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Assessment of Compliance with Contact Lens Wear and Care Among University-Based Population in Iraq

Abeer Imad Al-Dahhan[1] and Salah Zuhair Al-Asadi[2,3]

[1] *Senior Ophthalmologist, Al-Diwaniyah General Hospital, Iraq*

[2], *Department of Surgery, College of Medicine, University of Basrah, Iraq.*

[3]*Senior Ophthalmologist, Basrah General Hospital, Iraq.*

E-mail: abeeraldahhan@gmail.com, salah.abed@uobasrah.edu.iq

ABSTRACT

Purpose*: The aim of the study is to assess the compliance level with the wear of contact lens in a sample of students in Iraq.* ***Methods****: A self-administered questionnaire1 was used to collect data from the designated respondents group. The questionnaire consisted of 34 questions that cover 5 main subjects, these are: general information, usage, care, hygiene and storage.* ***Results****: There were 400 students that participated in the study. Of the study population 36 (9.0 %) were males and 364 (91 %) were females. The average age of the research participants was 22.8 (± 3.7). The study population had a high compliance rate of 31.25 % on 5 behaviours, these are: not sleep while wearing, not showering while wearing, not using saliva to clear, removing when eye gets red and not sharing lens case with friends. Moderate level of compliance rate was 56.25 % and reported in the following aspects: not sharing between users, not overuse solution after its expiry, not using water to clean, clean lens after its removal, adherence to instruction of cleaning, soaking more than 4 hours a night, checking for damage and hand washing before using. However, low levels of compliance rate were 12.5 % and reported in: not rubbing lens with fingers and cleaning and rinsing lens case.* **Conclusion:** *Participants indicated high to moderate compliance. It is advised, however, that improved strategies be used in order to further raise levels of compliance among Iraqi university students who wear contact lenses. Even though this study focuses on university students who use contact lenses, a larger sample of contact lens wearers from the general lay population is suggested to be investigated in future.*

Keywords: Contact Lenses, Refraction, Microbial Keratitis.

Article Information

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1. INTRUDUCTION

Contact Lens (CL) uses are indicated for optical, cosmetic and therapeutic purposes. It has been estimated that more than 140 million people around the globe are using CL (Shahid et al., 2019). Contact lens technology gained increasing popularity and a broader range of applications since it was commercialized. Since they are used for refraction, cosmetics, eye disease treatments and proven ability in treating some eye disease such as keratoconus or corneal scarring (Mannis et al., 2004) that causes an uneven corneal astigmatism, meant that CL becomes popular and especially among young age people. The vast number of options available, not only in terms of lens type and materials, but also the increased availability at many locations across almost every country at a significantly lower price in comparison to the prices that were charged in the past, are most likely the reasons for the growing popularity of the use of CL (Bowden & Harknett, 2006).

2. PROBLEM STATEMENT

Although CL is considered safe in general, there have been reports of its related side effects such as dryness, irritation, inflammation, and Microbial Keratitis (MK) (Keay et al., 2006). The range of these complications vary among users and can also result in sight-threatening diseases like MK. In addition, one-third of the complaints suffered by contact lens users are associated with low compliance to contact lens care guidelines (P. B. Morgan et al., 2011). Furthermore, contact lens complications lead to increased medical costs for patients and healthcare systems, and extra chair time for physicians. For instance, Figure 1 demonstrates some of the most frequent complications when CL handled inappropriately and that encompasses some cases of corneal staining, conjunctival redness, and papillary conjunctivitis.

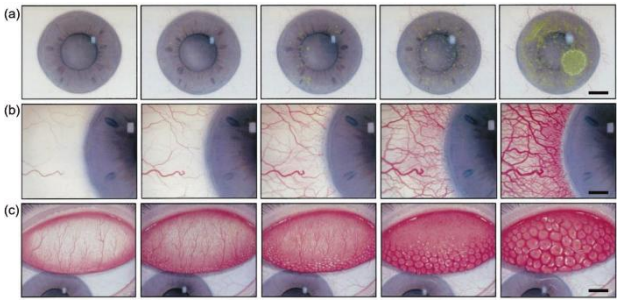

Figure 1: Contact lens complications. a) Corneal staining. Scale bar: 3.0 mm. b) Conjunctival redness. Scale bar: 1.5 mm. c) Papillary conjunctivitis. Scale bar: 3.0 mm. Grading scale, from left to right: normal, trace, mild, moderate, severe. Reproduced with permission (Shahid et al., 2019).

3. LITERATURE REVIEW

The common complications associated with the use of contact lens are dry eye, keratitis, neovascularization, giant papillary conjunctivitis, corneal abrasion, corneal edema, and a corneal ulcer (A. M. Khan, 2013). Adverse CL occurrences are often attributed to the improper of care practices (Bamahfouz et al., 2016). According to (Ibanga et al., 2017), it was demonstrated that 80% of CL complications are linked to some factors such as improper care, including inadequate cleaning and disinfection as well as not getting eyes checked regularly. The highest incidence of contact lens related complication occurs among younger generations, especially those who wear CL only for cosmetic purposes. This indicated a lack of awareness of contact lens complications and knowledge on proper contact lens practice (Robertson & Cavanagh, 2011). The study in (Bui et al., 2010) shown that 80% of CL users were knowledgeable with CL practice and the risk factors associated with inadequate of its caring. Due to the significance of the problem, researchers from various academic institutions around the world have carried out surveys such as (Dumbleton et al., 2011), (Sokol et al., 1990) and (Bakkar & Alzghoul, 2020) to investigate the awareness, knowledge, and hygiene behaviors regarding the wearing of contact lenses and how they should be cared for. These sorts of investigations are helpful in determining the possible dangers, carrying out the essential precautions, and issuing timely warnings.

Some risk factors, such as gender and age, are non-modifiable (Dart et al., 2008), however, some others like CL hygiene and cleaning hands are modifiable (Stapleton et al., 2008). Hence, modifiable factors can be targeted to eliminate CL related vision issues and augment the successful experience of wearing CL. The study by (Fogel & Zidile, 2008) has found that MK is highly likely to occur with those who are buying CL from the online shopping sites. Ocular health education, particularly knowledge of proper and attentive contact lens usage, could play a crucial role in preventing complications that would result from the inadvisable wear behavior. Wearer's perceptions about using CL could be one possible approach to investigate this issue (de Oliveira et al., 2003).

Determining an actual degree of compliance is challenging, particularly when there is no clear quantifiable measure of compliance. Numerous studies have been conducted to analyse compliance, with many of

these making use of self-reported written questionnaires. These studies have resulted in estimates of non-compliance that range anywhere from 40 to 91 percent (Collins & Carney, 1986), (Claydon & Efron, 1994) and (Donshik et al., 2007).

Most Iraqi studies in the field of CLs have mainly focused on the issues rather than the level of compliance. For instance, the study by (Alasadi et al., 2022) evaluated the rate of contamination and determined the types of microorganism in soft contact lenses and their cases among medical school students.

4. METHODOLOGY

This study follows quantitative research approach, questionnaire, which helps to obtain broad opinions that consequently supports the generalisation of the conclusions drawn from its results (Creswell & Clark, 2017). Participants of this study includes CL users who were asked to take a part in a survey aimed to evaluate their adherence to the recommended usage of CL. For simplicity, participants were volunteered through announcement via a self-administrative questionnaire online (google form), rather than in person or by paper. We have shared the questionnaire link[1] through universities students' groups on social media channels so that we make a snowball sample. We have been able to collect the samples from different Iraqi universities.

The participated were recruited randomly from different disciplines where that range over medical, engineering, science and humanity students. We have successfully collected 400 valid questionnaires.

4.1 Questionnaire

We have designed the questionnaire, which includes 34 questions, according to what is known and practiced about contact lens usage, maintenance and issues.

All the questions were written in Arabic, and the responses were likewise provided in Arabic by the study participants. After we collected the 400 questionnaires, the samples were translated to English for the purpose of easing the process of analysis.

According to earlier research studies in (Dumbleton et al., 2013) and (M. H. Khan et al., 2013), the questionnaire of this study was designed to gauge contact lens users' adherence to proper lens maintenance and practice. Participants' basic demographics, such as their gender, age and educational attainment, were first gathered. The questionnaire utilized in this research also contains questions about the kind of CL used, the modality of CL, the per day wearing duration, and the number of months of wear experience. Also, the questionnaire contains questions that ask about a user's compliance with CL maintenance, solution change, case, hygiene practices. Most of the questions are multiple choices that can be answered by yes/no and sometimes, which have been designed to infer the required information that could lead to draw the insight needed to assess the level of compliance among CL wearers.

3.2 CL Compliance

Contact lens practitioners and manufacturers both are concerned about contact lens wearer compliance due to its link to contact lens-related ocular problems and the potential for contact lens dropout from the market (Rah et al., 2014). According to findings from earlier conducted research, it is impossible to ensure complete compliance on the part of users with regard to the wearing and maintenance of CL. Compliance rates also varied, where it mostly depending on the country, population investigated and the type of CL (Uzel et al., 2018) . The state-of-the-art research has also employed a variety of ways to examine the compliance and results of CL users since there are no direct quantitative

[1] The online questionnaire can be found at: https://forms.gle/LXmeMohF2uUvKty4A

methods for the measurement (Kuzman et al., 2014).

In fact, there is a dearth of research pertaining to the adherence required for contact lens usage in Iraq. Therefore, the purpose of this study is to determine the level of compliance that is associated with the use of contact lenses in a population that was based in Iraqi universities.

4. RESULTS

4.1 Statistical Analysis

Analysis of data was carried out using the available statistical package of SPSS-28 (Statistical Packages for Social Sciences-version 28). Data were presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimum-maximum values). The significance of difference of different percentages (qualitative data) were tested using Pearson Chi-square test (x^2-test) with application of Yate's correction or Fisher Exact test whenever applicable. Statistical significance was considered whenever the P value was equal or less than 0.05 at 95% level of confidence.

4.2 Participants' demographics

A total of 400 participants were participated in this study. There was 364 (91%) females and 36 (9%) males. In general, participants were in the ages of 22.8 (± 3.7) years with a range of 18–35 years. Some of the study population 173 (43.3%) were identified as a medical field, 227 (56.8%) were classified as non-medical field participants. Table 1 shows demographic characteristics of the study population.

4.3 Contact lens wear profile

Participants were questioned about behaviors related to their previous experience with CL in terms of usage, duration and eye issues.

Table 1: Demographic characteristics of the population.

General information		No.	%
Age (years)	18-24	289	72.3
	25-35	111	27.8
	Mean±SD (Range)	22.8 ±3.7	18-35
Gender	Male	36	9.0
	Female	364	91.0
Medical field person	Yes	173	43.3
	No	227	56.8

All those who took part in this study did mention that they had worn contact lenses with less than a year to 1 year or more with 37.3% and 62.7% respectively. Table 2 shows the contact lens wearing habits of the participants. According to the table, the collected information can be classified into two categories, (i) eye-issue related and (ii) wearing routine. Regarding the eye-issue, the data reveals that 125 (31.3%) of the study population suffer from refractive error and 98 (24.5%) pointed out that they had eye problem because of CL usage. That explicates that 58.3 % of population visited ophthalmologist. Furthermore, only 128 (32%) have purchased the CL from care practitioner retails, where the rest population indicated that they bought through the Internet or other resources. In the context of wearing routine, the data disclosed that Rigid Gas Permeable (RGP) and Silicon are the most popular CL that widely used by the study population 189 (47.3%) and 187 (46.8%) respectively. According to the modality, 238 (59.5%) obtained the yearly ones, while 98 (24.5%) got the monthly and the rest using disposable CL.

Only 63 (15.8%) participants are wearing CL on daily basis, while 60 (15.0%) use weekly and the rest only use on occasions. In terms of CL sharing, it is reported that 105 (26.3%) participants are already shared with others. It is also shown that CL wearing is ranging from 5 to 7 hours a day for 329 (82.3 %) of the population and 8 to 11 hours for 55 (13.8%).

Table 2: Contact lens information of population.

General information		No.	%
Have refractive error	Myopia	100	25.0
	Hyperopia	21	5.3
	Astigmatism	25	6.3
	Myopia + Astigmatism	47	11.8
	Hyperopia + Astigmatism	5	1.3
	None	202	50.5
Visiting ophthalmologist	Yes	233	58.3
	No	167	41.8
Type of CL	Hydrogel	24	6.0
	RGP	189	47.3
	Silicone	187	46.8
Modality of CL	Disposable	64	16.0
	Monthly	98	24.5
	Yearly	238	59.5
Mode of wearing CL	Daily	63	15.8
	Weekly	60	15.0
	Occasionally	277	69.3
CL purchase	Eye care practitioner	128	32.0
	Online market (Internet)	113	28.2
	Other	159	39.8
CL experience duration	<12 months	149	37.3
	⩾ 12 months	251	62.7
Sharing CL between users	Yes	64	16.0
	No	295	73.8
	Sometimes	41	10.2
Purpose of CL wearing	Cosmetic	275	68.8
	Refraction	125	31.3
Eye problems due to CL	Yes	98	24.5
	No	302	75.5
Ever slept while wearing CL	Yes	42	10.5
	No	350	87.5
	Sometimes	8	2.0
Daily duration of CL wearing	5-7	329	82.3
	8-11	55	13.8
	⩾ 12 hrs.	16	4.0
Showering while CL wearing	Yes	17	4.3
	No	373	93.3
	Sometimes	10	2.4
Overuse of CL (more than recommended replacement schedule)	Yes	81	20.2
	No	287	71.8
	Sometimes	32	8.0

Although it is very rare to wear CL for more than 12 hours, i.e. only 16 (4.0%); it is reported that 50 (12.5%) of population already slept while wearing CL. In terms of wearing CL while taking a bath, the results reveal that 27 (7.2%) of the population did. Finally, to assess the compliance of the study population with the standard usage period, we reported that 113 (28.3%) are not following the recommendations and information of CL usage.

4.5 Care and hygiene practices for contact lenses

Participants were questioned about behaviors related to their lens care, storage case maintenance and hygienic information. Table 3 shows information correlated with solution care. The table shows that most of the participants 209 (52.3%) are changing the CL solution every alternative day. However, 50 (12.5%) are doing so on daily basis. Some participants doing the changing procedure either weekly or more than a week 57 (14.2%) and 84 (21.0%) respectively. Regarding the use of CL solution after it gets expired, most of the participants have not done that with 315 (78.8 %). However, 59 (14.8%) of the population believe this has no impact and hence they do so, while 26 (6.5%) are doing it at times

Table 4 presents information related to the Hygienic information in dealing with CL. In this context, 179 (44.8%) of the population are using water to clear their CL, while 31 (7.8 %) are using saliva. In terms of cleaning CL after use, it is shown that 223 (55.8%) are committed to clean, while the rest participates are failed to perform the cleaning every time after remove the CL. In the same context, 180 (44.6%) of the participants did neglect the formal instruction of CL cleaning. Furthermore, it is also shown that small percent of the population study, i.e. 89 (22.3%), who are rubbing CL with fingers every time before soaking in solution.

Table 3: Solution care statistics.

CL care solution %		No.	
Frequency of changing CL solution	Daily	50	12.5
	Alternative days	209	52.3
	Weekly	57	14.2
	More than one week	84	21.0
Using CL solution after its expiry date	Yes	59	14.8
	No	315	78.8
	Sometimes	26	6.4

Table 4: Hygienic statistics.

Hand/Lens Hygiene		No.	%
Using water to clear CL	Yes	179	44.7
	No	185	46.3
	Sometimes	36	9.0
Using saliva to clear CL	Yes	20	5.0
	No	369	92.3
	Sometimes	11	2.7
Hand washing before using CL	Yes	299	74.7
	No	51	12.8
	Sometimes	50	12.5

	Yes	223	55.8
Clean CL after its removal	No	123	30.8
	Sometimes	54	13.4
Adherence to instruction of CL cleaning	Yes	220	55.0
(Rub/Rinse/Soak)	No	85	21.3
	Sometimes	95	23.2
Rubbing CL with fingers before soaking	Yes	89	22.3
them in solution	No	273	68.3
	Sometimes	38	9.4
	Yes	193	48.3
Soaking CL more than 4 hours every night	No	178	44.5
	Sometimes	29	7.2
Removing the CL immediately	Yes	342	85.5
if the eye is red or inflamed	No	27	6.8
	Sometimes	31	7.7

Regarding soaking CL, the study revealed that only 193 (48.3%) are soaking CL every night for more than 4 hours, while the rest of population are failed to do so regularly. Finally, the study exposed that the majority of participants with 342 (85.5%) take off CL when eye gets red or inflamed. However, 58 (14.6%) are not very keen to remove due to redness or inflammation. Eventually, Table 5 presents information related to the care of CL storage case. In the context of CL case replacement, very few participants with 20 (5.0%) are changing the case weekly. However, 220 (55.0 %) do the replacement in a monthly basis; while the rest are not considering CL case replacement, and they do so from time to time. In the context of sharing CL case with friends, we report that 49 (12.3%) of participants do sharing their case with others, 327 (81.8%) never shared and 24 (6.0%) did at times. Finally, in terms of inspection and screening, 291 (72.8%) of the participants do check CL before putting back in the case, 57 (14.2%) never and 52 (13.0%) do check sometimes.

4.6 Compliance level classification

Compliance level was classified into three categories, these are: High, Moderate and Low. This is related to the behaviors that are listed in Table 6, in which we reported 16 behavior and recommended action according to the designed questionnaire. According to (P. Morgan, 2007), a behavior is considered "High

if receiving 80 percent (or better pass) of respondents; however, it is considered "Moderate" and "Low" when receiving 40-80 percent and below 40 percent respectively. After analysing the obtained results, we report the compliance and non-compliance behaviors in Table 7.

Figure 2 shows the compliance level against wearers behavior. High level of compliance, in which the compliance rate is greater than 80% were reported on 5 aspects of

all behaviors, these are: sleep while wearing CL, showering while wearing CL, using saliva to clear CL, removing CL when eye gets red and sharing CL case with friends. Moderate level of compliance, in which the compliance rate is greater than 40 % and less than 80 %, were reported on 9 aspects of all behaviors, these are: Sharing CL between users, Overuse of CL, Using CL solution after its expiry, Using water to clear CL, Clean CL after its removal, Adherence to instruction of CL cleaning, Soaking CL more than 4 hours a

night, Checking CL for damage and Hand washing before using CL. Low level of compliance, in which the compliance rate is less than 40 %, was reported on two aspects of all behaviors, these are: rubbing CL with fingers before soaking and cleaning and rinsing of CL case. Figure 3 shows the compliance level for individual respondents in which we calculated the ratio of those who were fully compliant, moderate and low according to the 16 behaviors of Table 7. Furthermore, we demonstrated a correlation between the compliance levels and some other behaviors from Table 1 and 2. The results of the correlational analysis are presented in Table 8 in which the level of compliance was associated with other factors such as medical field, visiting ophthalmologist, purpose of wearing, have refractive, type of contact lens and modality of CL. Further discussion on these results will be presented in the next section.

Table 5: Storage case statistics.

CL storage case		No.	%
Cleaning and rinsing of CL case (after use)	Yes	258	64.6
	No	142	35.4
CL case replacement	Weekly	20	5.0
	Monthly	220	55.0
	Never	-	-
	Sometimes	160	40.0
Sharing CL case with friends	Yes	49	12.2
	No	327	81.8
	Sometimes	24	6.0
Checking CL for damage and infection before insertion into the case	Yes	291	72.8
	No	57	14.2
	Sometimes	52	13.0

‘

Table 6: Compliant behaviors included in the designed questionnaire.

No.	Behavior	Compliance	Non-compliance
1	Sharing CL between users	73.8 %	26.2 %
2	Ever slept while wearing CL	87.5 %	12.5 %
3	Showering while CL wearing	93.3 %	6.7 %
4	Overuse of CL	71.8 %	28.2 %
5	Using CL solution after its expiry	78.8 %	21.2 %
6	Using water to clear CL	46.3 %	53.7 %
7	Using saliva to clear CL	92.3 %	7.7 %
8	Clean CL after its removal	55.8 %	44.2 %
9	Adherence to instruction of CL cleaning	55.0 %	45.0 %
10	Rubbing CL with fingers before soaking	22.3 %	77.7 %
11	Soaking CL more than 4 hours a night	48.3 %	51.7 %`
12	Removing the CL when eye gets red	85.5 %	14.5 %
13	Sharing CL case with friends	81.8 %	18.2 %
14	Checking CL for damage	72.8 %	27.2 %
15	Cleaning and rinsing of CL case	35.4 %	64.6 %
16	Hand washing before using CL	74.7 %	25.3 %

Table 7: Complaint behaviors related to CL use answered by study population.

No.	Behavior	Recommended
1	Sharing CL case with friends	No
2	Ever slept while wearing CL	No
3	Showering while CL wearing	No
4	Overuse of CL	No
5	Using CL solution after its expiry	No
6	Using water to clear CL	No
7	Using saliva to clear CL	No
8	Clean CL after its removal	Yes
9	Adherence to instruction of CL cleaning	Yes
10	Rubbing CL with fingers before soaking	Yes
11	Soaking CL more than 4 hours a night	Yes
12	Removing the CL immediately when eye gets red	Yes
13	Sharing CL case with friends	No
14	Checking CL for damage	Yes
15	Cleaning and rinsing of CL case	Yes
16	Hand washing before using CL	Yes

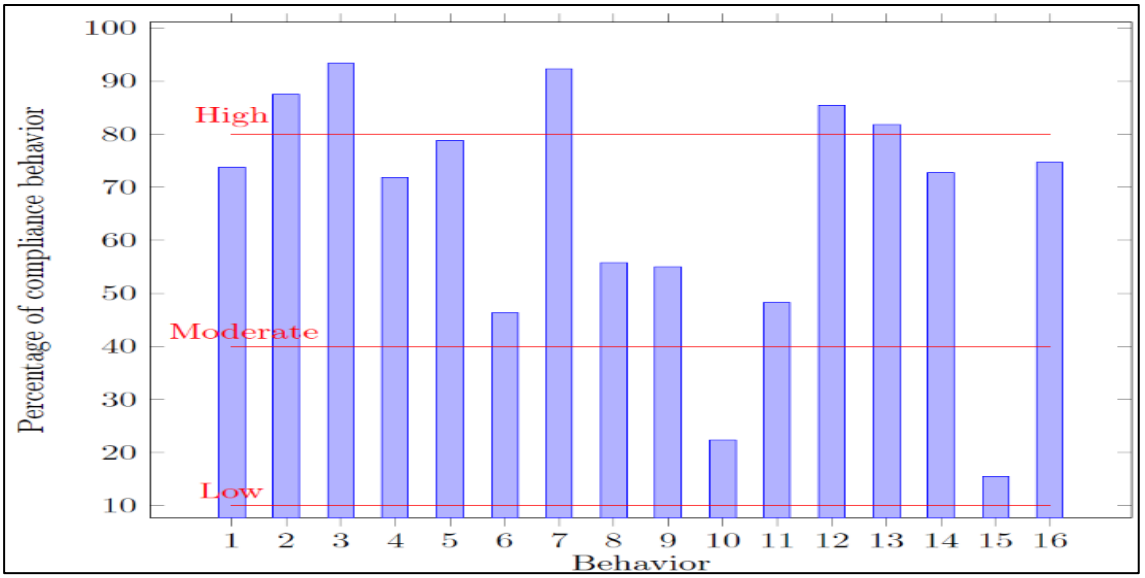

Figure 2: Complaint behaviors related to the usage of CL responses according to Table 6.

Table 8: Correlation between compliance levels and other factors.

		Compliance Level						P value
		Low		Moderate		High		
		No	%	No	%	No	%	
Have refractive error	Myopia	19	19.0	63	63.0	18	18.0	0.055
	Hyperopia	6	28.6	14	66.7	1	4.8	
	None	61	30.2	129	63.9	12	5.9	
	Astigmatism	6	24.0	16	64.0	3	12.0	
	Myopia + Astigmatism	7	14.9	32	68.1	8	17.0	
	Hyperopia + Astigmatism	1	20.0	3	60.0	1	20.0	
Visited ophthalmologist	Yes	50	21.5	153	65.7	30	12.9	0.070
	No	50	29.9	104	62.3	13	7.8	
Type of CL	Hydrogen	4	16.7	17	70.8	3	12.5	0.0001*
	RGP	32	16.9	122	64.6	35	18.5	
	Silicone	64	34.2	118	63.1	5	2.7	
Modality of CL	Disposable	16	25.0	39	60.9	9	14.1	0.636
	Monthly	29	29.6	59	60.2	10	10.2	
	Yearly	55	23.1	159	66.8	24	10.1	
Purpose of CL wearing	Cosmetic	82	29.8	178	64.7	15	5.5	0.0001*
	Refraction	18	14.4	79	63.2	28	22.4	
Daily duration of CL wearing	5---7	78	23.7	215	65.3	36	10.9	0.714
	8---11	18	32.7	32	58.2	5	9.1	
	=>12hours	4	25.0	10	62.5	2	12.5	
Medical field person	Yes	30	17.3	117	67.6	26	15.0	0.002*
	No	70	30.8	140	61.7	17	7.5	

*Significant difference between percentages using Pearson Chi-square test (^{2}-test) at 0.05 level.

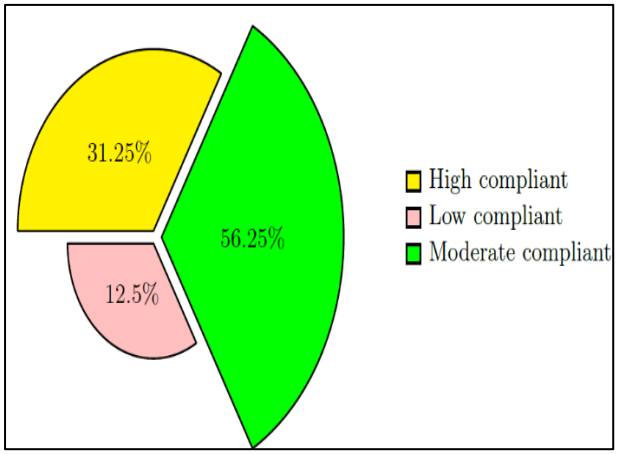

Figure 3: The compliance percentage based on the study population.

5. DISCUSSION

The main aim of this study is to assess the compliance with CL wear and care, hence, in this section, we discuss and compare the obtained results against those from the state-of-the-art.

5.1 High level of compliance behaviors

Our observation regarding "no sleep while wear CL" was only 12.5 % of the study respondents were non-compliant, which makes the overall rate of this habit marked as high compliance. High compliance rate in this habit was comparable to the study by (Bakkar & Alzghoul, 2020) where the reported compliance rate was 95.7%. The return rate is also similar to the study by (Garcia-Ayuso et al., 2022)where the non-compliance reported rate of this habit was 9.8 %, reflecting significant adherence as well.

Another high compliance rate of the study respondents was reported in "no showering while wearing CL" since 93.3% of the population admitted their adherence to the recommended action.

On one hand, the high rate of compliance shown here was consistent with the findings of Sapkota (Sapkota, 2015) where the majority of the study participants showed high compliance in preventing their CL from coming into touch with water when bathing or swimming.

Our findings dis-agreed with those reported in (Bakkar & Alzghoul, 2020) and (Uzel et al., 2018) as both studies showed moderate compliance with 55.7% and 45.0% respectively. Regarding the habit of "using saliva to clear CL", our study showed that only 7.7% of respondents were non-compliant and hence the high level. A high percentage of compliance in this habit was comparable to what earlier studies found. For instance, (Bakkar & Alzghoul, 2020) reported 2.8 % the rate of the non-compliance to this behavior and similarly, (Garcia-Ayuso et al., 2022) found that 85.2% is the compliance rate against this habit. Our study also shows a high rate of compliance in terms of "removing CL when eye gets red" and "sharing CL case" with 85.5 % and 81.8 % respectively.

5.2 Moderate level of compliance behaviors

In this regard, we observed that 28.2 % and 21.2% of study population admitted having worn CL longer than recommended replacement and used the solution after its expiry date respectively. It's probable that this is due to concerns about money, given that students often have a restricted budget and want to save costs by putting off lens replacement for as long as feasible. The study in (Noushad et al., 2012) revealed that 23% of the university students in south India are non-compliance with regard to their lens replacement routine. Similarly, (Garcia-Ayuso et al., 2022) showed that 28.6 % of the university students in Spain are also non-compliance with this behavior. Also, (Claydon & Efron, 1994) found that 65% of this behavior

were non-compliant. While according to the findings in (P. B. Morgan et al., 2011), the non-compliance rate of such behavior was 35%. The study in (Uzel et al., 2018) found that 28% of ophthalmologists in their study were non-compliant, while 48% was the rate of lay people. Our observation on this is that the non-compliance rate of lens replacement habit among students, e.g. in Iraq, Spain and India, is relatively close, however; it's lower reported in this study compared to other studies.

Moderate levels of compliance were also recorded for adherence to instruction of CL cleaning such as rubbing and rinsing where 45.0% were reported as noncompliant with this behavior. There have been a number of research studies that show a modest level of adherence to recommended practices for effective lens cleaning; for instance, 44.3% according to (Bakkar & Alzghoul, 2020), 58% according to (P. B. Morgan et al., 2011) and 47% according to (Claydon & Efron, 1994). Sharing CL between users also reported as a moderate compliant behavior in this study since 26.2% of population were non-compliant. The majority of the participated students with 68.8% admitted that they used CL for cosmetic purposes. It is probably that students believe if CL is not for refraction purposes, then it is not risky share.

Moreover, only 32.0% of the population got their CL from an eye care practitioner and a lack of knowledge on how sharing can damage the health of eyes and put the vision at risk. We observed that compliance rate of this behavior was higher, i.e., 92.4%, in some studies such as (Bakkar & Alzghoul, 2020). It seems that medical students in Vajira hospital (Thailand) have the highest level of compliance regarding this habit according to (Preechaharn & others, 2020) who found that only 1 out of 116 participants was non-compliant. In their discussion of share CL with others, (Wagner et al., 2014) pointed out that one out of every four students may be sharing their CL items with friends without knowing its consequence. This study also shows a moderate compliance level of "using water to clean CL" habit with rate of 53.7% of non-compliant participant. Despite the high risk of cleaning lenses with tap water, we found that only 46.3% of the population were complaint. This revealed that many individuals who use contact lenses do not realize that tap water and CL should not mix. In contrast, and compared with other investigations, (Bakkar & Alzghoul, 2020) showed that 97.2% of the study that conducted in Jordan were compliant to this habit. Similarly, Garcia-Ayuso et al. (2022) found that 14.8% of students in Spain were non-complaint to this behavior. Cleaning CL immediately after wearing is a must, where that can be done simply through rubbing it back and forth in a straight line with a few drops of cleaning solution. We found that such habit is of moderate compliance with 55.8%. The recently published report by the Contact Lens Institute revealed that consumers do not know as much about CL as the eye care industry may think. There was an observation about worrisome disinformation and an obvious lack of knowledge, which can be successfully handled by the practitioners and/or doctors. This might need just few extra seconds of talk to users in order to boost patient knowledge and satisfaction. We also observed that "soaking CL more than 4 hours a night" and "checking CL for damage" received a moderate level of compliance with 48.3% and 72.8% respectively. It has been shown that the contamination level of CL case is associated with the recommended soaking and cleaning procedure as well as on the effectiveness of disinfecting solutions used for rinsing (Wu et al., 2015). Finally, the compliance level of hand washing before using CL was moderate where only 25.3% were non-compliant to this habit. In this same vein, Garcia-Ayuso et al.

(2022) observed that 69.0% was the compliance rate of this behavior. Interestingly, Wagner et al. (2024) hold the view that young adults are more likely to be non-compliant for this habit. Whereas, in contrast, Bakkar et al. (2020) found considerable positive results where high compliance with 95.7% in their study was reported.

5.3 Low level of compliance behaviors

This part presents a comparison between the low compliant behaviors of this study with those from the state-of-the-art. First, we noticed that the worst level (with 22.3%) of compliance is reported by those who are not rubbing CL via their fingers before soaking. These results are similar to those reported by Garcia-Ayuso et al. (2022) where 28.0% of participants were non-compliant to this behavior through never rubbing or rinsing their CL. However, Bakkar et al. (2020) is different from Garcia-Ayuso et al. (2022) and our finding by revealing such habit is of moderate compliance with 55.7%. Second, with 35.4% of compliance, the behavior of cleaning and rinsing CL case was reported as the second worst case behavior in this study despite its importance. Congruent with our findings, in their study on 101 university students in Hong Kong, according to (Hall & Jones, 2010) stated that 68.0% of the study population (students) were non-compliant to this habit. The authors in (Yung et al., 2007) claimed that even when providing a proper advice on how to clean the CL case, there will be always a percent of users who are not following as shown in their study that 65% of wearers remained non-compliant to the case cleaning behavior. The American Optometric Association (AOA) has emphasized the crucial role of this behavior. Usually from 5 to 10 seconds of rubbing and rinsing is of importance and no matter what is the CL type. Also, AOA has provided irrefutable proof that rubbing and washing the lens after use results in the safest wear for all types of contact lenses and care systems that are now available on the market. The obtained results are in line with the outcome of Figure 1, where high compliant behaviors are of 31.25%, moderate compliant behaviors are of 56.25% and low compliant behaviors are of 12.5%. Such further analysis showed that the majority of the study population lies in the moderate level of compliance. It is also showed that the minority of the study population lies in the low level of compliance.

In many facets of contact lens care, the present research revealed high to moderate levels of compliance overall. Our findings seem to be in line with and comparable to some reported results from the state-of-the-art.

5.4 Factors correlated to the compliance behaviors

Recall the findings of Table 8, we are running an additional analysis on those findings which is required to build an association according to the compliance behavior rate. Our analysis shows that the majority of participants who have refractive error are of acceptable compliance with up to 60% in general. Similarly, it reveals that those who visited an ophthalmologist have relatively better compliance compared to those who did not. Regarding the type of CL, it is shown that those who are wearing Silicone CL are less complaint than those who use Hydrogel and RGP ones. This might encounter some risk factors. For instance, according to most of the epidemiology studies, it revealed that a doubling of the rate of corneal infiltrates with overnight wear of silicone hydrogels compared to that found with hydrogel according to (Szczotka-Flynn & Diaz, 2007) and (Stapleton et al., 2007). In terms of modality, we found that those who are using the yearly and disposable CL are more likely to adhere to CL usage recommendation than the monthly

wearers. Also, the table reveals that those who are using CL for cosmetics are less complaint than those who are using it for therapeutic purposes. The reason is attributed to the CL wearers remissness in adhering to the recommendations, where this could lead to the risk of microbial contamination (Thakur & Gaikwad, 2014).

Finally, we found that the compliance behavior of medical field participants with is higher than the non-medical field. This could suggest that medical field people are either (a) already aware about the risk of the improper use of CL or (b) more educated by their previous studies.

6. CONCLUSION

In this study, we investigated the CL compliance rate among university students in Iraq. The study showed high to moderate compliance. The study findings, on the other hand, revealed that further efforts are required to educate users and promote lens wearing and caring practices. Better strategies were recommended to further increase levels of compliance among contact lens wearers in Iraq related to adherence to the recommendations.

Although this study is targeted contact lens wearers from a university student's population, a future study is recommended to include larger sample of contact lens wearers from the general lay population.

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We acknowledge that all the references are listed in the reference list and written in **APA 7th (American Psychological Association) format** using Mendeley reference manager software.

Ethical approval

The present study Which is conducted by authors **Dr. Abeer Imad Al-Dahhan** and **Dr. Salah Zuhair Al-Asadi** was approved by the local Department of the **Iraqi Board for Medical Specializations** committee.

Statement of Permission and Conflict of Interests

The authers declare that there is no conflict-of-interest associates with this submission.

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