Eye care utilization among diabetics in the South African National Health and Nutrition Examination Survey (SANHANES-1): a cross-sectional study

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Abstract
Objective: Diabetes is a chronic disease of uncontrolled blood sugar levels. People with diabetes are at an increased risk of developing visual impairment and other diabetes-related visual complications. The study aims to determine the eyecare utilization pattern and its associated determinants among diabetics in the South African National Health and Nutrition Examination Survey (SANHANES-1).

Results: The mean age of participants was 56.2 years and 66.6% were females. The prevalence of eyecare utilization among participants was 49.0% and this differed significantly by age groups (p = 0.024) and the number of years since diabetes diagnosis (p < 0.001). After statistical adjustments, older age (55–64 years OR = 4.18, p = 0.003 and ≥ 65 years OR = 4.78, p = 0.002), having health insurance (OR = 6.32, p = 0.002), and having had diabetes for 6–10 years (OR = 4.23, p = 0.005) were significantly associated with eye care utilization. About half of people diagnosed with diabetes in South Africa have had an eye examination since diabetes diagnosis, which is disturbingly low given the impact of diabetes complications on eye health. Government policies must be directed at ensuring access to affordable health insurance and eye health education on diabetes.

Keywords: Eye care utilization, Diabetes, Population-based, South Africa, Sociodemographic characteristics, High-risk, Barriers, Disparities, Eye Care Services

Introduction
Globally, diabetes and its complications are major public health problems [1], with an increasing burden of blindness and vision loss [2], as well as potential financial loss to individuals and nations [3]. People with diabetes have higher risks of developing cataracts, glaucoma, dry eyes and retinopathy [4–6] in comparison to the general population.

The South African National Health and Nutrition Examination Survey (SANHANES-1) was established as a nationally representative population health survey to address epidemiological transition and the changing health needs of South Africans [7]. The survey found that the prevalence of inpatient and outpatient health care utilization was 20.1% and 27% respectively, and further reported chronic conditions (including diabetes) as reasons for the utilization of the health care services [7]. Considering the adverse effects of diabetes on the eye, people with diabetes have a greater need for ophthalmic care and are expected to utilize eyecare services more frequently than the general population. These bring to
fore the need to investigate the pattern of eye care utilization in this populace.

The purpose of this study therefore was: (1) to determine the eye care utilization patterns among people with diabetes in South Africa using data from SANHANES-1; and (2) to identify factors that influence the utilization of eye care services (i.e., sociodemographic or health-related factors correlates to eye care utilization). Secondary data analyses from this nationally representative study will contribute immensely to stakeholder policies on diabetic care and in general, eye care services and its delivery.

Main text
Participants and methods
Data and sample
This population-based (cross-sectional) study used data on self-reporting diabetic participants from the SANHANES-1 (a national survey conducted in 2011–2012). The survey used multi-stage disproportionate, stratified cluster sampling to select households within enumeration areas (EAs) stratified by province and locality types, where 10,000 occupied households were selected. Within the occupied households, 27,580 individuals of all ages were eligible to be interviewed and agreed to participate in the study. However, only 25,532 (92.6%) completed the interview. Of the latter number, 12,025 (43.6%) individuals volunteered to undergo a medical examination of which 7,455 were aged 15 years or older. A detailed description of the SANHANES-1 methodology has been previously reported [7].

Analyses were conducted on individuals aged ≥15 years who reported having been diagnosed with diabetes and who underwent the medical examination, where a clinician assessed their vision and measured their BMI and blood pressure. To investigate the association of all the predisposing, enabling and need factors on having had an eye examination, the analytic sample was based on individuals who had non-missing responses to all the independent variables.

Measures
Eye care utilization was assessed from participants’ responses to the following question: “Since you were diagnosed with diabetes, have you ever had your eyes examined? This is an examination during which your pupils are usually dilated. It can make you temporarily sensitive to bright light.” The individual factors associated with having an eye examination were investigated using Andersen’s Behavioural Model [8]. According to this model, variables were categorized into predisposing, enabling, and need factors.

Data analysis
Data were analysed in Stata 15.0. (StataCorp, Texas, USA 2016). The analyses applied sample weights to adjust for unequal probabilities of selection and nonresponse. The prevalence of having had an eye examination/s since diabetes diagnosis was presented by categories of the independent variables and difference between categories of a variable were tested using Chi square tests. Three multiple logistic regression models were used to investigate the predisposing, enabling and need factors associated with the outcome; having ever had an eye examination since being diagnosed with diabetes. Andersen’s model was applied in the multiple logistic regression models, where the predisposing, enabling and need factors were added sequentially. Model 1 included only the predisposing factors, Model 2, the predisposing and enabling factors and Model 3 included the predisposing, enabling and need factors.

Results
Description of the sample
Table 1 shows the demographic and lifestyle characteristics of the analytic sample (i.e. diabetics who underwent the physical examination including vision loss assessment with available data on all factors).

Eye care utilization among people with diabetes
Overall, 49.0% of people with diabetes reported having ever had an eye examination since their diabetes diagnosis (Table 2). The prevalence of having an eye examination since diagnosis differed significantly by age groups (p = 0.024) and the number of years since diabetes diagnosis (p < 0.001). It was significantly higher among those with health insurance than those without (72.0% versus 43.8%, p = 0.003) and among those with hypertension than without (53.7% versus 36.6%, p = 0.034).

Factors associated with eye care utilization among people with diabetes
Model 1, with predisposing factors (Akaike’s information Criteria (AIC): 750482.6, Prob > F = 0.112), showed that older age (55-64 years, odds ratio (OR) = 3.77, p = 0.007 and ≥65 years OR = 3.68 p = 0.011 compared with 15-44 years) was significantly associated with having had an eye examination (Table 3).

In Model 2 (AIC: 692682.6, Prob > F = 0.001), which included predisposing and enabling factors, the associations with older age were similar to that of Model 1. White or Indian ethnicity (OR = 0.29, p = 0.046 compared
with African ethnicity) and being overweight (OR = 0.40, p = 0.041 compared with normal-weight or underweight) were associated with significantly reduced odds of having had an eye examination. Having health insurance (OR = 6.98, p < 0.001) was significantly associated with increased odds of having had an eye examination.
Table 2 (continued)

| Had an eye examination since diabetes diagnosis | %  | 95% CI | n  | p value |
|-----------------------------------------------|----|--------|----|---------|
| Yes                                           | 59.1 | [46.4–70.7] | 97 |         |
| Self-reported vision problems                  |     |        |    |         |
| No                                            | 47.4 | [37.2–57.8] | 184 | .0628   |
| Yes                                           | 51.2 | [40.2–62.1] | 141 |         |
| Diabetic medication use                        |     |        |    |         |
| No medication                                 | 35.2 | [20.8–53.0] | 53 | .056    |
| Oral glycaemic medication                     | 46.6 | [36.2–57.3] | 178 |         |
| Insulin                                       | 64.3 | [20.7–92.6] | 12 |         |
| Insulin and oral glycaemic medication         | 66.9 | [54.1–77.6] | 82 |         |
| Years since diabetes diagnosis                |     |        |    |         |
| 0–5 years                                     | 33.0 | [23.9–43.5] | 148 | <.0001  |
| 6–10 years                                   | 68.2 | [50.4–81.9] | 50 |         |
| 11–20 years                                  | 66.0 | [49.3–79.5] | 63 |         |
| > 20 years                                   | 64.4 | [48.8–77.4] | 64 |         |

OR, odds ratio; CI, confidence interval; n, number of participants; ref, reference group

The final adjusted Model 3 (AIC: 654052.6, Prob > F = 0.008), included predisposing, enabling and need factors. Older age (55–64 years OR = 4.18, p = 0.003 and ≥ 65 years OR = 4.78, p = 0.002 compared with 15–44 years), having health insurance (OR = 6.32, p = 0.002), and having had diabetes for 6–10 years (OR = 4.23, p = 0.005 compared with 0–5 years) were significantly associated with having had an eye examination. However, being overweight (OR = 0.38, p = 0.034 compared with normal-weight or underweight) was significantly associated with reduced odds of having had an eye examination.

Discussion

This study presents data on the pattern of utilization of eye care services among people with diabetes in South Africa using data from a population-based national survey (SANHANES-1). Almost half of the persons who self-reported diabetes had accessed eye care services since diabetes diagnoses. Older age, having health insurance and duration of diabetes were associated with an increased likelihood of having an eye examination in this study. However, being overweight was associated with a decreased likelihood of having an eye exam among participants with self-reported diabetes.

The rates of eye care utilization among people with diabetes have been reported in different population-based studies [9–12]. For example, in the United States, both Benoit et al. [9] and MacLennan et al. [13] reported that nearly half of all patients with diabetes had not had an eye exam in over 5 years. In a hospital-based study in India, Sreenivas et al. [12] reported that about a third of diabetic patients sampled had accessed eye care services in the last 1 year. In Tanzania, Mumba et al. [11] reported that about 60% of diabetic patients sampled had undergone a dilated eye exam after their diagnosis. It is clear that the pattern of utilization varies in different countries and the barriers or factors that promote utilization are also varied.

Consistent with previous studies [9, 13, 14], older age was associated with eye care utilization among people with diabetes. Specifically, people aged 55 years and above were more likely to utilize eye care services. This may be attributed to the compounding effects of increasing resistance to insulin and dysfunction of the pancreatic islets with aging [15], thus diabetes often affects older people more than young people [16].

Having health insurance influences eye care utilization among people with diabetes [13, 17]. For instance, Mier et al. [18] reported that people with diabetes with medical insurance cover were five times more likely to utilize eye care services than those who did not have insurance. Contrary to most studies (including ours), a study in China reported that the absence of medical insurance cover does not serve as a barrier for eye care utilization among diabetes [10]. Diabetic eye exams in China are affordable and so the availability or otherwise of medical insurance is not a predictive factor for uptake of eye care services [10]. South Africa has both private and public health insurance systems. The public health insurance system primarily serves a large proportion of the population, but like in most developing countries, it is continually underfunded and understaffed. The Medical Aid Schemes Act introduced in 2004 [19] recommends that all medical aids are required by law to cover the cost of treatment and care of diabetes. These benefits, known as Prescribed Minimum Benefits, ensure that members of schemes have access to minimum health services.

Diabetes duration is also a major factor in eye care utilization among people with diabetes. We found that diabetes duration of 6–10 years was significantly associated with increased uptake of eye examination after adjusting for confounders. Longer diabetes duration is known to be associated with increased prevalence/incidence of retinopathy [20, 21] and thus an increased need for an eye examination by an eye care professional. It is recommended that persons with diabetes perform a yearly eye examination. The Ophthalmological Society of South Africa’s (OSSA) recommended guideline for a diabetic eye exam is that every patient must have a dilated retinal examination at least once every year to screen for diabetic retinopathy [22].
We found that being overweight was a barrier to eye care service utilization. This unanticipated finding, however, has been previously reported by Baumeister et al. [17] who found poor eye care service utilization among overweight people due to very minimal physical activity. Sedentary lifestyle, particularly in individuals whose work requires many hours seated and working on computers, has been associated with obesity, which in turn may lead

|                | Model 1 | Model 2 | Model 3 |
|----------------|---------|---------|---------|
|                | OR   | 95% CI (OR) | p-value | OR   | 95% CI (OR) | p-value | OR   | 95% CI (OR) | p-value |
| **Predisposing factors** |       |          |         |       |          |         |       |          |         |
| **Age**        |       |          |         |       |          |         |       |          |         |
| 15–44 years    | ref   | –        | –       | ref   | –        | –       | ref   | –        | –       |
| 45–54 years    | 1.82  | [0.66–5.00] | 0.243   | 1.62  | [0.6–4.35] | 0.338   | 2.00  | [0.77–5.21] | 0.154   |
| 55–64 years    | 3.77  | [1.45–9.77] | 0.007*  | 4.58  | [1.89–11.06] | 0.001*  | 4.18  | [1.63–10.72] | 0.003*  |
| ≥ 65 years     | 3.68  | [1.35–10.02] | 0.011*  | 5.90  | [2.2–15.82] | <0.001* | 4.78  | [1.75–13.05] | 0.002*  |
| **Sex**        |       |          |         |       |          |         |       |          |         |
| Males          | ref   | –        | –       | ref   | –        | –       | ref   | –        | –       |
| Females        | 0.81  | [0.41–1.6] | 0.546   | 0.89  | [0.43–1.84] | 0.753   | 0.95  | [0.45–2.02] | 0.897   |
| **Ethnicity**  |       |          |         |       |          |         |       |          |         |
| African        | ref   | –        | –       | ref   | –        | –       | ref   | –        | –       |
| 'Coloured'(mixed race) | 1.71  | [0.75–3.92] | 0.204   | 1.91  | [0.75–4.87] | 0.173   | 1.91  | [0.72–5.07] | 0.192   |
| White or Indian| 0.65  | [0.28–1.48] | 0.299   | 0.29  | [0.09–0.98] | 0.046*  | 0.30  | [0.09–1.05] | 0.060   |
| High risk alcohol use | 1.29  | [0.35–4.76] | 0.698   | 0.98  | [0.27–3.51] | 0.973   | 1.50  | [0.43–5.29] | 0.523   |
| Current smoker | 0.50  | [0.19–1.31] | 0.155   | 0.45  | [0.17–1.24] | 0.123   | 0.39  | [0.15–1.04] | 0.060   |
| **Body mass index (BMI)** |       |          |         |       |          |         |       |          |         |
| Underweight/normal weight: < 25 kg/m² | ref | –        | –       | ref   | –        | –       | ref   | –        | –       |
| Overweight: 25–29.9 kg/m² | 0.74  | [0.32–1.68] | 0.467   | 0.40  | [0.17–0.96] | 0.041*  | 0.38  | [0.15–0.93] | 0.034*  |
| Obese: ≥ 30 kg/m² | 1.05  | [0.47–2.35] | 0.907   | 0.75  | [0.33–1.72] | 0.495   | 0.77  | [0.32–1.85] | 0.563   |
| **Enabling factors** |       |          |         |       |          |         |       |          |         |
| **Residence**  |       |          |         |       |          |         |       |          |         |
| Rural          | ref   | –        | –       | ref   | –        | –       | ref   | –        | –       |
| Urban          | 1.44  | [0.74–2.82] | 0.283   | 1.41  | [0.68–2.91] | 0.355   |
| Has health insurance | 6.98  | [2.69–18.15] | <0.001* | 6.32  | [2.00–19.91] | 0.002*  |
| **Need factors** |       |          |         |       |          |         |       |          |         |
| Hypertensive   | 1.06  | [0.54–2.08] | 0.868   |
| High cholesterol | 0.64  | [0.3–1.38] | 0.253   |
| Cardiovascular disease | 1.33  | [0.6–2.94] | 0.479   |
| Access health care in past 5 years | 0.98  | [0.52–1.85] | 0.949   |
| Clinician assessed vision loss | 1.97  | [0.83–4.69] | 0.125   |
| Self-reported vision problems | 0.52  | [0.24–1.15] | 0.106   |
| Diabetic medication use |       |          |         |       |          |         |       |          |         |
| No medication | ref   | –        | –       | ref   | –        | –       |
| Oral glycaemic medication | 0.99  | [0.39–2.48] | 0.977   |
| Insulin | 2.67  | [0.47–15.2] | 0.267   |
| Insulin and oral glycaemic medication | 2.57  | [0.9–7.35] | 0.077   |
| Number of years since diabetes diagnosis |       |          |         |       |          |         |       |          |         |
| 0–5 years | ref   | –        | –       | ref   | –        | –       |
| 6–10 years | 4.23  | [1.55–11.54] | 0.005*  |
| 11–20 years | 2.72  | [0.99–7.43] | 0.052   |
| > 20 years | 2.38  | [0.91–6.2] | 0.076   |

OR, Odds ratio; CI, confidence interval; n, number of participants; ref, reference group; *, statistically significant p values (p < 0.05)
to diabetes. Lack of exercise and physical activity might even form barriers to consulting with a physician. Overweight persons may be discouraged to seek care because of numerous factors. Among these are inadequate medical equipment (e.g.: small/ill-fitting blood pressure cuffs), and dismissive attitudes among healthcare professionals in the form of attribution of all medical problems to weight.

In conclusion, should our sample be representative of the population; our findings suggest that less than half of the diabetic population in South Africa are accessing eye care services. This is worryingly low given the impact of diabetes on vision.

Limitations
Our study had a few limitations. Firstly, the data on eye exam since diagnosis, self-reported cardiovascular disease conditions, and cholesterol may be subject to recall bias. Also, hypertension was assessed by self-report as well as blood pressure measures obtained in the physical exam. A second limitation of our study design was that, the percentage of patients who had been utilizing eye care is likely to be underestimated. Based on the international guidelines for diabetic eye exam which requires that people with type 1 diabetes must have annual examinations, beginning 5 years after the onset of their disease while those with Type 2 diabetes should have a prompt examination at the time of diagnosis. However, we only assessed eye care utilization based on whether a participant had ever had an eye examination in the last 1 year without taking into cognizance the number of years since diabetes was diagnosed.

Abbreviations
HSRC: Human Sciences Research Council; REC: Research Ethics Committee; SANHANES: South African National Health and Nutrition Examination Survey; WHO: World Health Organization.

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Authors’ contributions
The authors’ contributions were as follows: conceptualization, KOA, RS and AKA; methodology, KOA and RS; formal analysis, RS and KOA; writing—original draft preparation, KOA, AKA, RS, EKA, EAM; writing—review and editing, KOA, AKA, RS, ND, EAM, DBK, EKA, and PR; supervision, KOA, DBK and PR. All authors read and approved the manuscript.

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Availability of data and materials
The dataset(s) supporting the conclusions of this article is (are) available on request from the Human Sciences Research Council (HSRC) data research repository via access dataset http://www.hsrc.ac.za/en/research-data/.

Ethics approval and consent to participate
Ethical approval for the study was obtained from the Research Ethics Committee (REC) of the South African Human Sciences Research Council (HSRC) (REC number: 6/16/11/11). The study adhered to the tenets of the Declaration of Helsinki. Informed written consent/assent was obtained from all the survey participants. Written informed consent was obtained from a parent or guardian or caregiver for participants aged below 18 years.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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