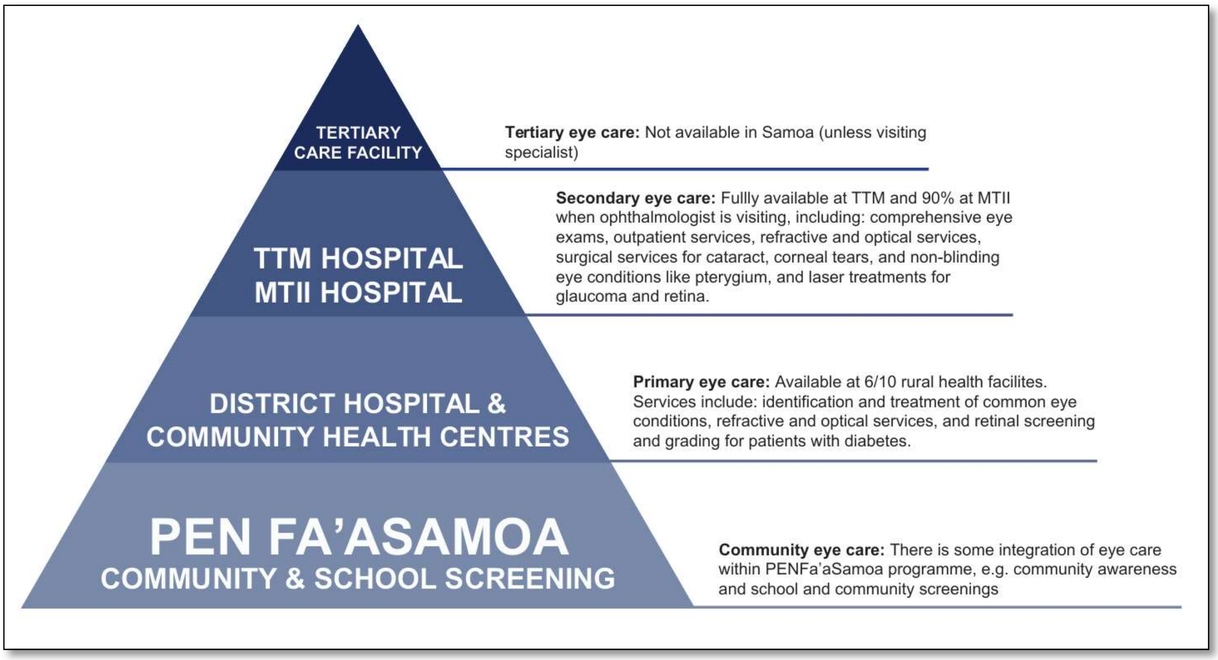

Figure 1: Overview of Eye Healthcare Services Provision in Samoa

Samoa Eye Health – Data, Strategic Health Initiatives and the National Eye Care Plan (NECP)

Samoa's eye health landscape has long been under-documented, with available data derived primarily from small regional surveys or clinic-level studies (11, 12), which provide only fragmented insights into national eye health needs. This lack of comprehensive data has hampered efforts to advocate for resources, develop effective eye care services, and monitor progress toward reducing preventable blindness among vulnerable populations. Recognizing these limitations, Samoa conducted its first Rapid Assessment of Avoidable Blindness with inclusion of a Diabetic Retinopathy module (RAAB+DR) survey in 2024, marking a critical step in addressing data gaps and informing targeted health interventions.

Samoa is now actively advancing a sustainable approach to reducing vision impairment through its first National Eye Care Plan (NECP) for 2024–2028 (13). The NECP addresses the significant public health and economic impacts of visual impairment by working toward accessible, high-quality eye care services nationwide. Aligned with national health goals for Samoa and the WHO eye health frameworks, the NECP emphasizes the need to build robust healthcare infrastructure capable of responding to common eye conditions, including cataracts and diabetic retinopathy.

Currently, the eye health infrastructure in Samoa faces significant challenges. With only one national ophthalmologist and a small network of trained eye care nurses (Figure 2), access to essential services is limited, especially for rural and remote populations (14). Recognizing these constraints, the NECP promotes a collaborative, multi-stakeholder approach, working with partners like The Fred Hollows Foundation NZ, to build the capacity of the eye care workforce. The NECP also prioritizes primary care by deploying ophthalmic nurses to district levels to train primary care workers in triage and referral of eye health conditions. This reduces barriers to care for rural populations and enhances access to cataract surgery. Informed by the RAAB+DR survey findings, the NECP is committed to integrating eye care into primary healthcare, aligning with Samoa's goals for Universal Health Coverage (UHC) and fostering a resilient, inclusive healthcare system for all.

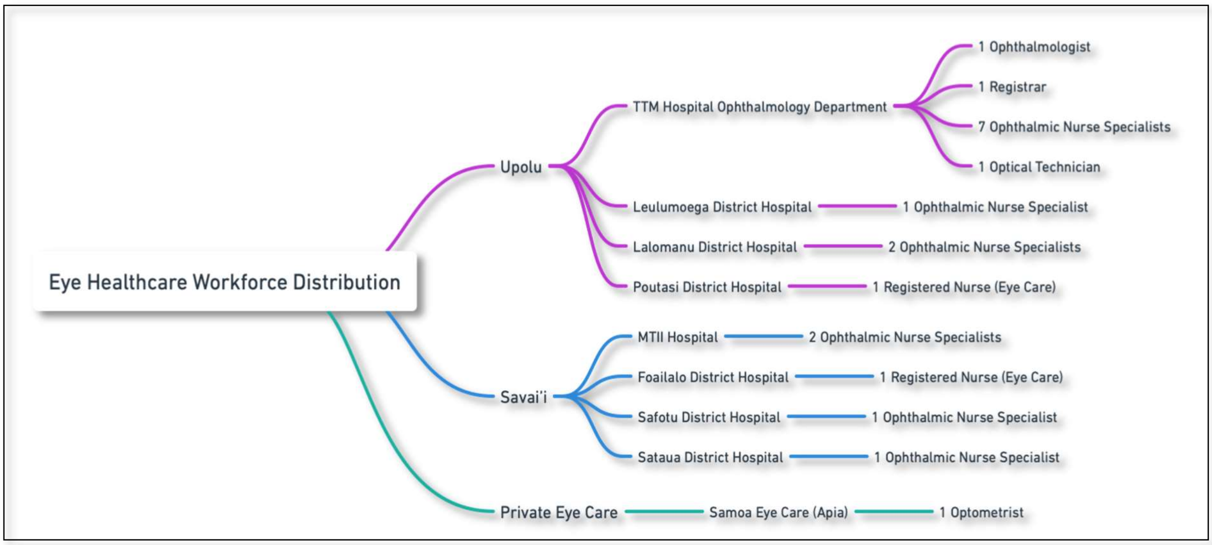

Figure 2: Eye Healthcare Workforce

The RAAB+DR Survey: Addressing Eye Health Needs in Samoa

The RAAB+DR survey is a standardized, cross-sectional, population-based survey that assesses the prevalence and primary causes of blindness and vision impairment among individuals aged 50 years and older, a demographic at increased risk due to aging and chronic diseases (15). Samoa's high diabetes prevalence makes the inclusion of the diabetic retinopathy (DR) module particularly crucial, as DR is a serious complication of diabetes that damages the retina's blood vessels and can lead to irreversible blindness if untreated. By capturing data on both traditional causes of vision loss, such as cataracts and refractive errors, and the impact of DR, the RAAB+DR survey provides a comprehensive evidence base for developing targeted eye care policies and interventions aligned with national health priorities.

The survey employed the latest RAAB7 protocol, which uses mobile data collection and cloud-based uploads for real-time data management and quality control. Survey teams, equipped with essential eye care tools, conducted door-to-door visits in selected regions, assessing visual acuity, screening for diabetic retinopathy, and documenting barriers to accessing eye care. This approach allowed for the collection of age-specific prevalence rates, primary causes of vision loss, cataract surgical coverage, and insights into obstacles to accessing necessary services like cataract surgery. These findings offer actionable data to guide Samoa's eye health planning, support evidence-based healthcare policy, and fill critical knowledge gaps in the national eye health structure.

Strategic Implications for Eye Health in Samoa

The RAAB+DR survey findings are expected to play a central role in shaping Samoa's national eye health strategy. Samoa's healthcare priorities, outlined in the "A Healthy Samoa" strategy, emphasize equitable healthcare and the pursuit of Universal Health Coverage (UHC) (16). The comprehensive data provided by the RAAB+DR survey supports these priorities by guiding resource allocation and informing targeted interventions. Additionally, this data enables Samoa to align with global health initiatives, such as WHO's Vision 2020: The Right to Sight and the Universal Eye Health Global Action

Plan, which underscore the importance of reducing preventable blindness and integrating eye care into national health systems (17). By basing decisions on data-driven strategies, Samoa can improve individual health outcomes, reduce the economic burden of vision loss, and support sustainable socio-economic growth.

The RAAB+DR survey also strengthens Samoa's role within the Pacific Island Countries and Territories (PICTs) by contributing valuable insights to regional health efforts. The survey data will facilitate collaboration with other Pacific nations, enabling the sharing of best practices, strengthening advocacy, and increasing capacity to address common eye health challenges. By identifying priority areas and common barriers to care, Samoa can more effectively reduce avoidable blindness and enhance public health resilience across the Pacific region.

Aims & Objectives

The overarching aim of this survey is to collect robust evidence on the prevalence and causes of avoidable blindness and vision impairment in Samoa. To fulfil this objective, the specific research aims are as follows:

- To determine the prevalence and main causes of blindness and vision impairment in individuals aged 50 years and older in Samoa.
- To assess the cataract surgical coverage rate, evaluate surgical outcomes, and identify barriers to accessing cataract services among individuals aged 50 years and older in Samoa.
- To ascertain the prevalence of diabetes and diabetic retinopathy in individuals aged 50 years and older in Samoa.

Methods

Study Design

This was a cross-sectional population-based survey conducted in Samoa. The study utilized the well-established Rapid Assessment of Avoidable Blindness (RAAB) methodology (18), which is designed to estimate the prevalence and causes of visual impairment, blindness, and diabetic retinopathy in people aged 50 years and older. RAAB7 software, which incorporates mobile data collection and cloud-based management, was used to streamline data collection and analysis.

Participants and Recruitment

The study population consisted of adults aged 50 years or older living in Samoa at the time of data collection.

Sample Size

The total population of Samoa was estimated to be approximately **205,557** people in **2021**, and the population aged 50 years or older was estimated at **35,513** individuals, according to data from the **Samoa Bureau of Statistics (2021 Census)** (6). The required sample size was determined to be 4,616 people, distributed across 132 geographical clusters of 35 participants aged 50 years or older. This sample size was calculated to have sufficient statistical power to estimate a national prevalence of blindness of 1.87%, with a 95% confidence level and a design effect of 1.4, accounting for a 10% non-response rate. The RAAB7 software was used to calculate the required sample size.

Recruitment Approach

A two-stage cluster sampling approach was adopted to ensure a representative sample of the target population aged 50 years or older in Samoa. The sampling frame was based on a comprehensive list of villages and communities provided by the Bureau of Statistics, which included the population size of each settlement. This allowed for sampling using the **probability proportional to size (PPS)** method.

One hundred and thirty-two clusters were randomly selected from the sampling frame, with the probability of selection based on the population size of each settlement. Since approximately 12% of Samoa's population was estimated to be aged 50 years or older, each cluster was expected to include around 35 individuals meeting the inclusion criteria. In cases where a settlement exceeded the expected size, it was subdivided into smaller segments, and a sub-segment was randomly chosen.

Survey teams, accompanied by village representatives, visited all households in the selected clusters, conducting door-to-door visits until 35 eligible participants were identified. The study's purpose and examination procedures were explained to all participants, and informed consent was obtained prior to data collection.

If an eligible participant was unavailable at the time of the survey, the team returned later in the day to complete the examination. In cases where the participant remained unavailable, their visual status information was gathered from relatives or neighbours. If the survey team could not identify 35 eligible participants within a cluster, they continued recruitment in the nearest cluster to meet the target sample size.

Data collection

The fieldwork for this RAAB7 survey was conducted between April and July 2024.

Data Collection Teams and Roles

Data collection was carried out by five teams, each consisting of an ophthalmologist and two ophthalmic nurses or technician, and a village representative. The teams were trained to use the RAAB7-enabled mobile devices to ensure standardized and consistent data collection practices. The following roles were assigned within each team:

- **Lead Ophthalmologist**: Responsible for assessing lens status, diagnosing the causes of blindness and visual impairment, and grading diabetic retinopathy.
- **Ophthalmic nurse or technician:** Conducted visual acuity (VA) and random blood glucose tests and assisted in identifying participants with diabetes for further retinal examination.
- **Village Representative (Sui o le nu'u or Sui tama'ita'i)**: Assisted with community engagement, and participant identification.
- **Driver**: Responsible for safe transportation of survey teams and their equipment between clusters; and assisted the examination team, if required.

Training and Quality Control

A comprehensive five-day training program was conducted by a certified RAAB trainer, focusing on the RAAB7 protocol, visual acuity testing procedures, DR grading, ethical considerations, and data management using the RAAB7 software. The training included theoretical sessions, practical field exercises, and inter-observer variation (IOV) assessments to ensure consistency in VA measurements, DR grading, and lens examinations. A Kappa agreement statistic of ≥0.60 was required for team members to qualify for field data collection, with additional training provided for those who did not meet the threshold.

Quality control measures included ongoing supervision by a certified RAAB trainer, regular reviews of data entry and protocol adherence, and weekly feedback sessions to address any issues or deviations. Data consistency checks were integrated into the RAAB7 software, allowing for real-time identification and correction of discrepancies.

Examination Protocols

Visual Acuity Measurement: Visual acuity was measured using the Peek Acuity mobile app at a 2–3-meter distance. For participants with a VA of less than 6/12, pinhole testing was conducted to identify refractive errors. If vision remained below 6/12 after pinhole correction, further evaluation was performed, including a dilated eye examination using tropicamide 0.5% to diagnose underlying pathologies such as cataracts, glaucoma, or retinal diseases.

Lens Examination: All participants underwent a lens examination using a binocular indirect ophthalmoscopy in semi-dark conditions. In select cases requiring closer anterior segment evaluation, a direct ophthalmoscope was used. For participants with unexplained visual impairment, a dilated lens examination was conducted to assess for lens opacity, posterior capsule opacification, or intraocular lens status.

Diabetic Retinopathy Assessment: Participants were first screened for diabetes using a random blood glucose (RBG) test via a finger prick. Participants with RBG levels ≥200 mg/dl or a self-reported history of diabetes were identified as suspected or known diabetics and received a comprehensive dilated retinal examination. The examination included both direct and indirect ophthalmoscopy, and retinopathy was graded using the Scottish grading scheme, which classifies the severity of DR from mild non-proliferative to proliferative diabetic retinopathy.

Local modifications to the RAAB form

The standard list of causes in the RAAB survey can be modified according to the specific needs of the local setting. During the training program, it was observed that onchocerciasis was not present in Samoa. To better reflect the local context, the survey teams decided to replace the condition 'onchocerciasis' on the RAAB record survey with 'pterygium,' as it was noted to be more prevalent in Samoa.

Data Management and Analysis

Data were collected electronically using the RAAB7 software on mobile devices, which ensured immediate data entry, storage, and real-time synchronization with a secure cloud- based server. The software provided built-in consistency checks and automated data validation to minimize errors and enhance data quality. Data analysis was performed using RAAB7's analytical tools, which provided automated outputs for key indicators, including the prevalence of blindness, visual impairment, cataract surgical coverage, and the primary causes of vision loss. The analysis also included the estimation of confidence intervals and the use of age-sex adjustment techniques to account for sampling design and non-response bias.

Ethical Approval and Consent

The study was approved by the Samoa Health Research Committee. Prior to conducting the survey, consent was obtained from each electoral constituency village representative in Samoa. This ensured that local leaders were fully informed about the survey process and granted permission for their communities to participate. Additionally, all participants provided informed consent prior to enrolment in the study. Given the inclusion of invasive procedures such as blood glucose testing and pupil dilation, written informed consent was required.

Participants were informed about the study's purpose, procedures, potential risks, benefits, and assured of data confidentiality. No financial incentives were provided for participation, and participants did not incur any costs for taking part in the survey.

Results

Response Rate and Demographic characteristics

The study aimed to examine 4,616 eligible individuals, and achieved a high response rate of 96.2%, with 4,440 participants successfully examined. This included 1,889 males (42.6%) and 2,551 females (57.4%). Among non-responders, 110 (2.4%) were unavailable at the time of the survey, 28 (0.6%) refused to participate, and 38 (0.8%) were not capable of being examined (Table 1).

Table 1. Demography of coverage, absenteeism and refusals

Exam status	Female n (%)	Male n (%)	Total n (%)
Examined*	2551 (97.1)	1889 (95.0)	4440 (96.2)
Refused	11 (0.4)	17 (0.9)	28 (0.6)
Incapable	22 (0.8)	16 (0.8)	38 (0.8)
Unavailable	44 (1.7)	66 (3.3)	110 (2.4)
Total	2628 (100.0)	1988 (100.0)	4616 (100.0)

* The response rate is the percentage examined

The largest age group was those aged 50–59 years, comprising 43.9% of the sample, followed by 33.5% aged 60–69 years, 16.6% aged 70–79 years, and 6.0% aged 80 years and older (Table 2). Compared with the 2021 census age-sex estimates, the study sample showed slight under-representation of men and women in the 50–59 age group, with a slight over-representation in the 60–69, and 70–79, and 80+ age groups. Census age- and sex-weighted estimates were applied to adjust for discrepancies between the sample and the population.

Table 2. Age and gender distribution of survey area and sample population

Age group Years	People examined in the sample			Survey Area (Census 2021)		
	Female n (%)	Male n (%)	Total n (%)	Female n (%)	Male n (%)	Total n (%)
50-59	1133 (44.4)	814 (43.1)	1947 (43.9)	8371 (47.4)	9295 (52.0)	17666 (49.7)
60-69	805 (31.5)	686 (36.3)	1491 (33.6)	5429 (30.8)	5706 (31.9)	11135 (31.4)
70-79	428 (16.8)	309 (16.3)	737 (16.6)	2632 (14.9)	2199 (12.3)	4831 (13.6)
80+	185 (7.3)	80 (4.2)	265 (6.0)	1219 (6.9)	662 (3.7)	1881 (5.3)
Total	2551 (100.0)	1889 (100.0)	4440 (100.0)	17651 (100.0)	17862 (100.0)	35513 (100.0)

Prevalence of blindness and vision impairment

The prevalence of bilateral blindness in the sample (PVA <3/60) was 1.6% (95% CI: 1.3– 2.0%); the prevalence of bilateral severe visual impairment (SVI, PVA <6/60 but ≥3/60) was 3.7% (95% CI: 3.1 - 4.3%); moderate VI (MVI, PVA <6/18 but ≥6/60) was 12.6% (95% CI: 11.5 - 13.7%), and mild VI (EVI, PVA <6/12 but ≥6/18) was 19.8% (95% CI: 18.3 - 21.4%). (Table 3).

The prevalence of blindness was slightly higher among women (1.8%, 95% CI: 1.3–2.3%) compared to men (1.4%, 95% CI: 0.9–2.0%). While similar differences in visual impairment by gender were consistent across all impairment categories, they were not statistically significant for severe and moderate visual impairment (p > .05).

The age- and gender-adjusted prevalence of bilateral blindness was 1.5% (95% CI: 1.1– 1.8%); SVI was 3.4% (95% CI: 2.8 - 4.0%); MVI was 11.5% (95% CI: 10.4 - 12.6%); mild VI was 18.2% (95% CI: 16.6 - 19.8%). When extrapolating these estimates to the general population of Samoa, it is estimated that approximately 517 individuals aged 50 and older are blind, 1,211 have severe visual impairment, 4,090 have moderate visual impairment, and 6,465 have mild visual impairment. (Table 3).

Table 3. The sample and age-sex-adjusted cumulative prevalence of blindness (any PVA <3/60), severe (any PVA <6/60), moderate (any PVA <6/18) and mild (any PVA <6/12) vision impairment

VI level	Female			Male			Total		
	n	%	95% CI	n	%	95% CI	n	%	95% CI
Sample prevalence									
Blind	45	1.8	1.3 - 2.3	27	1.4	0.9 - 2.0	72	1.6	1.3 - 2.0
Severe or worse	102	4.0	3.2 - 4.8	64	3.4	2.5 - 4.3	166	3.7	3.1 - 4.3
Moderate or worse	348	13.6	12.2 - 15.1	211	11.2	9.6 - 12.8	559	12.6	11.5 - 13.7
Mild or worse	553	21.7	19.7 - 23.7	327	17.3	15.3 - 19.3	880	19.8	18.3 - 21.4
Adjusted prevalence and extrapolated magnitude									
Blind	298	1.7	1.2 - 2.2	220	1.2	0.7 - 1.8	517	1.5	1.1 - 1.8
Severe or worse	674	3.8	3.0 - 4.6	537	3.0	2.1 - 3.9	1211	3.5	2.8 - 4.0
Moderate or worse	2300	13.0	11.6 - 14.5	1790	10.0	8.4 - 11.6	4090	11.6	10.4 - 12.6
Mild or worse	3672	20.8	18.8 - 22.8	2793	15.6	13.7 - 17.6	6465	18.3	16.6 - 19.8

Causes of blindness and vision impairment

Untreated cataract was the leading cause of blindness, responsible for 70.8% of cases, followed by posterior segment diseases (11.1%), with globe or CNS abnormalities, pterygium, and diabetic retinopathy contributing 5.6%, 4.2%, and 2.8%, respectively. Cataract was also the main cause of severe visual impairment (SVI) at 67.0% and moderate visual impairment (MVI) at 46.1%. Uncorrected refractive errors were the leading cause of early visual impairment (EVI) at 76.3% and contributed 10.6% to SVI and 40.2% to MVI (Table 4).

Aphakia, glaucoma, trachomatous corneal opacities, age-related macular degeneration, myopic degeneration, and globe or CNS abnormalities did not contribute to visual impairment in this sample (0%). While no cases of visual impairment attributable to glaucoma were identified in this sample population, the methodology did not include intraocular pressure (IOP) measurements or visual field testing—key diagnostic criteria for glaucoma. Therefore, this condition may have been underrepresented in these findings. Glaucoma primarily affects peripheral vision, which standard VA testing alone (that was used in this survey) cannot reliably assess.

Avoidable causes—untreated cataract, diabetic retinopathy, uncorrected refractive error, cataract surgical complications, corneal opacity, and pterygium— altogether these causes accounted for 83.4% of total blindness, 93.7% of SVI, 98.1% of MVI, and 99.3% of mild VI in Samoa (Table 4).

Table 4. Principal cause of blindness, severe, moderate and mild vision impairment

Principal cause	Blind		Severe		Moderate		Mild	
	n	%	n	%	n	%	n	%
1. Cataract	51	70.8	63	67.0	181	46.1	55	17.1
2. Cataract surgical complications	2	2.8	4	4.3	5	1.3	1	0.3
3. Other posterior segment disease	8	11.1	4	4.3	7	1.8	2	0.6
4. Other globe or CNS abnormalities	4	5.6	2	2.1	1	0.3	0	0.0
5. Pterygium	3	4.2	6	6.4	29	7.4	10	3.1
6. Diabetic retinopathy	2	2.8	4	4.3	11	2.8	6	1.9
7. Refractive error	1	1.4	10	10.6	158	40.2	245	76.3
8. Other corneal opacity	1	1.4	1	1.1	1	0.3	2	0.6
Total	**72**	**100.0**	**94**	**100.0**	**393**	**100.0**	**321**	**100.0**
A. Treatable (1, 7)	52	72.2	73	77.6	339	86.3	300	93.4
B. Preventable (PHC/PEC services) * (5, 8)	4	5.6	7	7.5	30	7.7	12	3.7
C. Preventable (Ophthalmic services) (2, 6)	4	5.6	8	8.6	16	4.1	7	2.2
D. Avoidable (A+B+C)	60	83.4	88	93.7	385	98.1	319	99.3
E. Posterior segment disease (3, 6)	**10**	**13.9**	**8**	**8.6**	**18**	**4.6**	**8**	2.5

*PHC: Primary Health Care; PEC: Primary Eye Care

Cataract

Crude Prevalence of Cataract by PinVA

The crude unmet need for cataract surgery among people aged 50 years and older was 0.5% for blindness (PinVA<3/60), 1.0% for severe visual impairment (SVI, PinVA <6/60), 3.5% for moderate visual impairment (MVI,PinVA <6/18), and 5.9% for early visual impairment (EVI, PinVA <6/12) (Table 5). Individuals with cataract in one or both eyes would benefit from surgery. No significant differences were observed in the unmet need between men and women at any visual impairment (VI) threshold.

The crude prevalence of bilateral cataract-induced blindness was 0.4%, and unilateral cataract-induced blindness was 5.2%. The prevalence of bilateral SVI was 1.0%, while unilateral SVI was 6.2%. For MVI, bilateral prevalence was 3.5%, and unilateral prevalence was 9.2%. EVI prevalence was 5.9% bilaterally and 11.1% unilaterally (Table 5).

Age- and Sex-Adjusted Prevalence of Cataract by PinVA

The adjusted prevalence of unmet need for cataract surgery was 0.4% for blindness, 0.9% for SVI, 3.2% for MVI, and 5.3% for EVI (Table 5). No significant differences were found between men and women at any VI threshold.

The age- and sex-adjusted prevalence of bilateral cataract-induced blindness was 0.4%, while unilateral cataract-induced blindness was 4.8%. For bilateral SVI, the prevalence was 0.9%, and for unilateral SVI, it was 5.7%. The prevalence of bilateral MVI was 3.2%, and for unilateral MVI, it was 8.5%. For bilateral EVI, the prevalence was 5.3%, and for unilateral EVI, it was 10.3% (Table 5).

It is estimated that 113 people have bilateral blindness, and 1.124 people have bilateral vision impairment worse than <6/18. Additionally, 1,689 people are blind in one eye, 3024 have vision worse than <6/18 in one eye due to cataract, and 3,662 people are affected at the <6/12 threshold. (Table 5).

Table 5. Crude and Adjusted prevalence and extrapolated magnitude prevalence of cataract at surgical thresholds <3/60, <6/60, <6/18 and <6/12

	Female			Male			Total		
	n	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Crude prevalence									
Bilateral									
Blind (PinVA<3/60)	12	0.5	0.2 - 0.7	7	0.4	0.1 - 0.7	19	0.4	0.2 - 0.6
SVI+ (PinVA <6/60)	25	1.0	0.6 - 1.3	19	1.0	0.6 - 1.4	44	1.0	0.7 - 1.3
MVI+ (PinVA <6/18)	88	3.5	2.7 - 4.2	66	3.5	2.7 - 4.3	154	3.5	2.9 - 4.0
EVI+ (PinVA <6/12)	164	6.4	5.5 - 7.4	98	5.2	4.2 - 6.2	262	5.9	5.2 - 6.6
Unilateral									
PinVA <3/60	147	5.8	4.8 - 6.8	84	4.4	3.4 - 5.5	231	5.2	4.5 - 5.9
PinVA <6/60	175	6.9	5.8 - 7.9	101	5.3	4.1 - 6.5	276	6.2	5.4 - 7.0
PinVA <6/18	250	9.8	8.6 - 11.0	160	8.5	7.2 - 9.8	410	9.2	8.4 - 10.1
PinVA <6/12	287	11.3	9.9 - 12.6	207	11.0	9.5 - 12.4	494	11.1	10.2 - 12.1
Adjusted prevalence and extrapolated magnitude									
Bilateral									
PinVA <3/60	78	0.4	0.2 - 0.7	78	0.4	0.1 - 0.7	133	0.4	0.2 - 0.6
PinVA <6/60	162	0.9	0.6 - 1.3	177	1.0	0.6 - 1.4	316	0.9	0.6 - 1.2
PinVA <6/18	573	3.2	2.5 - 4.0	636	3.6	2.8 - 4.4	1124	3.2	2.6 - 3.7
PinVA <6/12	1068	6.1	5.1 - 7.0	992	5.6	4.5 - 6.6	1882	5.3	4.6 - 6.0
Unilateral									
PinVA <3/60	957	5.4	4.4 - 6.4	732	4.1	3.0 - 5.2	1689	4.8	4.0 - 5.5
PinVA <6/60	1142	6.5	5.4 - 7.5	884	5.0	3.7 - 6.2	2026	5.7	4.9 - 6.5
PinVA <6/18	1639	9.3	8.0 - 10.5	1386	7.8	6.5 - 9.1	3024	8.5	7.6 - 9.4
PinVA <6/12	1886	10.7	9.4 - 12.0	1776	9.9	8.5 - 11.4	3662	10.3	9.4 - 11.3

Cataract Surgical Coverage and Effective Cataract Surgical Coverage

Cataract surgical coverage (CSC) measures the proportion of people with cataract and a predefined visual acuity (VA) who have undergone surgery. At 90.1%, the adjusted CSC among people who are blind (PVA <3/60) surpasses the target of 80% recommended by the International Agency for the Prevention of Blindness (IAPB) (19). This indicates that for every 10 people operated on, only one person remains blind from cataract. The CSC in men (89.4%) is similar to that in women (90.6%), with no significant difference between genders (Table 6).

The adjusted CSC for people with a VA of <6/60, <6/18, and <6/12 is 82.0%, 60.2%, and 48.8%, respectively (Table 6). This suggests that cataract surgeries are prioritized for individuals with severe visual impairment (blindness) over those with moderate or mild impairment, reflecting clinical guidelines that emphasize addressing advanced cases first.

Effective cataract surgical coverage (eCSC) combines both the coverage and the outcome of surgery, measuring what proportion of those who underwent surgery for bilateral operable cataract achieved a post-operative VA of 6/12 or better (15). The eCSC among those who are blind (VA of <3/60) is 67.9%. For individuals with a VA of <6/60, <6/18, and <6/12, the eCSC is 61.4%, 42.8%, and 34.1%, respectively. The quality gaps between CSC and eCSC, which reflect the difference between surgical coverage and successful visual outcomes, were 24.7%, 29.0%, and 30.3%, respectively (Table 6).

Table 6. Adjusted cataract surgical coverage (CSC) and effective cataract surgical coverage (eCSC) at the person level

	Female		Male		Total		Relative Quality Gap
	Adj. %	*95% CI*	*Adj. %*	*95% CI*	*Adj. %*	*95% CI*	*%*
Cataract surgical threshold <6/12							
CSC	50.3	45.1 – 55.5	46.9	39.6 - 54.2	48.8	44.5 - 53.2	
eCSC	34.7	29.4 - 40.1	33.1	26.3 - 40.0	34.1	29.8 - 38.3	30.3
Cataract surgical threshold <6/18							
CSC	63.8	57.8 - 69.7	55.6	47.7 - 63.5	60.2	55.0 - 65.4	
eCSC	44.5	37.9 - 51.2	40.5	32.1 - 48.9	42.8	37.1 - 48.4	29
Cataract surgical threshold <6/60							
CSC	83.7	78.6 - 88.8	79.7	72.2 - 87.2	82.0	77.6 - 86.5	
eCSC	61.1	52.9 - 69.3	61.8	51.7 - 71.9	61.4	54.8 - 67.9	25.2
Cataract surgical threshold <3/60							
CSC	90.6	86.1 - 95.1	89.4	82.1 - 96.6	90.1	86.2 - 94.0	
eCSC	66.3	57.8 - 74.8	70.2	59.8 - 80.5	67.9	61.0 - 74.7	24.7

Visual Outcome After Cataract Surgery

In this study, 523 eyes had undergone cataract surgery; 99.4% of eyes had an intraocular lens (IOL) implanted (Table 7). A good visual outcome, as defined by the WHO, was observed in 64.4% (PVA ≥6/12) and 77.8% (PinVA ≥6/12), of eyes with and without pinhole correction, respectively, while a poor outcome was recorded in 10.6% (PVA<6/60) and 7.6% (PinVA <6/60) of eyes (Table 8). The difference between PVA and PinVA outcomes can be minimized by precise biometry, optimal surgical techniques, individually tailored IOLs, and proper optical correction after cataract surgery.

Table 7. Type of cataract surgery performed, count by eyes

Surgery type	Female		Male		Total	
	n	*%*	*n*	*%*	*n*	*%*
IOL	314	99.7	209	99.1	523	99.4
Non-IOL	1	0.3	2	0.9	3	0.6
Couching	0	0.0	0	0.0	0	0.0
No view	0	0.0	0	0.0	0	0.0
Total	315	100.0	211	100.0	526	100.0

Following pinhole correction, the proportion of eyes with good outcomes was 79.7% in women and 74.9% in men, showing comparable results across genders. The number of eyes with poor outcomes was relatively low (5.7% in women and 10.4% in men), making it difficult to draw meaningful comparisons between the sexes (Table 8).

Most patients (94.1%) received surgery in government hospitals, with only a small percentage treated in private or overseas hospitals (5.9%) (Table 9). Visual outcomes appeared slightly better in government hospitals; however, the number of surgeries performed outside this setting was too small to draw any firm conclusions about differences in surgical success across these institutions.

Table 8. Post-operative visual outcome Presenting acuity (PVA) vs pinhole acuity outcomes (PinVA), count by eyes

	Female		Male		Total	
Presenting acuity (PVA)	*n*	%	*n*	%	*n*	%
Good (6/12)	203	64.4	136	64.5	339	64.4
Borderline (<6/12 to 6/60)	85	27.0	46	21.8	131	24.9
Poor (<6/60)	27	8.6	29	13.7	56	10.6
Total	315	100.0	211	100.0	526	100.0
Pinhole acuity (PinVA)						
Good (6/12)	251	79.7	158	74.9	409	77.8
Borderline (<6/12 to 6/60)	46	14.6	31	14.7	77	14.6
Poor (<6/60)	18	5.7	22	10.4	40	7.6
Total	315	100.0	211	100.0	526	100.0

Table 9. Post-operative visual outcomes (PVA) in eyes by place of surgery

Post-surgical VA	Government hospital n (%)	Private/overseas Hospital n (%)
Good (6/12)	320 (64.9%)	19 (54.8%)
Borderline (<6/12 to 6/60)	124 (25.2%)	7 (22.6%)
Poor (<6/60)	49 (9.9%)	7 (22.6%)
Total	493 (94.1%)	33 (5.9%)

Barriers to Cataract Surgery

Among people with bilateral cataract and best-corrected VA <6/60, the most frequently reported barrier to surgery was 'Need not felt' (43.1%), followed by 'Unaware of possible treatment' (15.5%) 'Cannot access treatment' (8.6%) and 'Fear' (6.9 %). Men reported some barriers more frequently than women including 'Need not felt' (56.5% vs 34.3%) and 'Cannot access surgery' (13% vs 5.7%) (Table 10). Women reported 'Unaware of possible treatment' (22.9% vs 4.3%) and 'Fear' (11.4% vs 0%) as barriers more frequently than men.

Table 10. Barriers to cataract surgery among participants with bilateral cataract and PinVA <6/60

Barrier	**Female**		**Male**		**Total**	
	n	%	n	%	n	%
Unaware treatment possible	8	22.9	1	4.3	9	15.5
Surgery denied by provider	0	0.0	1	4.3	1	1.7
Cannot access surgery	2	5.7	3	13.0	5	8.6
Cost	0	0.0	0	0.0	0	0.0
Felt not needed	12	34.3	13	56.5	25	43.1
Fear	4	11.4	0	0.0	4	6.9
Other	9	25.7	5	21.7	14	24.1
Total	35	100.0	23	100.0	58	100.0

* Participants can report 1 or 2 barriers each

Refractive Error

Refractive error, defined as uncorrected visual acuity (UCVA) worse than 6/12, improving to 6/12 with spectacle correction or pinhole, was observed in 10.8% of individuals aged 50 years and older, with the highest prevalence noted in those aged 80 years and older (22.3%). The prevalence was marginally higher in females (11.5%) compared to males (9.8%) (Table 11).

Table 11. Crude prevalence of distance refractive error by age group and gender

Age group	Female			Male			Total		
Years	n	%	95% CI	n	%	95% CI	n	%	95% CI
50-59	57	5.0	3.9 - 6.2	39	4.8	3.2 - 6.4	96	4.9	3.9 - 5.9
60-69	113	14.1	11.3 - 16.8	80	11.7	8.9 - 14.4	193	13.0	11.0 - 14.9
70-79	83	19.4	15.7 - 23.1	48	15.5	11.6 - 19.5	131	17.8	14.8 - 20.7
80+	41	22.2	16.8 - 27.6	18	22.5	13.7 - 31.3	59	22.3	17.6 - 26.9
Total	294	11.5	10.1 - 12.9	185	9.8	8.3 - 11.3	479	10.8	9.7 - 11.9

The age- and sex-adjusted refractive error coverage (REC) for distance vision was 10.1%, while effective refractive error coverage (eREC) was 8.1%. Men had slightly higher REC and eREC rates (10.7% and 8.7%, respectively) compared to women (9.6% and 7.6%), though these differences were not statistically significant. The quality gap between REC and eREC was 19.8%, suggesting that some individuals who require refractive correction may not be achieving optimal visual outcomes (Table 13).

Spectacle use was reported by only 2.4% of participants for distance vision and 18.0% for near vision. Most spectacle users had obtained their glasses within the past five years (Table 12).

Table 12. Distance and near vision spectacle use among study participants

	Female		Male		Total	
	n	%	n	%	n	%
Distance vision spectacles	66	2.6	40	2.1	106	2.4
<2 years	27	40.9	9	22.5	36	34.0
2-5 years	23	34.8	18	45.0	41	38.7
>5 years	16	24.2	13	32.5	29	27.4
Near vision spectacles	465	18.2	339	17.9	804	18.1

Table 13. Adjusted distance effective refractive error coverage (eREC) and refractive error coverage (REC)

	Female		Male		Total		Quality gap
	Adj. %	95% CI	Adj. %	95% CI	Adj. %	95% CI	%
Distance eREC	7.6	4.3 - 10.8	8.7	4.4 - 13.0	8.1	5.1 - 11.1	
Distance REC	9.6	5.9 - 13.2	10.7	5.7 - 15.7	10.1	6.7 - 13.4	19.8

Diabetic Retinopathy (DR)

The study assessed the prevalence of diabetes among participants. A total of 23.9% of participants were identified as having known or suspected diabetes, with 24.8% of women and 22.7% of men (Table 14). Among these individuals, 55.7% were previously diagnosed diabetics, while 44.3% were suspected cases based on random blood glucose readings of 200 mg/dL or higher (Table 14). A substantial proportion (70.0%) of those identified with diabetes (known or suspected) consented to a dilated fundus examination (Table 14).

Table 14. Known or suspected diabetes among participants assessed for diabetes status

Exam status	Female		Male		Total	
	n	%	*n*	%	*n*	%
Known or suspected diabetes	628	24.8	427	22.7	1055	23.9
Known	363	57.8	225	52.7	588	55.7
Suspected*	265	42.2	202	47.3	467	44.3
Consented dilated examination	446	71.0	293	68.6	739	70.0

*No known history of diabetes but random blood glucose 200mg/dl or higher

More than three quarters (76.5%) of the known diabetics (77.1% of women, 75.6% of men) had never undergone a diabetic retinopathy (DR) eye examination (Table 15). Only 17.5% (17.9% of women, 16.9% of men) had been examined within the past year, while 1.4% and 4.6% had been examined 'within 1-2 years' and 'more than two years' respectively (Table 15).

Table 15. Self-reported time since last eye examination for diabetic retinopathy among known diabetics

Last exam	Female		Male		Total	
	n	%	*n*	%	*n*	%
Never	280	77.1	170	75.6	450	76.5
Within 1 year	65	17.9	38	16.9	103	17.5
1-2 years	4	1.1	4	1.8	8	1.4
More than 2 years	14	3.9	13	5.8	27	4.6
Total	363	100.0	225	100.0	588	100.0

The crude prevalence of diabetic retinopathy (36.7%) and maculopathy (24.2%) was assessed among participants who underwent dilated fundus examinations, with the highest grade from either eye recorded. Sight-threatening DR was observed in 11.5% of diabetics examined and Table 16 presents further gradings of retinopathy and maculopathy observed in this survey.

Table 16. Prevalence of retinopathy and maculopathy among (known and suspect) diabetics in the sample

	Female			Male			Total		
	n	%	*95% CI*	*n*	%	*95% CI*	*n*	%	*95% CI*
Any retinopathy	180	40.4	35.2 - 45.5	91	31.1	24.9 - 37.3	271	36.7	32.2 - 41.2
Any maculopathy	120	26.9	22.9 - 30.9	59	20.1	15.1 - 25.1	179	24.2	21.0 - 27.4
Any retinopathy and/or maculopathy	181	40.6	35.3 - 45.8	92	31.4	25.2 - 37.6	273	36.9	32.4 - 41.4
Sight-threatening DR (R4 and/or M2)	60	13.5	10.5 - 16.4	25	8.5	5.0 - 12.0	85	11.5	9.1 - 13.9
Any laser scars	16	3.6	1.8 - 5.4	5	1.7	0.2 - 3.2	21	2.8	1.5 - 4.2

Among the diabetics, 58.5% showed no signs of retinopathy (R0), and this was more prevalent in men (67.6%) than women (52.5%). Mild retinopathy (R1) was observed in 17.3% of participants, and more frequent in women (19.3%) than men (14.3%). Observable retinopathy (R2) affected 9.9% overall, while referable retinopathy (R3) was found in 5.0% of diabetics, and higher in women (6.1%) than men (3.4%). Proliferative retinopathy (R4) was present in 4.5% of participants, with no significant gender differences. For maculopathy, 70.8% of participants exhibited no signs (M0), with men showing a higher prevalence (78.5%) than women (65.7%). Observable maculopathy (M1) was seen in 14.1% of participants, slightly more in women (15.0%) than men (12.6%). Referable maculopathy (M2) was present in 10.1% of diabetics, with a higher incidence in women (11.9%) compared to men (7.5%) (Table 17).

Table 17. Grade of retinopathy and maculopathy among (known and suspect) diabetics in the sample

	Female		Male		Total	
	n	*%*	*n*	*%*	*n*	*%*
Retinopathy						
None (R0)	234	52.5	198	67.6	432	58.5
Mild (R1)	86	19.3	42	14.3	128	17.3
Observable (R2)	42	9.4	31	10.6	73	9.9
Referable (R3)	27	6.1	10	3.4	37	5.0
Proliferative (R4)	25	5.6	8	2.7	33	4.5
Not visualised (R6)	31	7.0	4	1.4	35	4.7
Maculopathy						
None (M0)	293	65.7	230	78.5	523	70.8
Observable (M1)	67	15.0	37	12.6	104	14.1
Referable (M2)	53	11.9	22	7.5	75	10.1
Not visualised (M6)	32	7.2	4	1.4	36	4.9

* Graded using the Scottish Diabetic Retinopathy Grading Scheme

Discussion

This study presents the first comprehensive national assessment of the prevalence and causes of visual impairment (VI), blindness, cataract surgery outcomes, and diabetic retinopathy (DR) in Samoa, using the latest iteration of the RAAB survey methodology (RAAB7). The findings provide critical insights into the current state of eye health among individuals aged 50 years and older in Samoa and highlight significant challenges and opportunities for public health intervention.

Prevalence and Causes of Vision Impairment

The age- and sex-adjusted prevalence of blindness in Samoa is estimated at 1.5% (95% CI: 1.1%–1.8%), which aligns closely with other Pacific nations, such as Vanuatu (1.7%) (20) but is significantly lower than Papua New Guinea's (5.6%) (21) and Fiji (2.6%) (22). This suggests that while Samoa shares the regional burden of visual impairment, its rates are comparatively lower, possibly reflecting better accessibility to eye care services. The high prevalence of moderate-to-severe visual impairment (MSVI) at 10.1%, however, reflects a substantial impact on quality of life and productivity, underscoring an ongoing need for enhanced intervention to address age-related vision loss (23).

Cataract is the leading cause of blindness in Samoa, responsible for 70.8% of cases. This finding is consistent with global patterns in low- and middle-income countries where cataract remains a primary cause of blindness due to limited surgical intervention access (24). The high prevalence of blindness caused by cataract highlights a pressing need to expand access to cataract surgery, and outreach programs which can largely prevent cataract-induced vision loss (25).

Cataract Surgical Coverage and Outcomes

The Cataract Surgical Coverage (CSC) for individuals with blindness (PVA <3/60) was notably high at 90.1%, significantly exceeding the average reported for the Western Pacific region (43.1%) and surpassing the WHO's target of 80% (26, 27). This achievement indicates that a substantial proportion of individuals needing cataract surgery are receiving it, reflecting the relative accessibility of surgical services in Samoa. As visual acuity thresholds decrease, the CSC drops to 82.0%, 60.2%, and 48.9% for <6/60, <6/18, and <6/12, respectively, indicating that those with mild impairments are less likely to receive surgery, resulting in a backlog of people with visual impairment due to cataracts.

The effective cataract surgical coverage (eCSC) in Samoa, which assesses both coverage and successful post-surgical outcomes was 67.9% for PVA <3/60, with a quality gap of 24.7%. This is comparable to other low- and middle-income countries, underscoring a need for improvements in surgical techniques, post-operative care and equipment (27). These findings suggest a regional need for resources, training and personnel to improve cataract surgery coverage and outcomes across Pacific Island nations.

Barriers to Cataract Surgery

The most frequently reported barrier to cataract surgery in Samoa was the lack of perceived need, unaware of possible treatment, access issues and fear. These findings are consistent with those reported in other Pacific islands' studies (21, 28, 29), where similar barriers, including lack of perceived need, lack of awareness about possible treatment and access, prevent individuals from accessing cataract surgery. In Samoa, a "need not felt" perception was also prominent, especially among men and 'fear' was predominantly reported in women.

Refractive Error Coverage

Refractive error was the leading cause of early visual impairment (76.2%) in Samoa, with an adjusted prevalence rate of 10.8%, echoing findings from PNG (12.3%) and Vanuatu (7.1%) where uncorrected refractive errors are similarly prominent (20, 21). The effective refractive error coverage (eREC) rate of 8.1% and 2.4% spectacle use in Samoa points to a regional issue of unmet refractive needs, as many LMICs report low refractive error correction coverage (30) and underuse of spectacles (31). Addressing this gap will require expanding affordable refractive services, ensuring that spectacles are available, and promoting awareness and routine vision screening for older adults.

Diabetic Retinopathy (DR)

The prevalence of diabetic retinopathy (DR) in Samoa underscores a significant public health challenge, with 24% of the surveyed population diagnosed with diabetes, among whom 36.8% exhibit some form of DR, including 11.5% with sight-threatening diabetic retinopathy (STDR). Despite these numbers, a significant proportion of the diabetic population—76.5%—has yet to receive any form of screening or treatment for DR, reflecting a substantial gap in preventive care. This trend mirrors conditions in other Pacific Island nations with high diabetes prevalence, coupled with limited healthcare resources and awareness, increases the risk of undiagnosed and untreated DR (32). The prevalence of DR, particularly sight-threatening DR, emphasizes the need for more robust screening and management services. In Samoa, the lack of DR screening programs is a significant challenge, with many individuals either unaware of their condition or unable to access timely care. The limited availability of trained ophthalmologists and screening facilities across these regions highlights a systemic issue, where DR is often diagnosed at advanced stages, contributing to higher rates of preventable blindness (33). These findings emphasize the critical need for targeted policy interventions to improve DR screening accessibility and advocate for the incorporation of DR assessments into routine diabetes care. Such measures could meaningfully reduce the burden of DR-related vision loss in Samoa and other resource-limited regions across the Pacific.

Limitations

While this RAAB study provides valuable insights, it has limitations that should be considered. The cross-sectional design limits causal inferences, and the focus on individuals aged 50 and older may not capture the full spectrum of eye health issues in Samoa.

Conclusions

The RAAB survey in Samoa reveals that much of blindness and visual impairment in Samoa is avoidable, with cataract, refractive error, and diabetic retinopathy emerging as key priorities for intervention. Although Samoa has made significant progress in expanding service coverage for individuals who are blind or have severe visual impairments, it is essential to assess and enhance the visual outcomes. By addressing these eye health issues through targeted, evidence-based strategies, Samoa can make significant strides towards reducing the burden of vision impairment and improving the quality of life for its population.

Future research should focus on evaluating the effectiveness of interventions, exploring barriers to eye care utilization, and assessing the economic impact of vision impairment in the Samoan context. Regular follow-up surveys will be essential to monitor progress and guide ongoing policy and programmatic decisions in eye health.

Recommendations

- **Improve Cataract Surgery Outcomes and Accessibilit**y: Conduct regular audits of cataract surgery outcomes and increase access to surgical facilities in rural communities.
- **Expand Refractive Error Services**: Strengthen the provision of refractive error services into primary health settings. by making affordable corrective lenses widely available and accessible.
- **Integrate Diabetic Retinopathy (DR) Screening and Management**: Integrate systematic DR screening into the existing PEN-Fa'asamoa Initiative (9, 10). Strengthen treatment protocols within diabetes management programs to prevent severe vision loss among diabetic patients.
- **Public Awareness and Education:** Conduct public health campaigns to raise awareness about the importance of regular eye examinations, especially for those with diabetes and older adults. Informing the public about available services and preventive measures can improve the uptake of eye care services.
- **Strengthen Health Systems for Eye Care:** Build health system capacity by improving infrastructure, human resources, and supply chains for eye care services. Integrating eye health into national health plans and budgets will ensure sustainable funding and long-term support for eye care initiatives.
- **Policy and Advocacy:** Advocate for eye health as a national priority within health policies and budgets, with dedicated funding for comprehensive eye care programs. Emphasizing the economic and social benefits of investing in eye health can help garner support from policymakers and international donors.

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Appendix 1 Samoa RAAB 2024: Key Findings at a Glance

Rapid Assessment of Avoidable Blindness in Samoa

April – July 2024

MINISTRY OF HEALTH

The Fred Hollows Foundation NZ

What did we do?

The Rapid Assessment of Avoidable Blindness (RAAB) is a simple survey method used to find out how many people have vision problems, why they have them, and if they are getting the help they need.

The 2024 Samoa RAAB survey checked vision and diabetes in older adults across all the districts of the country.

How did we do it?

We made a list of all the villages and neighbourhoods across the 51 districts of Samoa with help from the Samoa Bureau of Statistics. We randomly picked 132 neighbourhoods and villages, and in each we then randomly picked 35 people who were 50 years old or older. We only chose older adults because most vision problems happen in this age group.

We ended up visiting close to 4,500 people all over the country and we looked at their eyes and we asked them questions about their eye health. We also checked if they had diabetes and if it affected their eyes. We had up to five teams to do this survey, and each team had one eye health specialist and at least one eye health nurse.

What did we learn?

Prevalence of Vision Impairment
One in 10 older people in Samoa has serious vision problems that could be prevented.

Avoidable blindness
Eight in 10 cases of blindness in older people could be avoided with access to proper treatment.

Cataracts as the Leading Cause
Cataracts are the main cause of blindness and severe vision problems in Samoa.

Uncorrected Refractive Errors
Not wearing the right glasses is the main reason for less severe vision problems in Samoa.

Cataract Surgical Coverage (CSC)
Samoa has a high coverage rate for cataract blindness, with 9 out of 10 people blinded by the condition having received surgery.

Visual Outcomes After Cataract Surgery
The majority of patients in Samoa achieve good vision after cataract surgery, with only a minority experiencing limited improvement.

Barriers to Cataract Surgery
The most common barriers to cataract surgery include lack of perceived need, unaware that treatment was possible, limited access to services, and fear. Targeted awareness campaigns can help address these barriers and encourage more people to seek treatment.

Effective Cataract Surgical Coverage (eCSC)
While Samoa has very good cataract surgery results, improving the quality of surgery can help more people achieve better vision.

Distance Refractive Error Coverage (REC)
One in ten older people in Samoa need glasses to see in the distance.

Effective Refractive Error Coverage (eREC)
Fewer than one in 10 older people who need glasses to see in the distance are getting the right glasses that work for them.

Use of reading glasses
Just one in five older people in Samoa who need reading glasses have them.

Prevalence of Diabetes and Diabetic Retinopathy (DR)
More than one in five older people in the survey had suspected or known diabetes. Around four in 10 people who had diabetes also had eye problems caused by the disease.

DR Screening
Nearly eight in 10 older adults with diabetes had never had their eyes checked before, highlighting the need to strengthen eye health services.

What can we do about it?

Improve Cataract Surgery Access and Outcomes
Increase surgical services in rural facilities and initiate regular audits of surgery outcomes.

Expand Refractive Error Services:
Ensure improved access, affordable corrective lenses and train more health care providers to manage refractive errors.

Implement Systematic DR Screening
Integrate regular DR screenings into diabetes care to detect and treat early-stage DR, with a focus on patient education.

Increase Public Awareness
Launch campaigns to promote routine eye exams and educate on available eye care services.

Strengthen Eye Health Infrastructure
Build capacity in eye care through improved infrastructure, trained personnel, and stable supply chains.

Promote Policy Support
Advocate for prioritizing eye health in national policies to secure sustainable funding and international support.

Appendix 2 Randomly selected clusters included in the RAAB survey

Code	Name	District	Population	Island	Replacement cluster
1	Vaitele Fou	Faleata 3	4657	Upolu	
2	Aleisa Sasa'e	Sagaga 3	3810	Upolu	
3	Faleasiu	Aleisa East	4431	Upolu	
4	Fasito'o Uta	A'ana Alofi 1	2214	Upolu	
5	Vaimoso	Faleata 1	2580	Upolu	
6	Siusega	Faleata 2,	3567	Upolu	
7	Vaitele Uta	Faleata 3	2771	Upolu	
8	Fale'ula	Sagaga 1	3278	Upolu	
9	Nu'u	Sagaga 1	2399	Upolu	
10	Malie	Sagaga 2	2623	Upolu	
11	Vailele Tai	Vaimauga 1	2164	Upolu	
12	Leulumoega	A'ana Alofi 3	1298	Upolu	
13	Nofoali'i	A'ana Alofi 3	2210	Upolu	
14	Faleatiu	A'ana Alofi 4	644	Upolu	
15	Fasito'o Tai	A'ana Alofi 4	1655	Upolu	
16	Satapuala (incl. Sina)	A'ana Alofi 4	2100	Upolu	
17	Vailuutai	A'ana Alofi 4	953	Upolu	
18	Faleu	Aiga-i-le-Tai	247	Manono-Tai	
19	Lalovi	Aiga-i-le-Tai	528	Upolu	
20	Manono Uta	Aiga-i-le-Tai	1526	Upolu	
21	Satuimalufilufi	Aiga-i-le-Tai	726	Upolu	
22	Neiafu Uta	Alataua i Sisifo	659	Savaii	
23	Mutiatele	Aleipata Itupa-i-Lalo	394	Upolu	
24	Satitoa	Aleipata Itupa-i-Lalo	715	Upolu	
25	Ti'avea	Aleipata Itupa-i-Lalo,	976	Upolu	
26	Vailoa	Aleipata Itupa-i-Luga	425	Upolu	
27	Falefa	Anoama'a 1	1707	Upolu	
28	Falevao	Anoama'a 1	733	Upolu	
29	Manunu	Anoama'a 1	286	Upolu	
30	Luatuanu'u	Anoama'a 2	936	Upolu	
31	Saolufata	Anoama'a 2	910	Upolu	

32	Solosolo	Anoama'a 2	1835	Upolu	
33	Fataloa	Fa'asaleleaga 1	429	Upolu	
34	Sapulu	Fa'asaleleaga 1	1352	Savaii	
35	Lalomalava	Fa'asaleleaga 2	465	Savaii	
36	Salelavalu Uta	Fa'asaleleaga 2	660	Savaii	
37	Vaifou	Fa'asaleleaga 2	308	Savaii	
38	Sapapali'i	Fa'asaleleaga 3	986	Savaii	
39	Vaimaga	Fa'asaleleaga 3	384	Savaii	
40	Sa'asa'ai	Fa'asaleleaga 4	622	Savaii	
41	Siufaga	Fa'asaleleaga 4	680	Savaii	
42	Pu'apu'a	Fa'asaleleaga 5	613	Savaii	
43	Poutasi	Falealili 1	457	Upolu	
44	Satalo	Falealili 1	338	Upolu	
45	Salesatele	Falealili 2	324	Upolu	
46	Falealupo,	Falealupo	539	Savaii	
47	Alafua	Faleata 1	1455	Upolu	
48	Lotopa	Faleata 1	1474	Upolu	
49	Moamoa	Faleata 1	1442	Upolu	
50	Moamoa Fou	Faleata 1	1303	Upolu	
51	Sinamoga	Faleata 1	1346	Upolu	
52	Tuanimato Sasa'e (Tuanimato East)	Faleata 1	525	Upolu	
53	Falelauniu	Faleata 2	396	Upolu	**Lepea**
54	Tanumapua	Faleata 2	552	Upolu	
55	Vaigaga	Faleata 2	696	Upolu	
56	Vailoa	Faleata 2	1523	Upolu	
57	Vaiusu	Faleata 2	2596	Upolu	
58	Vaitele Tai	Faleata 3	796	Upolu	
59	Puipa'a	Faleata 4	1417	Upolu	
60	Toamua	Faleata 4	2401	Upolu	
61	Samatau,Falevai	Falelatai	218	Upolu	
62	Samatau,Samatau	Falelatai	1181	Upolu	
63	Samatau,Siufaga	Falelatai	695	Upolu	
64	Samalae'ulu	Gaga'emauga 1	1006	Savaii	
65	Fagamalo	Gaga'emauga 2	389	Savaii	
66	Safotu	Gaga'ifomauga 1	1301	Savaii	

67	Leagiagi	Gaga'ifomauga 2	171	Savaii	
68	Aopo	Gaga'ifomauga 3	416	Savaii	
69	Falease'ela,Falese'ela	Lefaga	930	Upolu	
70	Falease'ela,Matautu	Lefaga	941	Upolu	
71	Falease'ela,Savaia	Lefaga	455	Upolu	
72	Lealatele	Lepa	547	Upolu	
73	Lotofaga	Lotofaga	1097	Upolu	
74	Foailalo	Palauli 1	391	Savaii	
75	Salailua	Palauli 1	908	Savaii	
76	Taga	Palauli 1	808	Savaii	
77	Papa	Palauli 2	364	Savaii	
78	Vaiala	Palauli 2	175	Savaii	
79	Vailoa	Palauli 3	605	Savaii	
80	Sa'anapu Tai	Safata 1	122	Upolu	
81	Salamumu Uta	Safata 1	376	Upolu	
82	Sataoa Uta	Safata 1	1362	Upolu	
83	Mulivai	Safata 2	399	Upolu	
84	Vaie'e	Safata 2	636	Upolu	
85	Tafaigata	Sagaga 1	1628	Upolu	
86	Afega	Sagaga 2	2332	Upolu	
87	Tuana'i	Sagaga 2	1573	Upolu	
88	Le'auva'a	Sagaga 3	999	Upolu	
89	Levi	Sagaga 4	1133	Upolu	
90	Lotosoa	Sagaga 4	853	Upolu	
91	Salepouae	Sagaga 4	726	Upolu	
92	Tufulele	Sagaga 4	1458	Upolu	
93	Fogatuli	Salega 1	236	Savaii	
94	Fogasavai'i	Salega 2	336	Savaii	
95	Moasula	Satupa'itea	491	Savaii	
96	Maninoa	Si'umu	445	Upolu	
97	Siumu	Si'umu	1364	Upolu	
98	Sauano	Va'a-o-Fonoti	256	Upolu	
99	Fagali'i	Vaimauga 1	1670	Upolu	
100	Lauli'i	Vaimauga 1	2217	Upolu	
101	Letogo	Vaimauga 1	1565	Upolu	

102	Vailele Uta	Vaimauga 1	1120	Upolu	
103	Moata'a Uta	Vaimauga 2	232	Upolu	
104	Vaiala Tai	Vaimauga 2	560	Upolu	
105	Vaivase Tai	Vaimauga 2	824	Upolu	
106	Avele	Vaimauga 3	407	Upolu	
107	Leone	Vaimauga 3	626	Upolu	
108	Magiagi Tai	Vaimauga 3	1822	Upolu	
109	Magiagi Uta	Vaimauga 3	351	Upolu	
110	Nafanua	Vaimauga 3	344	Upolu	
111	Tanugamanono	Vaimauga 3	810	Upolu	
112	Vaoala	Vaimauga 3	1008	Upolu	
113	Alamagoto	Vaimauga 4	922	Upolu	
114	Lalovaea Sasa'e (Lalovaea East)	Vaimauga 4	471	Upolu	
115	Palisi	Vaimauga 4	1004	Upolu	
116	Togafuafua	Vaimauga 4	261	Upolu	
117	Matavai	Vaisigano 1	1140	Savaii	
118	Vaisala	Vaisigano 1	479	Savaii	
119	Sataua	Vaisigano 2	858	Savaii	

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