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**Impact of vision loss on health-related quality of life in Trinidad and Tobago**

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**Conflict of interest**

Henry Bailey is a member of the EuroQol research group. The work included in this article formed part of Tasanee Braithwaite’s thesis, submitted for the degree of Doctor of Medicine to the University of Oxford. The authors report no conflicts of interest.

**Keywords**

Utility, blindness, vision impairment, presbyopia, health-related quality of life, Trinidad and Tobago

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This article contains additional online-only material. The following should appear online only: eComponent Supplementary Table 1

eComponent Supplementary Figure 2

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**Abstract**

**Purpose:** To determine whether distance vision impairment (VI)(LogMAR >0.30), or near VI (NVI) (LogMAR 0.32 to 1.30 at 40cm with <0.30 at 3m) independently predict health-related quality of life (HRQoL) in a high-income Caribbean country, and to estimate societal impact.

**Design:** The National Eye Survey of Trinidad and Tobago was a population-based, cross-sectional eye survey using multi-stage, cluster random sampling with probability-proportionate-to-size methods.

**Participants:** Adults aged > 40 years.

**Methods:** Responders rated general health level in the five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) of the EQ-5D 5-level instrument. Multivariable regression analysis with robust standard error estimation explored the relationship between utility score and presenting vision, with adjustment for significant variables.

**Main Outcome Measures:** Utility value and Quality Adjusted Life Year (QALY) loss.

**Results:** 62.4% (2658/4263) adults completed the EQ-5D-5L. Mean age was 58.4 (SD 11.8, range 40 to 103) years and 56.3% were female. Blindness had the largest independent effect on utility coefficient of any variable in the multivariable model, at -0.140 (95% CI -0.092 to -0.192). Near VI was also independently associated with utility loss of -0.012 (95% CI -0.004 to -0.021). Other independent predictors included female sex, older age, taking prescription medications, illiteracy, and co-morbidities including previous stroke, chronic renal impairment, depression and arthritis. A hypothetical person, experiencing onset of constant vision loss in their better-seeing eye at 40 years, would be expected to accrue lifetime loss of 0.45 QALYs for near VI, 0.72 QALYs for mild VI, 1.64 QALYs for moderate VI, 3.30 QALYs for severe VI and 5.13 QALYs for blindness. VI caused an estimated 762.3 QALY loss per 100,000 population per year, of which 36.5% was attributable to near VI, exceeding the equivalent rate of QALY loss from stroke (307 QALYs), depression (284 QALYs), and arthritis (522 QALYs). 91% (694.9/762.3) of the VI-related QALY loss was potentially avoidable.

**Conclusions:** This is the first population-based survey to identify that both distance and near VI independently reduce HRQoL. The estimated QALY loss highlights the importance of VI relative to other conditions, and the societal value of continued investment to address avoidable causes.

Estimating quality adjusted life years (QALYs) lost to vision impairment (VI), and the cost-effectiveness of alternative interventions, requires reliable measurement of health-related quality of life (HRQoL). The association between VI and utility loss remains uncertain, with estimates for blindness ranging from zero to -0.20 in the literature.[1](#_ENREF_1) Two population-based surveys, in Singapore, and South Korea, report independent association between severe distance VI and utility loss. The impact of mild VI and near VI (NVI), resulting from presbyopia, on HRQoL is unclear. Here we report novel findings from adult participants aged >40 years in the National Eye Survey of Trinidad and Tobago (NESTT).

## METHODS

The NESTT (2013-2014) is the most comprehensive population-based eye survey conducted within the Caribbean for decades. Details are provided elsewhere.[2](#_ENREF_2) Briefly, we sampled 9913 eligible people aged >5 years, including 4263 aged >40 years, residing in 3556 households (95.9% coverage) in 120 clusters, using multi-stage, random cluster sampling with probability-proportional-to-size methods. We measured presenting uniocular distance and binocular near visual acuity outside households, using Logarithm of the mimimum angle of resolution (LogMAR) acuity charts (Precision Vision) at 3m and 40cm, respectively, and a standardized protocol. Vision categories included mild VI (LogMAR 0.32 to 0.48), moderate VI (LogMAR 0.50 to 1.00), severe VI (LogMAR 1.02 to 1.30), blindness (LogMAR >1.32), and NVI (LogMAR 0.32 to 1.30 at 40cm with <0.30 at 3m). We defined avoidable VI to include that caused by uncorrected refractive error, age-related cataract, diabetic retinopathy and glaucoma.

All participants >40 years were invited for clinic-based assessment, including EQ-5D-5L.[3](#_ENREF_3) EQ-5D-5L contains questions on mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each question asks the participant to indicate whether they have no (score 1), slight (score 2), moderate (score 3), severe (score 4) or extreme (score 5) effects or problems. These answers result in 3125 (55) possible health states ranging from 11111 (best health) to 55555 (worst health). We transformed composite raw health states into utility values using a Trinidad and Tobago value set and scoring algorithm for EQ-5D-3L, by “cross-walking”, following a standard approach.[4](#_ENREF_4) In addition, participants selected a number on the visual analogue scale (EQ-VAS), ranging from 0 to 100 (worst to best imaginable heath state).

We obtained ethics committee approvals from the University of the West Indies (Trinidad), Anglia Ruskin University (UK), and Ministry of Health (Trinidad and Tobago). The study adhered to the tenets of the Declaration of Helsinki.

**Statistical analysis**

We performed analyses using standard statistical software (StataCorp. 2013. Release 13.1). We adjusted crude data for multilevel sampling (island, cluster), and weighted for selection probability and cluster response rate. A post-stratification adjustment used Census data (15 municipalities, gender and 5-year age categories). We applied finite population corrections to first and second sampling stages.[2](#_ENREF_2) We applied VI prevalence to the 2014 mid-year population to estimate cases.

We estimated utility coefficients and EQ-VAS scores using single variable ordinary least squares (OLS) regression analysis, with robust standard error estimation (RSE).[5](#_ENREF_5) We explored the odds of less than full health, and of experiencing difficulty (score >2) in each domain, by vision category, using single and multivariable multi-level mixed effects logistic regression analysis. We determined the most parsimonious multivariable model by initially exploring 32 variables previously reported to predict HRQoL or VI or considered potentially relevant. We dropped variables in which significant data were missing for VI people. We then removed variables which were not significant in single variable analysis, followed by variables which were significant in SVA but not in MVA, taking a stepwise approach, and selecting the model with the smaller value of Akaike’s and Schwarz’s Bayesian information criterion. We used the classical likelihood ratio test to obtain p values following logistic regression, and Wald p values following linear regression, setting significance at 5%.

We estimated prevalent QALY loss by multiplying cases by utility coefficients. To illustrate individual lifetime QALY loss, we assumed that VI persisted from age 40 years to death 36.1 years later, applying no discount.

In sensitivity analysis we explored the effect on utility coefficients of: Alternative analysis approaches (with adjustment for age and sex); a UK population EQ-5D-5L value set, and; binocular vision category definitions.

## RESULTS

3589(84.2%) participated in vision screening and 62.4%(2658/4263) completed EQ-5D-5L. Mean age was 58.4 years(SD 11.7, range 40-103 years), 56.3%(n=1496) were women, and the majority were African (45.4%, n=1177) or South Asian (41.4%, n=1074) ethnicity. Full health (utility value 1.000) was reported by 52.8%(95%CI 50.6-54.9). The adjusted mean utility was 0.920(95%CI 0.916-0.925), and the adjusted mean EQ-VAS was 80.2(95%CI 79.6-80.8).

Blindness had the largest independent effect on EQ-VAS score and utility value of any variable explored (Figure 1). Utility coefficients ranged from -0.140(95%CI -0.092 to -0.192) for blindness, -0.091(95%CI -0.031 to -0.151) for severe VI, -0.045 (95%CI -0.024 to -0.067) for moderate VI, and -0.020(95%CI -0.004 to 0.013) for mild VI, to -0.012(95%CI -0.004 to -0.021) for NVI. The reduction in EQ-VAS score independently predicted by vision category ranged from -7.8(95%CI -0.2 to -15.3) for blindness, to -2.5(95%CI 0.7 to -5.7) for mild VI, and -1.6 (95%CI -0.2 to -3.0) for NVI (Figure 2, available at [http://aaojournal.org](http://aaojournal.org/)).

The odds of reporting less than full health were 11 times greater for blindness (OR 11.14, 95%CI 1.39-89.42), and 1.3 times greater for NVI (OR 1.32, 95%CI 1.04-1.67)(p=0.004), than normal vision. Other independent predictors are detailed in Table 1 (available at [http://aaojournal.org](http://aaojournal.org/)).

NVI significantly increased the odds of reporting some difficulty in mobility (OR 1.84, 95%CI 1.35-2.50, p<0.001), self-care (OR 2.24, 95%CI 1.33 to 3.76, p=0.002), and usual activities (OR 1.89, 95%CI 1.29-2.77, p=0.001). Distance VI significantly increased the odds of reporting some difficulty in all domains.

One 40-year-old would experience a lifetime loss of 0.45 QALYs for NVI, 0.72 QALYs for mild VI, 1.64 QALYs for moderate VI, 3.30 QALYs for severe VI and 5.13 QALYs for blindness. We estimate 4,131 lost QALYs from VI in 2014, including 1502 QALYs (36.4%) for NVI, 621 QALYs (15.0%) for mild VI, 1446 QALYs (35.0%) for moderate and severe VI, and 562 QALYs (13.6%) for blindness. This is equivalent to 762.3 QALYs per 100,000 people per year, 694.9 of which were potentially avoidable.2 This exceeded the equivalent rate of QALY loss from stroke (307 QALYs), depression (284 QALYs), and arthritis (522 QALYs).

### Sensitivity analysis

Blindness disutility coefficients were similar for OLS with RSE estimation (0.138), Tobit (0.135), robust linear regression with M-estimator and Tukey biweight function (0.110) and CLAD (0.090) analyses. Utility coefficients using the UK value set demonstrated close agreement, for example, of -0.011(95% CI -0.003 to -0.019) for NVI, and -0.159 (95% CI -0.098 to -0.220) for blindness. Uniocular blindness was associated with significant utility loss, ranging from -0.019(95%CI -0.002 to 0.037, p=0.029) to -0.101 (95%CI -0.060 to 0.138, p<0.001) when the other eye had normal vision, or moderate or severe VI, respectively.

Uncertainty in the 95% CI for total VI cases resulted in a range of 3504 to 4743 QALYs lost. Uncertainty in the 95% CI of the utility coefficients by vision category resulted in a range of 1655 to 6608 QALYs lost.

## DISCUSSION

This national survey is the first to report that both distance VI and NVI independently predict HRQoL loss. One fifth of adults > 40 years (120,842 people) have NVI, accounting for a third of all QALYs lost to VI in Trinidad and Tobago. The QALY loss estimated here was similar to that reported by the Singapore Malay Epidemiology of Eye Disease Survey,[6](#_ENREF_6) but further research is needed to explore whether VI-associated utility decrements are replicated in other high-income countries. This study highlights the societal impact of NVI, and importance of continued investment to address avoidable VI.

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**Figure legends**

Figure 1: Utility coefficients (with 95% confidence intervals) from the multilevel multivariable model showing the independent effect of vision impairment category

Supplementary Figure 2: EQ-VAS coefficients (with 95% confidence intervals) from the multilevel multivariable model showing the independent effect of vision impairment category