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Dry eye disease in bank workers in Port harcourt city rivers State, Nigeria

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Abstract
Aim: To determine the prevalence, distribution and risk factors for dry eye disease (DED) among bank workers in Port Harcourt city local government area (LGA) of River State, Nigeria and to compare the reliability of the evaluation parameters.
Methods: It was an institution-based descriptive cross-sectional study. Ocular Surface Disease Index (OSDI) directly administered to the participants. Dry eye disease was objectively assessed with Schirmer 1 test and Tear-film Break-up Time (TBUT). An OSDI score ≥ 13 was considered as diagnostic of DED. The data were analysed using SPSS (Version 20.0), and p value < 0.05 was considered statistically significant.
Results: Four hundred and thirty (430) bankers participated in the study. They were made up of 166 males (39%) and 264 females (61%) with M: F ratio of 1:1.6. The age range was 18-49 years; the mean (SD) age was 30.9±6.1 years.
The prevalence of dry eye disease with OSDI was 57%, with Schirmer 1 test 24% and TBUT 21%. The sensitivity, specificity and Positive predictive value (PPV) of Schirmer 1 test was shown to be 43%, 74% and 68.4% respectively and the sensitivity, specificity and Positive predictive value (PPV) of TBUT was 26%, 86% and 71.1% respectively. The receiver operating characteristics analysis in this study revealed that the Schirmer test and the TBUT were marginally useful in the diagnosis of DED.
The use of contact lens, computers and presence of allergic conjunctivitis had significant effect on the onset of DED using OSDI score. Allergic conjunctivitis was the only risk factor identified with TBUT score. Allergic conjunctivitis and intake of alcohol were significantly found to be protective risk factors using Schirmer 1 test.
Conclusion: There was a high prevalence of DED among this cohort of bank workers, who were generally young.

Keywords: Dry eye disease, Schirmer test, Tear breakup time, bank workers

Introduction
Dry eye syndrome is an established chronic ocular surface disease [1, 2]. It is one of a common public health problem and one of the most frequent reasons for seeking eye care.[2] Dry eye is a symptomatic disease, the patients typically complain of sensations of burning, grittiness, foreign body sensation and actual dryness [2]. These symptoms are usually increased by wind, air conditioner, prolonged staring (Reading or computer use) and other conditions that lead to a decrease in the blink rate or an increase in evaporation rate [3]. In patients with more severe dry eye, intermittent continuous blurring of vision may arise due to damage in the central corneal epithelium as well as changes in the quality of tears [3]. Dry eye symptoms can also have a negative impact on physical, social and psychological health as well as overall sense of well-being of the individual [6].
The prevalence of Dry eye disease (DED) reported had varying range from <0.1% [7] to as high as 66% [8]. This wide variation among studies was believed to be as a result of different DED definitions, study populations, diagnostic criteria used and the clinicians' subjective assessments of dry eye [2].
Although the aetiology of Dry Eye Disease (DED) is still largely unknown, some of the risk factors have been identified [9], According to the report by the Dry Eye Workshop (DEWS), some of the risk factors for DED include computer use, contact lens wear, hormonal imbalance, environmental factors and female gender [1].
A variety of diagnostic test for DED are available and among them include tear break-up time test (TBUT) which is used in assessing the stability of tear film and Schirmer-1 test used in evaluating tear production. Unfortunately, no single diagnostic test can be performed in the field or in the clinic to reliably diagnose dry eye [2]. Furthermore, although a variety of diagnostic tests are commonly used for dry eye; there is no consensus on which combination

of tests should be used to define the dry eye disease, either in the clinic or for the purposes of a research protocol [2]. Much of this discrepancy can be explained by the lack of repeatability of many of the clinical tests commonly used and the natural variability of the disease process and also the variability in pain thresholds and cognitive responses to questions about the physical sensations in the eyes [2].

The diagnosis of dry eye is not straightforward [10]. A clinical diagnosis of dry eye disease requires both objective findings from eye examinations and a subjective report of dry eye symptoms [11]. However, a subjective report of the symptoms can be the sole criterion for the diagnosis of dry eye disease [12].

Clinical observations have long suggested that computer users may be at increased risk of developing dry eye disease [4, 12]. Banks and other financial institution are heavy users of computers in maintaining customer's accounts, electronic fund transfer and processing of huge amount of cheques, credit cards, and other major transactions that takes place daily [13]. Computers help bankers operate more efficiently and effectively; without computers, it would be very hard for a banker to offer efficient daily good customer services [14]. If dry eyes among computer users in, this case bankers, are not managed properly, the consequences may be: discomfort or pain, loss of earnings, inability to work, problems in quality control and productivity, decreases in efficiency, absenteeism from work, costs of staff replacement and training; risk of litigation and risk of bad publicity [15].

There is paucity of information on the prevalence of dry eye among computer users, in this case bankers, in Nigeria. Also, there is also no study in Nigeria that had studied DED among bank employees. The result of this study can also be beneficial in banking policy formulation by incorporating frequent ophthalmic review of the bank staff as a welfare package. Moreover to the best of the authors' knowledge, there is a paucity on the reliability of the diagnostic values of the two commonly used clinical tests for dry eye (Schirmer test and the tear break up time (TBUT) and the Ocular Surface Disease Index in Nigeria, this study will do so in order to add to the determination of appropriate tool in the diagnosis of dry-eye disease.

Materials and Methods

This was an institution-based descriptive cross-sectional study conducted between the 8th of June and 6th of October 2019 in Port Harcourt City Local Government Area. The study population comprised of eligible and consenting adults 18 years and above who worked in the selected banks that are within Port Harcourt City Local Government Area during the time of survey. Excluded from the study were participants with red eye, those with previous history of ocular surgery and those wearing artificial eye lashes.

Using the Leslie Kish formula, the minimum sample sized was calculated to be 427 with 10% allowance for non-responders [16].

A two-stage random sampling technique was used to recruit the participants:

Ethical approval was obtained from the Ethical Committee of University of Port Harcourt Teaching Hospital, Rivers State. Written informed consent was also obtained from the bank and all participants before enrolment into the study. The study abode by the tenets and provisions of the Declaration of Helsinki for research involving human subjects.

The study proforma and the OSDI questionnaires were administered by the first author (ANN) on the subjects. Heavy drinking was defined as current or past consumption of 4 or more servings (Bottles) of alcoholic beverages daily while a current or ex-smoker was an individual who had smoked at least 100 cigarettes in his or her life or 20 cigarettes per day; this was as stated in the Beaver dam eye study in the United States [17].

The OSDI (a 12- item scale) questionnaire consists of three sub-fields on vision related symptoms (Question 1-5), ocular symptoms (questions 6-9) and environmental triggers (questions 10-12) of DED. The response to each OSDI questions has 5 options. The options were graded as follows: 'All of the time' =4. 'Most of the time' =3, 'Half of the time' =2, 'Some of the time' =1 and 'None of the time' = 0. Higher OSDI score is a sign of greater disability with dry eye and the score ranges from 0-100. The total OSDI score was calculated on the basis of the following formula: OSDI= [(sum of scores for all questions answered) × 100] / [(total number of questions answered) × 4] [18, 10]. The OSDI scores was then scaled and categorised as normal (0-12 points) or mild (13-22 points), moderate (23-32 points), or severe (33-100 points) [19]. An OSDI score of ≥13 was considered as Dry eye disease.

Anterior segment examination

Basic ocular examinations, which include examination of the eyelids for scars, globe for phthisis, conjunctiva injections and cornea for opacity or pterygium were carried out by the first author using pen-torch and the hand-held slit lamp.

Tear break up time

The first author, who was masked to the outcome of the questionnaires, conducted the objective examination which was TBUT and the Schirmer1 test. Tear break up time (TBUT) was measured after instilling a solution of 2% fluorescein dye (Ophthalmic technology pvt.ltd. India) into the inferior conjunctival fornix of the subjects. The participants were allowed to blink several times before stopping. The tear film was examined with a broad beam of cobalt blue light from the hand-held slit lamp bio microscope for appearance of black spots representing areas of dryness. The interval (recorded with the in-built Samsung galaxy stop-watch) between the last blink and the appearance of first dry spot around the central cornea was noted as the TBUT. The eyes were gently cleaned with the cotton wool and a TBUT of less than 10 seconds was considered as abnormal and as an indication of DED [20].

Schirmer 1Test

Basal and reflex tear secretion was measured by using the Schirmer 1 test 5 minutes after the TBUT. This is because Schirmer 1 test can disrupt tear film stability and cause false-positive result of TBUT. Schirmer 1 test was done using 5 mm by 35 mm Whatman's filter paper without prior instillation of topical anaesthetic drops (Schirmer method 1). The filter paper was folded 5mm from one end and inserted midway between the outer and middle third of the lower lid. The participants were allowed to gently close their eyes for 5 minutes after which the paper was removed and the amount of wetting measured from the fold. Schirmer1 test reading of ≥ 10 mm wetting of the paper after 5 minutes was considered as normal [21].

Data Analysis

The data of the 430 bankers were imputed into computer and analysed using SPSS software version 20.0. The age distribution, gender and other socio clinical characteristics

of the bankers were presented using frequency charts and table. Also the duration of computer use by the bankers was shown using the frequency table

The prevalence of dry eye diseases was determined using the OSDI score, Schirmer 1 test and TBUT respectively using the formula n/N x 100. The small (n) represents the population of the bankers while the big (N) represents the total population studied multiplied by 100.

Confidence interval of prevalence at 95% confidence level was obtained from the analysis using the bootstrap method.

The evaluation parameters used for assessing DED were compared for reliability using the Receiver Operating Characteristics curve. The OSDI score was used as the reference evaluation parameter based on other studies and comparison made with Schirmer and TBUT. The specificity, sensitivity, Area under the curve, predictive values and accuracy values were used to determine the reliability of the test parameters vis a vis the reference.

The percentage distribution of the evaluation parameters by gender, age, contact lens use, smoking, social alcohol drinking amongst others were also presented using the chi-square test of analysis and t-tests of analysis as appropriate at a statistical level of significance also set at p-value <0.05.

Lastly, multinominal regression analysis was performed to determine the risk factors associated with DED using the three evaluation parameters. The odd ratio (Exp(B)) expresses the risk effect of the identified factor with the 95% C.I also represented at a significant p-value <0.05. Only the risk factors with statistical significance were displayed in the regression tables others are shown as foot notes to the tables.

Results

A total of 430 participants were enrolled into the study, 0.7% more than the calculated sample size. This also has an advantage of increasing the significance level of the results. There were 166 males (39.4%) and 264 females (60.6%) with a male to female ratio of 1:1.6 and there is a statistically difference between the number of the gender (X^2 =22.33, p-value =0.0001).

The mean age of the bankers was 30.9±6.1 years (Age range, 19-45 years) and majority of the bankers were between age 20 and 29 years (n=196, 45.6%). See figure 1. The mean age for the male bankers was 32.7±7.4 years and 29.6±4.8 years for females. The age difference was statistically significant (t= 5.221, p-value <0.001).

More than three-quarter of the bankers had tertiary education (366, 85.1%) while 64 (14.9%) had secondary education.

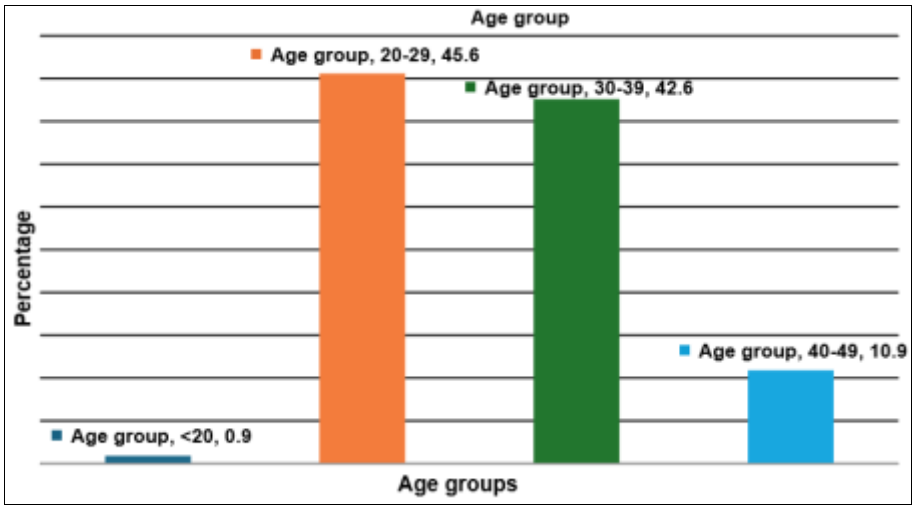

Fig 1: Age distribution of the study population

Prevalence of DED among the study population

The prevalence of DED was 57% based 0n abnormal OSDI score ≥13 (95% C.I between 52.3% and 61.9%), those with abnormal Schirmer1 test (<10) was 24% (95% C.I between 31.4% and 40.5%) while those with abnormal TBUT was 21% (95% C.I between 17.0% and 24.9%). This implied that prevalence of abnormal OSDI score was comparatively higher than abnormal Schirmer test and abnormal TBUT (57% > 24% > 21%) as shown in table 1.

Table 1: Prevalence of Dry Eye Disease by OSDI score, Schirmer 1 test and TBUT

Variable	Frequency	Percentage	C.I of prevalence %
OSDI score (>12)	245	57	52.3 to 61.9
Schirmer 1test (<10)	101	24	19.5 to 27.4
TBUT (<10 secs)	90	21	17.2 to 24.9

Comparing the diagnostic usefulness of the test parameters for DED

The receiver operating characteristics (ROC) curve analysis was used to determine the sensitivity, specificity and accuracy of the TBUT and Schirmer test against the OSDI.

Table 2 and Figure 2 showed that TBUT and Schirmer had very low sensitivity for DED testing (26.1% and 28.6%) compared to OSDI score though the test parameters had high specificity for DED (85.9% and 83.2%). The area under the curve (AUC) for TBUT and Schirmer compared to OSDI respectively were very narrow and poor (0.560 and 0.559) and this implied that the two tests' parameters marginally useful in the assessment of DED compared to OSDI among the bankers. See table 3

Table 2: Test of reliability between OSDI score versus TBUT, and OSDI score versus Schirmer's test

DED (OSDI score)			
Variable	**Positive ≥13**	**Negative <13**	**Total**
TBUT			
Positive (<10 secs)	64 (26.1) (TP)	26 (14.1) (FP)	90 (20.9)
Negative (>10 secs)	181 (73.9) (FN)	159 (85.9) (TN)	340 (79.1)
Total	245(100.0)	185(100.0)	430
Schirmer			
Positive (<10)	70 (28.6)	31 (16.8)	101 (23.5)
Negative (>10)	175 (71.4)	154 (83.2)	329 (76.5)
Total	245 (100.0)	185 (100.0)	430

True positive = 64, False positive =26 False negative = 181
True negative = 151
Sensitivity (True positive/ TP +FN) (64/245) = 26.1%
Specificity (True Negative / TN + FP) (159/185) = 85.9%
Positive likelihood ratio (sensitivity/100-specificity) = 1.85 (95% CI = 0.37 to 3.61)
Negative likelihood ratio (100 -sensitivity/specificity) = 0.19 (95% CI = 0.01 to 0.51)

Schirmer's test
Positive predictive value (PPV: 64/90) = 71.1% (95% CI, 60.1% to 90.0%)
Negative predictive value (NPV: 159/340) =46.7% (95% CI, 36.2% to 58.0%)
True positive = 70, False positive =31 False negative= 175
True negative = 154
Sensitivity (True positive/ TP +FN) (70/245) = 28.6%
Specificity (True Negative/TN +FP) (154/185) = 83.2%
Positive likelihood ratio (sensitivity/100-specificity) = 1.70 (95% CI = 0.97 to 3.11)
Negative likelihood ratio (100 -sensitivity/specificity) = 0.86 (95% CI = 0.48 to 1.11)
Positive predictive value (PPV: 70/101) = 69.3% (95% CI, 54.1% to 79.0%)
Negative predictive value (NPV: 154/329) =46.8% (95% CI, 33.2% to 51.0%)

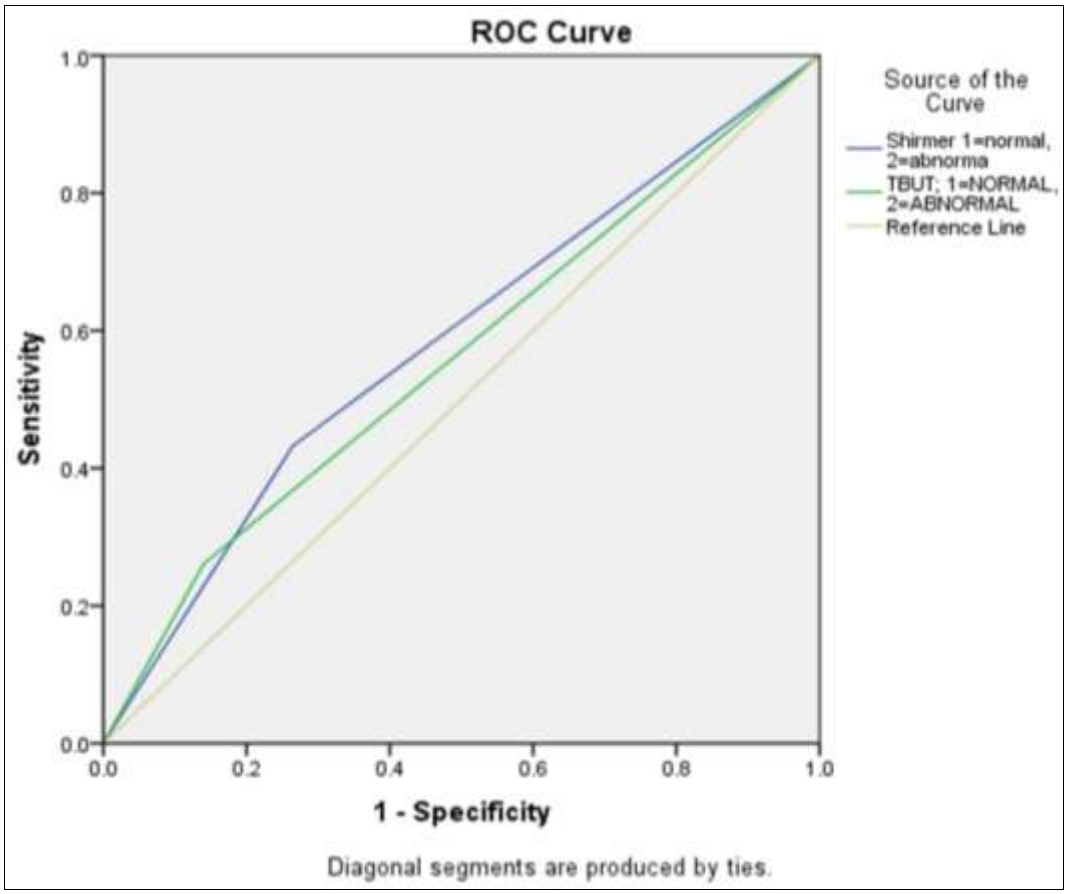

Fig 2: ROC curve assessing reliability of TBUT and Schirmer test for DED

Table 3. Area Under the curve for the test parameters

Test kits	N	ROC Area	S.E	95% C.I
TBUT	430	0.56	0.037	0.506 - 0.615
Schirmer	430	0.559	0.028	0.505 - 0.613

Chi square test X^2 =5.8, P-value = 0.020

The Area under the curve represents the usefulness of the test parameters.
ROC curve Area normally lies between 0.5 and 1.0 (i.e 0.5= Worthless, 0.51 - 0.69 = marginally useful test, 0.7 - 0.9 =good test.1.0 = Perfect test)ref

Distribution of component of OSDI score
The responses to the 12 questions making up the OSDI score is shown in Table 4. These questions were divided into three parts: ocular symptoms, vision related symptoms and environmental triggers. Eyes sensitivity to light (n=111, 25.8%) and blurred vision (n=94, 21.9%) were the most common ocular symptoms. Commonest vision related symptoms reported was reading (n=65, 15.1%) followed by watching TV (n=58, 13.5%). Windy condition was reported as the most common environmental trigger (n=58, 13.5%). Other details are shown in table 4.

Table 4: Distribution of component of OSDI score

OSDI Characteristics	None	Sometimes	Half of the times	Most of the times	All the time
Have you experienced any of the following during the last week (vision-related symptoms)					
Eyes sensitive to light	170	128	21	75	36
Eyes that feel gritty	224	131	31	19	19
Painful or sore eyes	277	69	49	25	10
Blurred vision	248	65	23	58	36
Poor vision	380	9	12	20	9
Have problems with your eyes limited you in performing any of the following during the last week (ocular symptoms)					
Reading	270	66	29	42	23
Driving at night	291	67	15	42	15
Computer or ATM use	261	50	68	35	16
Watching TV	272	78	34	49	9
Have your eyes felt uncomfortable in any of the following during the last week (environmental triggers)					
Windy conditions	257	76	39	49	9
Places with low humidity	296	83	31	20	-
Air-conditioned areas	340	43	29	18	-

Predisposing risk factors for DED among the bank workers

Four bankers (0.9%) have mild to moderate sleep lagophthalmos, eight (1.8%) used contact lenses, 20 (4.6%) had allergic conjunctivitis and 319 (74.1%) use computers daily for work.

None of the participants gave any history of past ocular surgery, previous dry eye disease, topical anti-glaucoma medications and systemic diseases like (Diabetes mellitus, thyroid disease, allergy or rheumatoid arthritis.)

Distribution of Dry Eye Disease risk factors using OSDI score, Schirmer test and TBUT

Distribution of risk factors for dry eye disease among the bank workers were assessed using OSDI score, Schirmer test and TBUT test. The proportion of dry eye disease was relatively higher in the females compared to males using any of the three-evaluation parameter with OSDI score given a proportion of 60% versus 52%, Schirmer test (24.6% versus 21.7%) and TBUT (17.8% versus 25.9%). However, with any of the evaluation parameter no statistically significant difference in the gender proportion for DED was found (p-value >0.05).

The age distributions of bankers with DED revealed that majority of the bankers with DED were between 30 to 39 years using Schirmer test and TBUT while majority of bankers with DED were between 40 to 49 years using OSDI score. The distribution of DED significantly increased with age using TBUT (X^2 =.8.561, p-value 0.002). The distribution of DED also increased with age using OSDI score but was not statistically significant.

Of the eight bankers who use contact lens; all of them had DED using OSDI score and Schirmer test, while half of them had DED using TBUT.

Also, of the 319 bankers who use computers; the proportion that had DED with OSDI score was significantly higher compared to Schirmer and TBUT (63.6% versus 34.8% versus 21.0%). Other details are shown in Table 5.

Table 5: Distribution of Dry Eye Disease risk factors using OSDI score, Schirmer test and TBUT

Variables	OSDI Score ≥13 (n=245)	TBUT <10 s (n=90)	Schirmer test <10 (n=101)
Sex			
Male (n=166)	87 (52%)	43 (25.9%)	36 (21.7%)
Female (n=264)	158 (60%)	47 (17.8%)	65 (24.6%)
p-values	0.061	0.124	0.177
Age range			
10-19 (n=4)	4 (100.0%)	-	-
20-29 (n=196)	102 (52.0%)	33 (16.8%)	43 (21.9%)
30-39 (n=183)	106 (57.9%)	44 (24.0%)	48 (26.2%)
40-49 (n=47)	33 (70.2%)	13 (27.7%)	10 (21.3%)
p-values	0.161	0.002	0.451
Contact lens users (n=8)	8 (100.0%)	4 (50.0%)	8 (100.0%)
Lagophthalmos (n=4)	4 (100.0%)	-	-
Smoking (n=4)	-	4 (100.0%)	-
Social Alcohol drinkers (n=71)	35 (49.3%)	42 (59.2%)	13 (18.3%)
Use of computers (n=319)	203 (63.6%)	67 (21.0%)	70 (21.9%)
Allergic Conjunctivitis (n=20)	20 (100.0%)	15 (75.0%)	15 (75.0%)

Discussion

The participants in this study were indoor workers. The prevalence of DED using OSDI score noted in this study was 57%. This was higher than that obtained by Ünlü among office workers in Japan which showed a prevalence OSDI score of 35% [10]. This difference may be attributed to the fact that the cut-off OSDI score used in this present study was ≥ 13 while the cut-off used by Ünlü was ≥35. [10]

In a study of indoor office cleaners in Nigeria, Echieh *et al* reported a prevalence of 20% using OSDI scores of ≥33 [22].

In a population-based cross-sectional study on adult population with dry eye disease in Iran, the prevalence of DED with OSDI score was 18% and the cut-off used was ≥ 23 [22]. The lower value may have been because the age range of the participants was narrow (40 - 69years) and based on the OSDI cut-off used in the study.

The OSDI score was used to define DED in this study, however, it is still relevant to compare the results of DED using Schirmer 1test values and TBUT scores. The prevalence of DED using Schirmer 1test in this study was 24%. This was comparable to the 30.4% reported by Echieh *et al*. [22] This was lower than that obtained by Ünlü among

office workers in Japan which was observed to be 95% [10]. This difference was attributed to the reflex epiphora which Ünlü noticed among his participants and also probably due to the fact that he considered wetting of Schirmer strip ≤ 6mm as indication for DED [10]. A high prevalence value of 50% was also observed by Alireza *et al* among bank workers in Isfahan, Iran while another prevalence of 32% was obtained among computer users in Japan [8, 11]. A prevalence of 19% was obtained from a study on adult population with DED also in Iran [22]. The reason for this wide range in prevalence value may be due to the differences in the study population and cut-off value for the Schirmer test.

The prevalence of DED using TBUT test in this study was 21%. This high prevalence finding was similar to the findings among office workers in Nigeria and Japan where the prevalence of 32.2% and 42% respectively was reported [22, 10]. Similarly a much higher prevalence was reported in a study among bank workers in Isfahan, Iran where the prevalence was 53% and also, a study on adult population with DED in Iran where the prevalence was 34% [10, 8, 22]. Although the whole prevalence values were high, the difference in the values obtained was probably because of different methodologies used in the studies and because of the differences in the study population.

Additionally, in this study, prevalence rate obtained from the test parameters is lower than that gotten from OSDI and this is in agreement with the study by Ünlü who observed that the clinical tests of dry eye have generally found lower prevalence rates than questionnaire-based studies [10].

The result of the prevalence from this study shows that office workers like bankers will likely present more with symptoms of DED than with signs and the management should commence in such patients without the need to wait for the presence of the clinical signs before commencing treatment.

This study, using OSDI as a gold standard, observed the sensitivity, specificity and Positive predictive value (PPV) of Schirmer 1test to be 43%, 74% and 68% respectively and the sensitivity, specificity and Positive predictive value (PPV) of TBUT to be 26%, 86% and 71% respectively.

A population-based study among elderly Korean population, showed Schirmer 1test to have a low sensitivity of 36% while TBUT did not show any significant association with sensitivity or specificity of dry eye [23]. The study used dry eye questionnaire (DEQ) as a gold standard and Schirmer 1 score of ≤5 mm as cut-off for DED. Another population-based study, the Shihpai Eye Study, observed that Schirmer test II demonstrated 62.5% sensitivity and 43.7% specificity in detecting symptomatic subject from a self-designed invalidated questionnaire [24]. The study however did not analyse the sensitivity and specificity of TBUT as it did not show any significant association with the symptoms.

A hospital-based study in India showed the sensitivity, specificity, and positive predictive value (PPV) of Schirmer 1test to be 65.69%, 68.50% and 45.58% respectively, and the sensitivity, specificity and PPV of TBUT to be 80.43%, 64.96% and 45.40% respectively [25]. However, the study used conjunctival impression cytology as a gold standard unlike this present study that used OSDI as gold standard, moreover his exclusion criteria differ from the exclusion criteria of this present study. Another hospital-based study in India, showed that the sensitivity of TBUT was 86.4%, specificity was 82.4%, positive likelihood ratio (LR) was 4.50 and negative LR was 0.09 [26]. The sensitivity of the Schirmer 1test was also 48.2%, specificity 88%, LR 2.12 and negative LR 0.83; however Dry Eye Scoring System, (DESS) was used as gold standard in this study while the study population was contact lens users.

The receiver operating characteristics analysis in this study revealed that the Schirmer1 test and the TBUT were marginally useful in the diagnosis of DED; the area under the curve (AOC) was 0.584 for Schirmer 1 and 0.560 for TBUT. This was surprisingly in agreement with a population-based study in Korea which showed the AOC for Schirmer 1score with cut-off value ≤ 5 mm has a diagnostic value which has a limited accuracy [23].

Thus, from the result obtained in this study, because of the low sensitivity; the Schirmer test and TBUT may not be appropriate as a screening test for DED, however this does not denote that these clinical tests should be discarded as the tests are still marginally useful and can still be used in hospitals in developing countries where sophisticated test may not be available.

In this study, using the OSDI score, eye sensitivity to light (n=111, 26%) was the most vision related symptom while the commonest ocular symptoms reported was problem with reading (n=65, 15%) and windy condition was the most common environmental trigger (n=58, 14%). The fact that problem with reading and eye sensitive to light (glare) were the major symptoms complained by the bank workers supports opinion that DED can lead to reduced efficiency and productivity at a working place [15]. Moreover since most of the workers use computer it is not surprising that glare (Eye sensitive to light) was a major vision-related symptom. Contrary to expectation, windy condition (And not air-condition areas) was the most environmental trigger of DED symptoms however, this will be an area for further research. The result was similar to the result gotten by Onwubiko *et al* in south-east Nigeria, where problem with reading and windy condition were the commonest ocular symptoms and environmental trigger, however grittiness was the commonest vision related symptom in her study.[27] This is not surprising considering the nature of her study population.

Comparing other studies that did not use OSDI questionnaire, Bekibele *et al*, using a self-designed dry eye questionnaire, in south-west Nigeria, observed that itching was the commonest ocular complaints among his participants with DED while Sahai and Bhatnagar in hospital-based studies in India observed that reduced vision and burning sensation were the commonest complaint by the participants respectively [28-30].

We observed that the proportion of dry eye disease was relatively higher in the females compared to males using OSDI score, but this was not statistically significant, (60% versus 52%) p=0.061, however, the proportion is significant in females than in males using Schirmer 1test(41% versus 21%) p=0.007 and points to the fact that female gender are susceptible to dry eye secondary to decrease in aqueous tear production caused by hormonal changes [31]. On the other hand, Kawashima, in his study among office workers observed a significant proportion of symptoms of DED among females than males using a self-designed web-based self-screening questionnaire [11]. Comparing the distribution of DED among gender with hospital-based studies, Sahai in India observed that the distribution of DED was more in

females (23%) than in males (15%),(P = 0.024), however the study did not use OSDI questionnaire neither did it analyse the distribution using the different parameters [29].

Gender was not a risk factor for DED using any of the three evaluation parameters. Using logistic regression analysis, a study by Uchino, *et al* among office workers in Japan observed that female gender has a high risk of DED (OR = 2.00; 95% confidence interval [CI], 1.29-3.10, P =.002) [32]. Other studies among office worker in Japan had also shown that female gender is associated with DED, however these study used different definitions for DED [11-12]. Comparing the result in this study with hospital-based studies: study in south east Nigeria observed that gender was not associated with dry eye disease while another in India observed that males were more associated with dry eye in the ratio of 2.3:1 [27, 30]. Comparing the result in this study with population-based studies, a study in Iran and Beijing Eye Study observed that gender was associated with dry eye [22, 33].

It was observed in this study that age was not a risk factor for DED using any of the three evaluation parameters and this was presumably because this study included participants of younger age and also because of the restricted age range. Kawashima did not analyse the association between age and dry eye among computer users in his study and Uchino observed that dry eye was significant among young and middle-aged Japanese office workers [11-12]. Using logistic regression analysis, a study by Uchino, *et al* among office workers in Japan observed that workers over 30 years of age had a higher risk of DED (OR = 2.22; 95% CI, 1.06-4.66) [32]. Some hospital-based studies using different methodologies, different study population and different definitions for dry eye had shown that age was not a predictor for DED while some studies in south-east Nigeria, India showed that age was associated with dry eye [27, 30]. Some population-based studies in Iran, and Korea using different methodologies, different study population and different definitions for dry eye had also shown that age was not associated with DED while some studies, Blue Mountains Eye Study, Beijing Eye Study showed that age was associated with dry eye [22-23, 33-34].

The use of computers has between two- and three-fold risk effect in the onset of DED using OSDI score but does not have a risk effect when analysed with Schirmer 1 test and TBUT. This was like that noted by Kawashima in Japan, who observed that computer use is not significantly associated with DED using Schirmer test however he did not use OSDI and TBUT in his study for comparison [11]. Contrarily, Nakamura *et al* also in Japan, observed a significant association between computer use and lower Schirmer 1 test and not with TUBT [35]. Ünlü in Turkey, on the other hand, observed that there was no significant association between computer use and the OSDI, TBUT, and Schirmer 1 test scores [10]. Although the reason for this is not clear; these results are contrary to the opinion that the use of computer cause evaporative dry eye [36].

This study showed that the risk of DED increases significantly with duration of computer use per day using the OSDI parameter. The risk was one-fold with the use of computer for 6-12 hours/day and threefold for >12 hours/day.

This was similar to the study by Bhargava *et al* in India which observed that greater than 4 hours of computer use was associated with a significantly higher risk of dry eye when analysed with TBUT and dry eye scoring system (DESS) and not with Schirmer 1 test [37]. He, however, did not use OSDI questionnaire. Using logistic regression analysis, Uchino, *et al* in Japan observed that using computer for more than 8 hours a day has a high risk of DED (OR = 1.94; 95% CI, 1.22-3.09) [32]. Dehghani *et al* in Iran also showed that greater than 4 hours of computer use was associated with a significantly higher risk of dry eye [38].

In study, previous or currently diagnosed allergic conjunctivitis has between two- and three-fold risk effect in the onset of DED using OSDI score, Schirmer 1test and TBUT. However allergic conjunctivitis was found to be a protective risk factors using Schirmer 1 test (B= -1.755, SE=0.527, Exp(B)= 0.173,C.I(B)= 0.062 to 0.485, p-value = 0.001); the reason for this protective effect with Schirmer 1 test cannot be explained and will be an area for future research. A hospital-based study in Southern California demonstrated that allergic conjunctivitis was associated with dry eye but the study used only validated questionnaire known as Subjective Evaluation of Symptom of Dryness questionnaire in the analysis [39].

The use of contact lens has between two- and three-fold risk effect in the onset of DED using OSDI score (B= 1.132 SE= (0.111) Exp(B) =1.781, C.I(B) =1.637 to 1.937 p value = 0.013) but does not have a risk effect when analysed with Schirmer test and TBUT. This was similar to that noted by Kawashima who observed that contact lens is not significantly associated with DED using Schirmer test however he did not use OSDI and TBUT in his study for comparison [11]. Although Uchino in his study among office workers in Japan, used a different definition for DED and did not analyse his findings separately using the different testing parameters, he however observed that use of contact lens increased the risk of dry eye symptoms (OR, 3.91; 95% CI, 3.37-4.53) [12].

The fact that contact lens wear is a risk for developing dry eye had been observed in a population-based study in Japan, as well as hospital-based study in the United States, however this studies used different methodologies [40-41].

We noted that inability to close the eye well during sleep, was not a risk factor for DED using any of the three evaluation parameters. This finding cannot be compared with other previous DED studies since none analysed the relationship between lagophthalmos and DED. Similarly, we observed that occasional smoking was not a predictive risk for developing DED among the participants using any of the three evaluation parameters. This was similar to that noted by Kawashima among office workers in Japan who observed that smoking is not significantly associated with DED using Schirmer test however he did not use OSDI and TBUT in his study for comparison [11]. Comparing with a hospital-based study, Sahai in India observed that a 1.42 fold increase was found in the odds for dry eye among smokers [29]. However he did not explain how he defined smoking. Comparing the present study with a population-based study, the Beaver dam eye study in the United States, observed that smoking status is significantly associated with likelihood of developing DED (past, OR, 1.22; 95% CI, 0.97-1.52; current, OR, 1.82; 95% CI, 1.36-2.46) [17]. The difference in the result could attributed to the fact that while the smokers in our study agreed to smoking less than 3 cigarettes occasionally and not daily, the sokers in Beaver dam study agreed on smoking at least 100 cigarettes in a

lifetime or smoking more than 20 cigarettes daily.
Social drinking habit was found to be a protective risk factors using Schirmer 1 test (B = -0.661, S.E = (0.262), Exp(B) = 0.516, C.I(B) = 0.309 to 0.864, p-value = 0.012). However, Beaver Dam Eye study did not observe alcohol consumption as a risk for DED [17]. It is interesting to note that in this study, the participants agreed to consuming alcohol only occasionally while in Beaver Dam Eye study alcohol consumption was defined as current or past consumption of 4 or more servings of alcoholic beverages daily [17].

Conclusion
From our findings, we concluded that there was high prevalence of dry eye disease among bank workers in Port Harcourt city LGA in Rivers State using subjective symptoms, Schirmer test 1 and TBUT. Although Schirmer 1 test and TBUT were observed to have low sensitivity in the diagnosis of dry eye, it was still found to be marginally useful and therefore should not be discarded in clinical practice.

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