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Research article

Knowledge, attitude and perception of optometrists in Trinidad and Tobago towards teleoptometry

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ABSTRACT

Background: The limited accessibility of in-person optometry services during the coronavirus disease 2019 highlighted the need for teleoptometry but no data exists to substantiate the foregoing in Trinidad & Tobago (T&T). The study assessed the knowledge, attitude and perception (KAP) of optometrists toward teleoptometry in T&T.

Methods: This cross-sectional study utilized a convenient sampling technique to administer a structured, web-based survey to all registered optometrists in T&T between March and June 2021. Information on demographics and KAP of teleoptometry were collected. Descriptive statistics (mean, percentages, and standard deviations) were used to describe the characteristics of respondents. The mean scores for the main outcomes (KAP) were compared between the categorical groups of the demographic variables, using a one-way analysis of variance. A *P*-value of less than 0.05 was considered statistically significant.

Results: Of the 116 registered optometrists in T&T, 63 responded to the survey (response rate, 54.3%), and were mostly women (44, 69.8%), aged 21–30 years (42, 66.7%), worked in urban regions (41, 65.1%), and half of them (32, 50.8%) had practiced optometry for five or more years. More than two-thirds of the optometrists (76.4%) reported that they had never provided teleoptometry services, and only a few (2, 3.2%) had training on teleoptometry. The percentage mean scores for knowledge were significantly lower than attitude (38.5 ± 17.9% vs 78.2 ± 29.9%; $P = 0.002$) and perception (46.2 ± 11.4%; $P < 0.001$) scores, all of which were significantly lower among self-employed than employed optometrists ($P < 0.02$, for all three variables). While men and non-professional computer users had higher mean scores for attitude than women (3.03 [95% CI: 2.14, 3.93] vs 2.31 [95%CI: 1.41, 3.21], $P = 0.037$) and professional users (3.15 [95%CI: 2.07,

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4.24] vs 2.18 [95%CI: 1.12, 3.24], $P = 0.001$), knowledge and perception scores varied significantly with practitioners' years of experience ($P = 0.042$) and age ($P = 0.041$), respectively.
Conclusion: The findings of the study suggest that although there was limited knowledge of teleoptometry among the participants, particularly the self-employed and the less experienced optometrists, most of them had good attitudes and perceptions toward teleoptometry. To fill the identified knowledge gap, there is a need for teleoptometry training among optometrists in T&T.

1. Introduction

Telehealth is defined as the delivery of health care, health education, and health information services through remote technologies [1]. It provides a platform for accessing the required health care services for those in need by reducing barriers and minimizing exposure to and risk of infection, as well as reducing travel time and associated costs [2]. Prior to the coronavirus disease 2019 (COVID-19) pandemic, telehealth was underappreciated and was used for aiding and promoting long-distance healthcare and education, with a special focus on overcoming barriers to the utilization of healthcare services for people in rural and remote areas [3,4]. Access to in-person healthcare services for most people, especially those at risk, the elderly, socially disadvantaged, children and differently-abled people, has been greatly affected even in urban settings due to the COVID-19 pandemic [5]. This abrupt interruption to in-person optometric services during the pandemic has led to increased public interest in teleoptometry [1].

During the initial COVID-19 outbreak, the use of telehealth rose from less than 1% of visits to as much as 80% in places that have been most affected by the pandemic [6]. In general, the uptake of telehealth has increased globally from 257% to 700%, in places like Canada, Australia, the United States of America (USA) and the United Kingdom [7–9]. Telehealth has, therefore, been adopted and modified according to health disciplines: telemedicine, teleophthalmology, telepharmacy, teleradiology, telepsychiatry and teleoptometry [14]. Despite the proven effectiveness and increased adoption of telehealth, the technology has been confronted with several challenges in terms of finance/cost, techniques used, limited English proficiency, logistics, lack of knowledge and personal barriers [3,10–13].

Teleoptometry, which is the application of optometrist-provided care via telehealth and its care models, is being delivered during the COVID-19 pandemic as urgent care for people with acute eye health concerns, deterioration of chronic eye conditions, and other consultations including contact lens care follow-up [1]. The common online platforms used in teleoptometry include Opternative, Facetime, Google Meet, Zoom, Skype, and Google Hangout [15]. Several studies have recommended teleoptometry as an applicable alternative to in-person optometry care [1,13,16]. Notwithstanding the established benefits and popularity of teleoptometry during the COVID-19 pandemic, the technology is yet to be explored in Trinidad and Tobago (T&T), let alone its adoption into the mainstream of optometry service. This suggests the need to identify the barriers to the non-adoption of teleoptometry among optometrists in T&T.

Furthermore, understanding the knowledge, attitude and perception (KAP) of optometrists towards teleoptometry is crucial since these factors may influence the use of any new technology [3,9,11,12]. There is a dearth of data on KAP and barriers to adopting teleoptometry in T&T, and this provided the rationale for this study. Thus, this study was conducted to determine the KAP of optometrists towards teleoptometry and identify the barriers to teleoptometry among optometrists in T&T. The findings of this study will provide the first evidence of the awareness of optometrists on teleoptometry practice in T&T, and ways of overcoming identified barriers to the adoption and implementation of this technology.

2. Methods

2.1. Study area

This cross-sectional descriptive study was conducted in T&T. The country has a multi-ethnic population of approximately 1.4 million, mostly East Indians (40.3%) and Africans (39.6%), with about 18.4% of mixed and 1.7% of other ethnic groups [17]. The University of West Indies (UWI) is the only university in T&T that trains optometrists, and they practice on the island alongside other overseas-trained optometrists to address the eye care needs of the inhabitants [18,19].

2.2. Ethical consideration

Ethical approval to conduct the study was sought and obtained from the UWI Campus Research Ethics Committee (CREC-SA/0633/11/2020). The study procedures adhered to the tenets of the Declaration of Helsinki.

2.3. Study population and study design

The study was restricted to registered optometrists in T&T who consented to participate in the study. Permission to access the database of practitioners, including names and email addresses of registered members, was obtained from the optometry association of T&T. This included 116 registered optometrists at the time of this study. Information sheets, an invitation to participate in the research, and consent forms were sent to the participants. An e-link to the questionnaire, which was developed using Google forms, was sent to all consenting optometrists through email and WhatsApp. The survey could only be completed once from a single email address to

avoid double entry. Names and email addresses of practitioners were not recorded to maintain anonymity. Practitioners were allowed two weeks to respond anonymously, and non-responders were not followed up. The design of the questions was adapted from a previous online questionnaire [2,11,20–23] with slight modifications to suit the current study objectives. A sample of the survey is presented as a supplementary file (S-Table 1). The preference for an online questionnaire was justified by the fact that 84% of the population had access to the internet, including speed broadband and mobile internet [17]. However, this questionnaire was created on Google forms, and distributed to the study participants. The survey consisted of 36 questions and elicited information on demographics and KAP. See Appendix 1 for details of the survey items.

2.4. Data analysis

Data were presented using descriptive statistics, including proportions for categorical variables and means (standard deviations) for continuous variables. All 'Yes' responses in the questionnaire were assigned a score of 1, and 0 for all 'No' responses. For the perception items, a score of 0 was assigned to 'strongly disagree' and 4 for 'strongly agree', except for one item on '*whether teleoptometry would induce medical errors*', which used reverse scoring (4 points for 'strongly disagree' and 0 for 'strongly agree'). A 'neutral' response was assigned a score of 2 across the perception items. For comparison, the raw scores of each of the KAP items in the questionnaire were converted to percentages and checked for the normality of their distributions. The Pearson correlation coefficient was used to assess the relationship between the three main outcomes. The calculated mean percentage scores were compared between the three outcome variables using paired *t*-tests, while a comparison between the categorical groups of the demographic variables for each of the three main outcome variables (KAP) was done using one-way analysis of variance (ANOVA). A *P* value of less than 0.05 was considered statistically significant ($P < 0.05$).

3. Results

3.1. General data from the participants

Table 1 presents the characteristics of the practitioners in this study. Sixty-three (54.3%) practitioners responded to the survey. Most of them were women (69.8%), married (60.3%) and were aged between 20 and 30 years (66.7%). Sixty-five percent (65%) of the practitioners were Christians, 84.1% were locally trained optometrists, the majority were employed (87.3%) and many worked in urban areas (65.1%). A high proportion (93.7%) had a bachelor's degree, and about half of them had practiced optometry for five or more years (50.8%). About one-third of all practitioners rated their computer skills as professional, while the rest were either average or beginners.

Table 1
Characteristics of the study participants (n = 63).

Variable	Subgroups	Frequency	Percentage
Demography			
Gender[a]	Women	44	69.8
	Men	18	28.6
Age group, years	>30	21	33.3
	21–30	42	66.7
Marital status	Married/defacto	25	39.7
	Not married	38	60.3
Religion	Christianity	41	65.1
	Non-Christian	22	34.9
Ethnicity	Afro-Trinidad	13	20.6
	Indo-Trinidad	30	47.6
	Others including mixed	20	31.7
Country of optometry training	Foreign trained	10	15.8
	Locally trained	53	84.1
Highest educational qualification	Bachelor	59	93.7
	Masters/OD	4	6.3
Mode of practice[b]	Optical company employed	55	87.3
	Self-employed/practice owner	8	12.7
Practice location	Rural	22	34.9
	Urban	41	65.1
Level of computer use	Beginner/average user	41	65.1
	Professional user	22	34.9
Years of practice	Less than 5 years	31	49.2
	5 years and above	32	50.8

[a] One participant preferred to not mention gender.
[b] Optometrist who are employed by the optical companies. OD = Doctor of optometry.

3.2. Main outcomes

The mean percentage scores and their corresponding 95% confidence intervals (CI) for the three main outcomes of KAP are presented in Fig. 1. There were significant correlations between knowledge and attitude ($R = 0.28$, $P = 0.028$), attitude and perception ($R = 0.56$, $P < 0.001$), but knowledge and perception towards teleoptometry were not significantly correlated ($R = 0.22$, P=0.080). Paired *t*-test analysis revealed that attitude scores were significantly higher than knowledge and perception scores ($P < 0.001$, for both). Perception scores were also higher than the knowledge scores (P=0.002) of the practitioners. The percentage responses for each of the KAP items towards teleoptometry are presented in Tables 2–4, respectively.

3.3. Responses of practitioners on knowledge of teleoptometry

Table 2 presents the responses of the practitioners on awareness and knowledge items. Almost two-thirds (66.7%) of the practitioners had heard of teleoptometry, and many (65.1%) used electronic medical records in their practices. The majority (84.1%) correctly defined teleoptometry as 'the remote diagnosis and treatment of patients through telecommunication technology', but 76.4% of the practitioners had not used teleoptometry in their practice and only a few (19.0%) were practicing teleoptometry in their places of work. It was also observed that most (79.4%) practitioners had the capacity for teleoptometry use, and 25.4% (n = 16) were familiar with tools for teleoptometry, while only two (3.2%) people had training on teleoptometry (Table 2). Approximately one-third (31.7%) of the practitioners surveyed reported a preference for the use of video consultation for teleoptometry practice.

The mean score for knowledge varied significantly with the practitioner's mode of practice ($P = 0.001$; Table 4), such that people who were employed by other organizations had higher mean scores for knowledge compared to those who had private practices (3.39 [95%CI: 1.84, 4.93] vs 1.93 [95%CI: 0.05, 3.82], $P = 0.016$). Similarly, practitioners with 5 or more years of experience had higher knowledge scores compared to those with less than 5 years of experience (3.44 [95%CI: 2.95, 3.93] vs 2.71 [95%CI: 2.21, 3.21], $P = 0.042$).

3.4. Responses of practitioners on attitudes and perceptions towards teleoptometry

The full results for percentage responses on the items for attitude and perception are shown in Table 3. For 42.9% of the practitioners, the main reason to use teleoptometry would be to reduce the spread of COVID-19 or make optometric services readily available and accessible to patients (33.3%). A few optometrists (20.6%) perceived teleoptometry as an aid in improving clinical decisions. Furthermore, 87.3% considered teleoptometry to be beneficial to clinical practice and 69.8% thought it was feasible in T&T. Whereas 81.7% were interested in trying out the mobile app-based technology for teleoptometry practice, 71.4% were willing to incorporate this technology into their practice. Forty-three percent of the practitioners were either concerned or unsure about the possibility of medical errors from teleoptometry and the majority (84.1%) either disagreed or were unsure that teleoptometry would enable fast completion of tasks. Only six optometrists (9.5%) agreed that teleoptometry should be used for consulting patients with ocular conditions.

The percentage mean scores for attitude and perception towards teleoptometry are presented in Fig. 1. As shown in Table 4, a one-way analysis of variance revealed that attitude towards the practice of teleoptometry varied significantly with gender (higher scores in men than women; $P = 0.036$), country of optometric training (higher scores among foreign-trained optometrists; $P = 0.036$) and the mode of practice: those who worked in optical companies (employed) had higher mean scores than those who were self-employed/practice owners (3.72 [95%CI: 2.73, 4.71] vs 1.62 [95%CI: 0.41, 2.82]; $P < 0.001$). The mean scores for attitude are also shown in Table 4 and varied significantly with the practitioner's level of computer use such that those who reported being average users or beginners had higher mean scores for attitude compared to those who reported being professional users (3.15 [95%CI: 2.07, 4.24] vs 2.18 [95%CI: 1.12, 3.24]; $P < 0.001$).

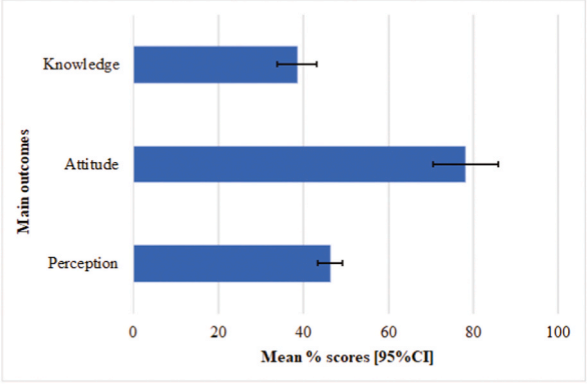

Fig. 1. Mean percentage scores for knowledge, attitude, and perception of teleoptometry practice among optometrists in Trinidad (n = 63). Bars represent 95% confidence intervals (CI) of the means.

Table 2
Responses of participants to items on awareness of teleoptometry.

Knowledge items	Subgroups	Frequency	Percentage
Current use of electronic medical records in practice?	No	22	34.9
	Yes	41	65.1
Aware of tele-optometry/telemedicine?	No	21	33.3
	Yes	42	66.7
Correctly defined tele-optometry?	No	10	15.9
	Yes	53	84.1
Previously used tele-optometry?	No	48	76.2
	Yes	15	23.8
Capacity for tele-optometry use?	No	13	20.6
	Yes	50	79.4
Familiarity with tools for tele-optometry?	No	47	74.6
	Yes	16	25.4
Had training in tele-optometry?	No	61	96.8
	Yes	2	3.2
Use tele-optometry at the workplace?	No	51	81.0
	Yes	12	19.0
Mode of preferred tele-optometry?	Audio consultation	4	6.3
	Text based consultation	5	7.9
	Video consultation	20	31.7
	Video and audio consultation combination	34	54.0

Table 3
Responses of participants to items on attitude and perception of teleoptometry.

Variable	Subgroups	Frequency	Percentage
Attitude items			
Interested in trying mobile app-based optometry?	No	10	15.9
	Yes	53	84.1
Willingness to incorporate mobile-app optometry in practice?	No	18	28.6
	Yes	45	71.4
Think tele-optometry is feasible in T&T?	No	19	30.2
	Yes	44	69.8
Think is beneficial to practice?	No	8	12.7
	Yes	55	87.3
Perception items			
Tele-optometry would induce medical errors?	Strongly agree	1	1.6
	Agree	3	4.8
	Neutral	24	38.1
	Disagree	26	41.3
	Strongly disagree	9	14.3
Teleoptometry would enable fast completion of tasks	Strongly disagree	2	3.2
	Disagree	20	31.7
	Neutral	31	49.2
	Agree	10	15.9
Teleoptometry would provide more comprehensive health services?	Strongly disagree	1	1.6
	Disagree	19	30.2
	Neutral	25	39.7
	Agree	18	28.6
Teleoptometry would improve clinical decisions?	Strongly disagree	1	1.6
	Disagree	19	30.2
	Neutral	30	47.6
	Agree	13	20.6
The most important benefit of teleoptometry?	Could replace the traditional method of services	5	7.9
	Facilitate patient's doctor relationship	6	9.5
	Readily available and accessible	21	33.3
	Saves a lot of time	1	1.6
	Saves money and resources	3	4.8
	To reduce the spread of COVID-19	27	42.9
Ocular conditions should be consulted via teleoptometry?	No	57	90.5
	Yes	6	9.5
All age groups should be consulted via teleoptometry?	Maybe	8	12.7
	No	46	73.0
	Yes	9	14.3

COVID−19=coronavirus disease 2019.

Table 4
Mean scores [95% confidence intervals, CI] for knowledge, attitude and perception of teleoptometry among optometrists in Trinidad and Tobago. *P* values are from one-way analysis of variance.

Subgroups	Knowledge	*P*-value	Attitude	P-value	Perception	*P*-value
Gender						
Women	2.75 [1.35, 4.16]	0.968	2.31 [1.41, 3.21]	0.037	7.54 [5.61, 9.48]	0.442
Men	2.82 [1.42, 4.22]		3.03 [2.14, 3.93]		7.60 [5.67, 9.52]	
Age groups						
>30 years	2.29 [0.57, 4.02]	0.178	2.43 [1.32, 3.53]	0.169	5.74 [3.37, 8.12]	0.041
21–30 years	3.03 [0.84, 4.72]		2.91 [1.82, 3.99]		7.30 [4.96, 9.63]	
Marital status						
Married/defacto	2.97 [1.54, 4.39}	0.869	3.04 [2.13, 3.95]	0.375	7.38 [5.42,9.34]	0.564
Not married	2.83 [1.46, 4.19]		2.64 [1.76, 3.52]		6.97 [5.09, 8.86]	
Religion						
Christianity	2.29 [0.63, 3.96]	0.185	2.56 [1.49, 3.63]	0.523	6.52 [4.22, 8.81]	0.996
Non-Christian	3.03 [1.23, 4.79]		2.78 [1.65, 3.91]		6.52 [4.10, 8.95]	
Ethnicity						
Afro-Trinidad	3.03 [1.21, 4.84]	0.423	2.65 [1.49, 3.81]	0.992	7.17 [4.67, 9.67]	0.357
Indo-Trinidad	2.22 [0.47, 3.96]		2.70 [1.58, 3.81]		6.27 [3.87,8.66]	
Others including mixed	2.73 [1.02, 4.44]		2.66 [1.56, 3.75]		6.13 [3.78,8.49]	
Country of optometry training						
Foreign trained	3.98 [1.79, 6.16]	0.083	3.70 [2.30, 5.09]	0.036	8.40 [5.40, 11.41]	0.072
Locally trained	1.34 [0.89, 3.57]		1.64 [0.21, 3.07]		4.64 [1.57, 7.71]	
Highest educational qualification						
Bachelor	2.88 [1.20, 4.56]	0.663	2.08 [1.01, 3.16]	0.073	5.58 [3.27, 7.90]	0.177
Masters/OD	2.44 [0.33, 4.55]		3.25 [1.90, 4.60]		7.40 [4.57, 10.36]	
Mode of practice						
Optical company employed	3.39 [1.84, 4.93]	0.016	3.72 [2.73, 4.71]	0	7.70 [5.57, 9.83]	0.005
Self-employed/practice owner	1.93 [0.05, 3.82]		1.62 [0.41, 2.82]		5.35 [2.75, 7.94]	
Practice location						
Rural	3.12 [2.52, 3.75]	0.819	3.18 [2.67, 3.70]	0.793	8.32 [7.44, 9.20]	0.998
Urban	3.05 [2.60, 3.50]		3.10 [2.72, 3.48]		8.32 [7.67, 8.96]	
Level of computer use						
Beginner/average user	2.55 [0.85, 4.25]	0.608	3.15 [2.07, 4.24]	0.001	6.85 [4.51, 9.18]	0.265
Professional user	2.77 [1.11, 4.42]		2.18 [1.12, 3.24]		6.20 [3.92, 8.48]	
Years of practice						
Less than 5 years	2.71 [2.21, 3.21]	0.156	3.03 [2.60,3.47]	0.541	8.45 [7.71, 9.19]	0.614
5 years and above	3.44 [2.95, 3.93]	0.042	3.22 [2.79,3.64]		8.19 [7.46,8.92]	

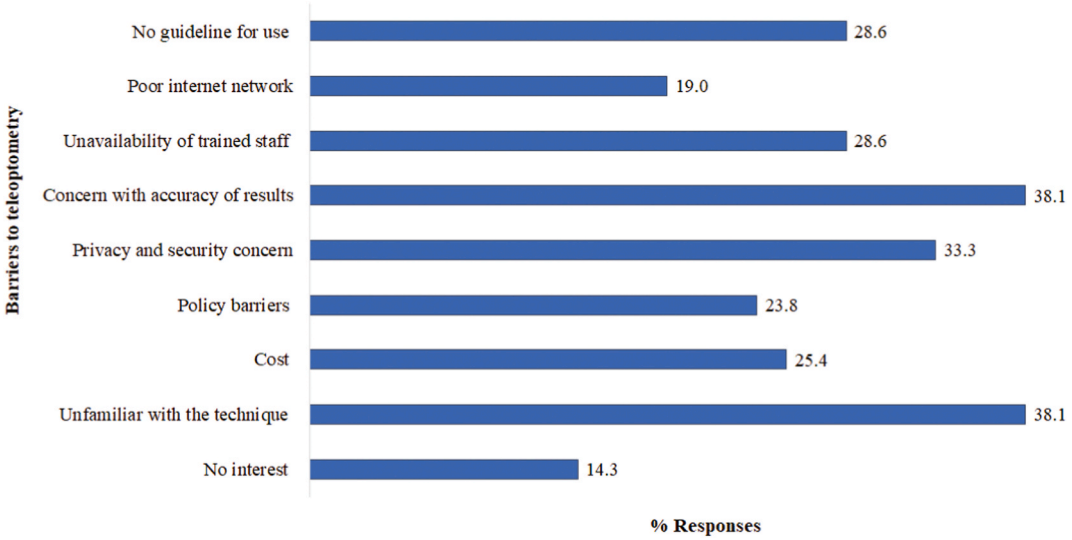

Fig. 2. Barriers to teleoptometry practice among optometrists in Trinidad (n = 63).

The mean scores for perception towards teleoptometry were significantly different between age groups (21–30 years 7.30 [95%CI: 4.96, 9.63] vs > 30 years: 5.74 [95%CI: 3.37, 8.12]; $P = 0.041$), and mode of practice (optical company employees 7.70 [95%CI: 5.57, 9.83] vs self-employed/practice owners 5.35 [95%CI: 2.75, 7.94]; $P = 0.005$).

3.5. Responses of practitioners on barriers to practicing teleoptometry

Participants were asked to select from a list of options regarding barriers to practicing teleoptometry, and their responses are shown in Fig. 2. A range of items was identified, but one in three optometrists reported that concern about the accuracy of the test results obtained from teleoptometry, lack of familiarity with teleoptometry, and security/privacy concerns were the major barriers to the practice of teleoptometry. Fourteen percent also stated a lack of interest in teleoptometry as a major barrier to adopting teleoptometry practice.

4. Discussion

During the COVID-19 pandemic, the infection control practices put in place have led to limited accessibility of in-person optometric services, raising the need for teleoptometry services across the globe [1]. The delivery of eye care services through teleoptometry have become an accepted norm with various guidelines being published for general and sub-specialty eye-care services in different places [1,26,27]. Telehealth practice can be influenced by many factors, including the KAP of health practitioners [9,23–25] and as such, this study explored the knowledge, attitude and perception of optometrists in T&T towards the use of teleoptometry. In this study, we found that knowledge of teleoptometry was significantly correlated with practitioners' attitude towards teleoptometry, but not with the perception of teleoptometry practice. There was an overall low level of knowledge with a high positive attitude towards teleoptometry, while the participants expressed concerns about privacy/security and the accuracy of test results performed through teleoptometry. The details of these findings are provided below in various sections.

4.1. Knowledge of teleoptometry among practitioners

The low level of knowledge about teleoptometry among the surveyed optometrists can be attributed to several factors which were also evident in this study, including the lack of resources for teleoptometry such as training courses or programs, the fact that teleoptometry is not common in T&T, insufficient information dissemination, and inadequate marketing of platforms to facilitate teleoptometry practice in the region. A similar low level of knowledge about telemedicine has been recorded among other healthcare practitioners in Libya [3], Pakistan [11], Saudi Arabia [26] and India [27]), suggesting the need for teleoptometry training and increased publicity among health care practitioners, especially in developing countries like T&T. In addition, incorporating teleoptometry training into the optometry program or curriculum of training institutions will help to increase awareness and adoption, and sustained development of the practice.

We found that more than three-quarters of the optometrists in this study could implement teleoptometry in their practices, but the majority never used the facilities. This could be due to the low level of knowledge and lack of training on the tools for teleoptometry and/or how they can be used. These findings showed that teleoptometry practice is still in its infancy in T&T and would benefit from a national-level awareness promotion. There is a need for national guidelines for training healthcare practitioners on the use of teleoptometry or telehealth in general, and implementation of the services.

Among ophthalmologists in the USA, a study found that despite the high level of awareness of the tools for teleophthalmology, more than 90% of the participants never used the technology. Not being comfortable with using the technology, and lack of confidence in the results obtained via teleophthalmology consultation were the perceived barriers by ophthalmologists [28]. These findings suggest that the utilization of telehealth does not only depend on knowledge or awareness of the techniques, but also the perception and interest of the practitioner. It might appear that compared to other medical practitioners, eye care practitioners are less aware of the practice and have poorly utilized telemedicine [28,29] in their practices.

4.2. Attitude and perception of teleoptometry among practitioners

Similar to a previous study among ophthalmologists in the USA [28], the practitioners' attitudes towards teleoptometry varied significantly with their level of computer use. Despite the low level of teleoptometry knowledge among the surveyed practitioners in this study, they demonstrated a positive attitude towards teleoptometry. This was evident in the high proportion of practitioners who expressed a willingness to try and incorporate mobile app-based optometry into their practices. Similar to the findings of this study, studies have reported that positive attitude was associated with perception rather than knowledge of teleophthalmology among ophthalmologists in the Philippines [30] and the USA [28] as well as other KAP studies on telemedicine [9,20,31–33], which recorded positive attitude among practitioners despite their low level of knowledge of telemedicine.

Although the practitioners in our study felt that teleoptometry was beneficial to their practice, many expressed concerns about the possibility of medical errors from teleoptometry and their lack of confidence in the test results for diagnosis obtained through teleoptometry. This is understandable as many optometry practices involve conducting a series of tests that could depend on the availability of equipment, quality of images obtained and interpretation of results, some of which might not be possible with the use of teleoptometry. Similar findings were reported for teledentistry in Saudi Arabia and Pakistan [21], despite the strong evidence on the accuracy and reliability of the tool used for the diagnoses of dental caries and the finding that results obtained via telemedicine are

almost equivalent to those obtained via non-telemedicine alternatives [34]. In addition, the majority of our study participants were positive about teleoptometry being feasible in T&T, although some were still unsure of whether teleoptometry will help with the fast completion of tasks as recorded in other studies [11,35].

In this study, the main reason optometrists would adopt teleoptometry is that it reduces the spread of COVID-19. Although this was noted previously [21,34,36], these studies were mostly conducted during the COVID-19 pandemic lockdown. Also, the finding that optometrists who owned their practices were less open to adopting teleoptometry compared with those who worked with established institutions/companies was in agreement with a previous study on teleophthalmology among ophthalmologists [30]. It is possible that the poor organizational set-up and lack of access to resources in privately owned practices in T&T may deter practitioners from using this technique.

4.3. Barriers to practicing teleoptometry

We found that concerns about the accuracy of the results derived from teleoptometry were a major barrier to adopting teleoptometry in practices, and this was expressed by ophthalmologists [28,30] and other medical practitioners in previous studies [31,33]. Ashfaq et al. [11] also highlighted the licensing of telemedicine practitioners as the major barrier to the implementation of telehealth in Pakistan, which was not explored in our study. For some other practitioners in this study, the lack of interest was a barrier to the adoption and implementation of teleoptometry, and this can be linked to the low level of knowledge and exposure to teleoptometry in the region. Ayatollahi et al. [9] reported similar findings on the adoption of telemedicine by physicians. The practice of teleoptometry or telemedicine is an emerging field with little or no guidance on the evaluation framework for implementation in most places, and even more so in T&T. However, with the recent global surge in the demand for telemedicine, and the possibility of a resurgence of other viruses that could interrupt the traditional face-to-face consultation, it is important to ensure that the necessary tools, training and incentives are provided. This will encourage the adoption of teleoptometry by optometrists and as such, maximize the use of teleoptometry and telemedicine in healthcare practices/facilities. This is crucial for people living in rural and remote regions with little or no access to eye care services.

4.4. Limitations and strengths of the study

This study has some limitations which should be considered when interpreting the results. Firstly, there were twice as many urban than rural practitioners, and therefore, the responses may be biased towards urban practitioners. Secondly, the number of responses from optometrists was fewer than estimated from their registry. However, they were higher than the response rate in previous studies among health professionals during the pandemic [37,38]. Thirdly, as a cross-sectional study, it is difficult to establish any causal relationship, rather, only inferences can be made from the study findings. Future studies should consider other ways of reaching optometrists in T&T to encourage participation, as their knowledge and practice as front-line workers are important. Further studies are needed to investigate the knowledge and preparedness of optometrists in T&T to provide teleoptometry services during periods of an outbreak. This can be a great resource to reach those in rural regions with limited access to eye care services. It would also be helpful to study the KAP of tele-eye health among ophthalmologists in the country to obtain a complete picture of the nature of eye care services in the region. Despite these limitations, this study provided the first evidence of teleoptometry practice in T&T. The study also identified major gaps in the ability of optometrists to continue providing care after the COVID-19 pandemic has ceased. Addressing these gaps might increase the optometrists' ability to close the gap in the delivery of eye care services to remote communities and strengthen their capacity to continue providing services in future pandemics. Training is needed to build confidence among optometrists and their patients, and this is crucial as the virus continues to spread.

5. Conclusion

Although the optometrists in T&T had limited knowledge of teleoptometry, most of them had good attitudes and perceptions toward teleoptometry. The fact that the majority had not practiced teleoptometry before this study, despite having the capacity to do so at their workplaces during the pandemic, suggests the need for teleoptometry training and workshops. This will bridge the knowledge gap and eventually boost the practitioners' confidence to meet expectations. To ensure that practitioners continue to provide the needed services, especially to remote communities during a pandemic or similar events, there is a need for training on how to incorporate teleoptometry in their practices, the available platforms to use, and the required eye care consultations to be delivered through teleoptometry. The optometry institutions and stakeholders need to strengthen their systems by improving and extending training on teleoptometry practices to meet eye care delivery expectations in remote communities. This promises to be a model of eye care that will be useful during the pandemic and post-pandemic era.

Declarations

Author contribution statement

Ngozika Esther Ezinne, OD, MSc; Kingsley Kene Ekemiri, OD, MSc: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data.Anayochukwu E. Anyasodor, PhD, MSc; Khathutshelo Percy Mashige, PhD, MSc: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.Dipesh

Bhattarai, PhD, MPH: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.James Aliah, BSc; Phillips Kureem, BSc; Michael Agyemang Kwarteng, BSc: Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.Uchechukwu Levi Osuagwu, PhD, MSc, OD: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e13686.

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