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Original Research Article.

Compliance with Hygiene Rules Related to Use of Contact Lenses and Its Impact Among Users: A Cross-Sectional Study

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ABSTRACT

Background: Although the use of contact lenses is a practical and aesthetic solution due to its ability to provide an effective vision correction and comfort, users are exposed to increased risk of complications because of inadequate related-hygiene.

Objectives: To assess the level of compliance among contact lens wearers with related hygiene rules and the prevalence of associated eye complaints, and to determine the demographic factors of compliance and the correlation between compliance and eye complications.

Materials & Methods: A Cross-sectional study was conducted at ophthalmology clinic of a tertiary care hospital and a large shopping mall in Jeddah, Saudi Arabia. Contact lens wearers (N=500). Most of the participants were young aged (21-40 years; 89.2%) females (95.8%) with a high educational level (university+; 85.4%), who were regular (30.2%) or irregular (69.2%) contact lens wearers. Participants were interviewed regarding their compliance with general hygiene rules related to contact lens, such as use of sterile solution, change of solution, lens washing, etc. (10 items). A compliance score (0-10) was calculated as the number of rules to which the participant is fully compliant. Ocular symptoms like eye pain, redness, and blurred vision, were investigated. Sociodemographic data were analyzed as factors for compliance and correlation of compliance scores with the presence and number of ocular complaints.

Results: Contact lenses were used for cosmetic purpose (47.8%), and for refractive errors (38.6%); and most frequent lens type was monthly (42.6%). Results showed that 22.6% participants changed sterile solution daily; 15.8% changed the lens box monthly, 81.2% washed their hands before, 89.6% washed lens before and 33.2% after wearing the lenses, and 37.2% followed the correct washing method. The mean (SD) compliance score was 4.67 (1.60) and females had a moderately higher score than men (*P*=.036). The majority of participants (93.0%) reported eye complaints and 73.6% had two or more concomitant symptoms. Sleeping with lenses was associated with reduced eye complaints (*P*=.015), while infrequent change of the solution was associated with higher risk (*P*=.027). No statistically significant correlation was found with other hygiene rules or compliance score.

Conclusions: Contact lens wearers have poor compliance with several hygiene rules resulting in the high prevalence of eye complaints. Therefore, it is important to educate the target population to prevent serious eye complications.

Limitations: Subjective measurement of eye complaints relying only on self-reported symptoms.

Keywords: Compliance, Hygiene Rules, Contact Lenses Wearers.

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INTRODUCTION

In 2005, the number of contact lens users worldwide were reported to be 140 million and the trend is increasing since last two decades.[1] In Saudi Arabia, a survey among Saudi women estimated that 70.2% of women were using contact lenses, majorly (approximately 2 out 3) for cosmetic purpose.[2] According to the data from the U.S. reports, approximately 41 million adult contact lens wearers were reported in 2015, representing 16.7% of U.S adults in the same year.[3]

Although use of contact lenses is a practical and aesthetic solution due to its ability to provides an effective vision correction and comfort, users are exposed to increased risk of complications because of inadequate related-hygiene.[3] Wearing contact lenses represents an important risk factor for developing microbial keratitis.[4] It is incriminated in several eye infection outbreaks, with a rise of atypical infections such as *Acanthamoeba* keratitis and *Fusarium* keratitis that were reported in several countries.[5-7] These eye complications are known to affect 2 out of 1,000 contact lens users, leading severe outcomes like blindness, in addition to consequent care expenditures.[4,8,9] Studying contact lens-related eye complications and their associated risk factors have enabled

determining safe lens wear modalities and hygiene rules, which are generally well known by eye specialists and practitioners.[1] These modalities include general hygiene rules such hand cleaning before wearing lenses, as well as specific rules like lens rinsing, disinfection, storage, replacement frequency, etc. Compliance with these rules was demonstrated to improve contact lens-related eye symptoms and associated complications.[10] However, majority of studies have reported poor compliance with these rules among 40% to almost 100% of users, which constitutes a supplemental challenge for the prevention against these eye complications.[11-14] A high proportion of contact lens users do not consult an eye specialist prior to begin its use,[2] which might be limiting awareness about the related hygiene rules thereby increasing the risk of further complications.

Therefore, it is crucial to assess the level of awareness and compliance with hygiene rules among contact lens users and the associated eye outcomes and to investigate the factors of poor compliance. Studying these factors may help define the relevant preventive measures and targeted awareness rising campaigns within a particular population, to reduce the rate of related eye complications.

This study aims to assess the level of compliance among contact lens users with related hygiene rules in Jeddah, Saudi Arabia; and to determine the prevalence of associated eye complaints, as well as the demographic and clinical factors of compliance with hygiene rules.

METHODS

A cross-sectional study was carried out among cosmetic and therapeutic contact lens users, between May 2016 and June 2016. Participants (N=500) were recruited among patients attending the ophthalmology clinic at King Abdulaziz University Hospital (KAUH), Jeddah, Saudi Arabia; as well as among visitors of a large shopping mall in Jeddah. A semi-structured questionnaire was administered to investigate the compliance with general hygiene rules related to contact lens wearing, such as change of sterile solution, change of solution can, lens washing before and after usage, hand washing, etc. (10 items). A compliance score (0-10) was calculated as the number of rules to which the participant is compliant. Ocular symptoms including eye pain, redness, dryness, tearing, blurred vision, and photophobia were investigated. The eye outcome was defined as the number of symptoms and divided into three categories: 1) none; 2) 1; 3) 2 symptoms or more. Participants were also interviewed about the presence and severity of an eye irritation and patient's attitude in case of irritation (go to doctor, wait next day, do nothing, or remove lenses). Demographic and socioeconomic factors such as age, gender, and educational level, as well as lens type, frequency of use and purpose (cosmetic, therapeutic, or both) were analyzed as factors for both compliance and eye complications. In addition, correlation of compliance and compliance score with incidence and number of ocular symptoms were analyzed. The study was approved by the institutional review board of KAUH.

Statistical Methods

Statistical analysis was performed with the Statistical Package for Social Sciences version 21.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to present participants characteristics, contact lens usage pattern, compliance levels with different hygiene rules and the number of eye complaints. For each hygiene rule, a compliance rate was calculated as the percentage of participants who declared being strictly compliant with the given rule and results were presented as a frequency and percentage in a bar chart. Analytical statistics was used to study the factors of compliance with hygiene rules, as well as factors of eye outcomes and correlation between compliance and eye outcomes. Compliance score showed a bell-shaped distribution and was analyzed using independent *t*-test and OneWay Analysis of Variance (ANOVA), as appropriate. Results were presented as mean±standard deviation (SD). Variables used to analyze eye outcome included presence of eye complaints (yes/no) and number of eye complaints (0, 1, 2 or more). Chi-square test was used to analyze the correlation between these two categorical variables. A p value of <0.05 was considered to reject the null hypothesis.

RESULTS

Participants' Characteristics

Majority of the participants were females (95.8%), aged 21-40 years (89.2%) with high educational level (university+; 85.4%). Pattern of contact lens use showed that 30.2% of participants were regular users, mostly using yearly (31.4%) or monthly (42.6%) lenses; with cosmetic purpose being the first usage purpose in 47.8% followed by refractive error in 38.6%. Contact lenses price ranged between 151-300 Saudi Riyal (approximately US$40-80) in 34.2% of the users (Table 1).

Compliance with Hygiene Rules and Ocular Outcomes

Analysis of compliance with hygiene rules showed that 60.6% used specific sterile solution for lens disinfection, 22.6% only changed sterile solution daily, 15.8% changed the lens box regularly (monthly), and 10.6% only wetted lens regularly. On the other hand, 81.2% declared washing their hands and 89.6% washing the lenses before use; however, only 37.2% followed the appropriate lens washing method. Furthermore, 3.4% declared sleeping with their lens and 65.0% declared using make-up after lens wear (Table 2). Compliance rates to all investigated hygiene rules are depicted in Figure 1.

Regarding ocular outcomes, prevalence of eye complaints was 93.0% (95%CI=90.4; 95.1%) and 73.6% reported having or having experienced 2 or more relevant symptoms. Eye irritation was reported in 18.8% cases and moderate to severe irritation in 52.4%, ultimately resulting in removal of lenses in 76.0% and doctor visit in only 5.4% (Table 2).

Factors of Compliance with Hygiene Rules

Compliance score (min=0; max=10) was relatively higher among female participants (mean [SD]=4.70 [1.59]) when compared with male participants (3.95 [1.77]) and the difference was statistically significant (*P*=.036). No significant difference in compliance score was observed across other demographic parameters such as age (*P*=.144) or educational level (*P*=.807). No significant difference was found reported between different lens types (*P*=.500), regular and irregular users (*P*=.847), usage purpose (*P*=.238) and lens price (*P*=.449) (Table 3).

Factors of Eye Complications

Participants of Saudi nationality had a higher prevalence of eye complaints (94.9% versus 81.8%; p=0.004), with 2 or more eye complaints reported in 74.8% versus 59.1% (*P*=.002) in non-Saudi participant. The prevalence of eye complications among contact

lens users was relatively higher among females and old age people (21+ year old), as compared with their counterparts; however, the differences were not statistically significant. No remarkable difference in prevalence of eye complications was observed between use of different lens types (*P*=.786), regular and irregular users (*P*=.870), usage purpose (*P*=.251) or lens price (*P*=.389). As to the number of eye complaints, no statistically significant association was observed with the previous factors (Table 4).

Correlation between Eye Outcomes and Compliance with Hygiene Rules

The prevalence of eye complications was 100% among contact lens users who declared that they never change the solution, while it ranged between 88.1% and 94.9% among those who declared changing the solution at least every 6 months and the difference was statistically significant (*P*=.027). Paradoxically, participants who declared always sleeping with the contact lenses were less likely to have an eye complication (76.5%; versus 93.1% and 96.7%; *P*=.015) and complained less frequent 2 or more symptoms (70.6% versus 72.3% and 83.6%; *P*=.017), when compared to those who never or sometimes sleep with the lenses, respectively. Analysis of compliance with other hygiene rule showed no statistically significant correlation with the prevalence of eye complications or number of eye complaints (Table 5). Additionally, no statistical significant difference in compliance score was observed between participants who reported eye complications (mean=4.69/10) and those who reported having no eye complications (4.34/10; *P*=.210); as well as between those who reported none (4.34/10), one (4.80/10) and 2 or more (4.67/10) symptoms (*P*=.343).

Table 1: Participants characteristics (n=500) and pattern of contact lens wearing.

PARAMETER	CATEGORY	FREQUENCY	PERCENTAGE
Gender	**Male**	21	4.2
	Female	479	95.8
Age (years)	**15-20**	40	8.0
	21-40	446	89.2
	41-60	14	2.8
	>60	0	0
Educational level	**Up to primary**	0	0
	Middle school	5	1.0
	Secondary	68	13.6
	University+	427	85.4
Nationality	**Saudi**	429	85.8
	Non-Saudi	44	8.8
	Not Specified	27	5.4
Residency	**Popular house**	9	1.8
	Apartment	231	46.2
	Villa	255	51.0
Career	**Field**	305	61.0
	Office	164	32.8
	Not Specified	31	6.2
Lens type	**Daily**	101	20.2
	Weekly	19	3.8
	Monthly	213	42.6
	Yearly	157	31.4
	More than one type	7	1.4
Wearing frequency	**Regular**	151	30.2
	Irregular	349	69.8
Usage purpose	**Refractive error**	193	38.6
	Cosmetic	239	47.8
	Therapeutic	12	2.4
	Multiple purposes	56	11.2
Cost (SAR per pair)	**30-60**	4	0.8
	61-150	95	19.0
	151-300	171	34.2
	> 300	32	6.4

Because of missing data, all frequencies do not sum up to the total; SAR: Saudi Riyal

Table 2: Compliance with hygiene rules and eye complications among contact lens wearers.

PARAMETER	CATEGORY	FREQUENCY	PERCENTAGE
COMPLIANCE WITH HYGIENE RULES			
Sterile solution used	**Specific**	303	60.6
	Generic	197	39.4
Frequency of solution change	**Everyday**	113	22.6
	Every 2 days	45	9.0
	Every 3 days	80	16.0
	>3 days	258	51.6
Frequency of lens box change	**Monthly**	79	15.8
	Every 2 months	52	10.4
	Every 3 months	96	19.2
	>3 months	265	53.0
Frequency of solution can change	**< 3 months**	158	31.6
	3-6 months	162	32.4
	>6 months	159	31.8
	Never	17	3.4
Lens wetting	**Always**	53	10.6
	Sometimes	34	6.8
	No	411	82.2
Hand washing before lens wearing	**Yes**	406	81.2
Lens washing before use	**Yes**	448	89.6
	No	47	9.4
	Not specified	5	1.0
Lens washing method	**Correct**	186	37.2
	Incorrect	261	52.2
	Not applicable	47	9.4
Lens washing after usage	**Regularly**	166	33.2
	Sometimes	59	11.8
	No	78	15.6
Sleep with lens	**Yes**	17	3.4
Using make-up	**Before lens wearing**	148	28.6
	After lens wearing	325	65.0
Swimming with lens	**Never**	399	79.8
	Sometimes	38	7.6
	Yes	63	12.6
Long nails	**Yes**	235	47.0
OCULAR OUTCOMES AND ATTITUDE			
Eye complaint	**(prevalence)**	465	93.0
Number of eye symptoms	**None**	35	7.0
	One	97	19.4
	2 or more	368	73.6
Lens-induced eye irritation	**Yes**	94	18.8
	No	141	28.2
	Moderately	262	52.4
Attitude regarding irritation	**Go to doctor**	27	5.4
	Wait next day	48	9.6
	Do nothing	45	9.0
	Remove lens	380	76.0

Because of missing data, all frequencies do not sum up to the total

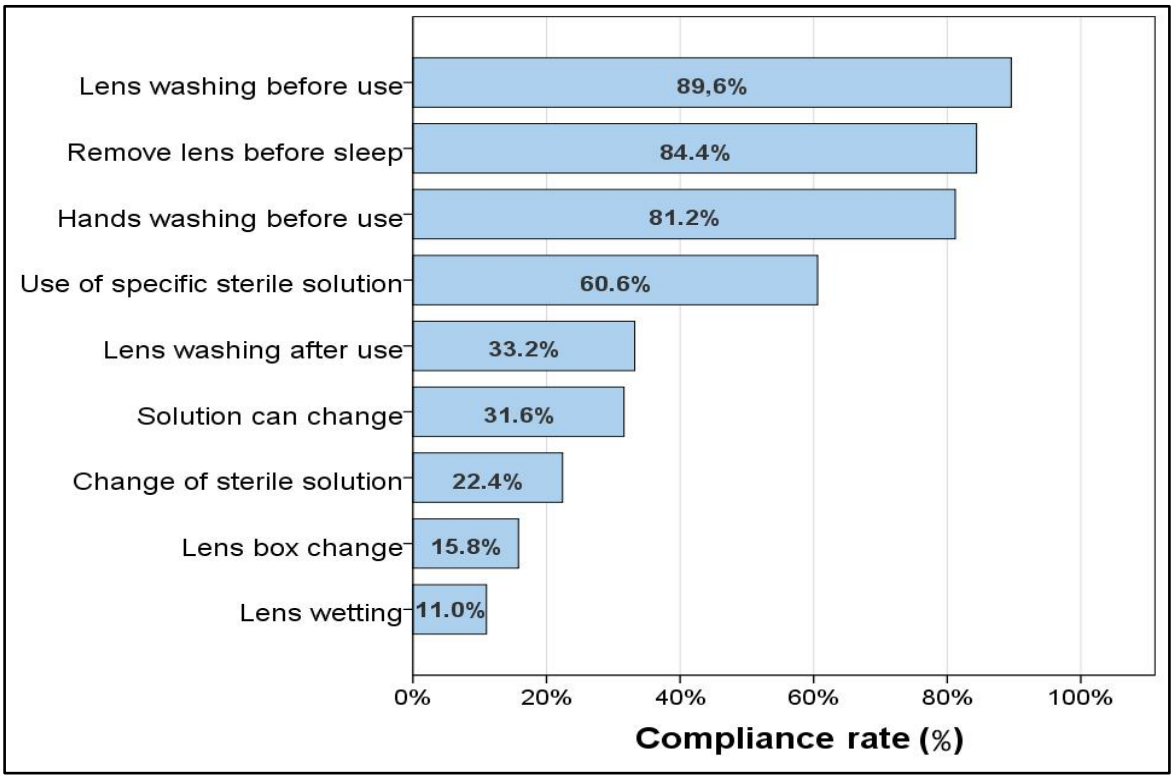

Figure 1: Compliance rates to all investigated hygiene rules

Table 3: Factors of compliance with hygiene rules.

PARAMETER	CATEGORY	COMPLIANCE (SCORE)		
		Mean	SD	*P* value
Gender	**Male**	3.95	1.77	.036*
	Female	4.70	1.59	
Age (years)	**15-20**	5.03	1.37	.144
	21+	4.64	1.62	
Educational Level	**Up to secondary**	4.71	1.62	.807
	University+	4.66	1.60	
Nationality	**Saudi**	4.69	1.62	.458
	Non-Saudi	4.50	1.58	
Residency	**Popular house**	5.67	0.87	.160
	Apartment	4.66	1.49	
	Villa	4.63	1.71	
Career	**Field**	4.70	1.55	.336
	Office	4.55	1.71	
Lens type	**Daily**	4.79	1.95	.500
	Weekly	4.58	1.39	
	Monthly	4.63	1.59	
	Yearly	4.59	1.40	
	More than 1 type	5.57	1.27	
Wearing frequency	**Regular**	4.65	1.65	.847
	Irregular	4.68	1.57	
Usage purpose	**Cosmetic**	4.58	1.43	.238
	Therapeutic (+/-cosmetic)	4.75	1.74	
Cost (SAR per pair)	**Up to 150**	5.03	1.50	.449
	151-300	5.06	1.49	
	> 300	5.41	1.64	

*Statistically significant result ($P<0.05$); statistical tests used; independent t-test or Oneway ANOVA as appropriate.

Table 4: Factors of eye complications among contact lens wearers.

Parameter	Category	Eye complaints			Number of eye symptoms						
					0		1		2 or more		*P* value
		Freq.	%	*P* value	Freq.	%	Freq.	%	Freq.	%	
Gender	Male	18	85.7	.175[F]	3	14.3	2	9.5	16	76.2	.249
	Female	447	93.3		32	6.7	95	19.8	352	73.5	
Age (years)	15-20	35	87.5	.185[F]	5	12.5	10	25.0	25	62.5	.191
	21+	430	93.5		30	6.5	87	18.9	243	74.6	
Educational Level	Up to secondary	68	93.2	1.000[F]	5	6.8	12	16.4	56	76.6	.778
	University+	397	93.0		30	7.0	85	19.9	312	73.1	
Nationality	Saudi	407	94.9	.004*[F]	22	5.1	86	20.0	321	74.8	.002*
	Non-Saudi	36	81.8		8	18.2	10	22.7	26	59.1	
Residency	Popular house	8	88.9	.625	1	11.1	1	11.1	7	77.8	.865
	Apartment	218	94.4		13	5.6	46	19.9	172	74.5	
	Villa	236	92.5		19	7.5	50	19.6	186	72.9	
Career	Field	288	94.4	.056	17	5.6	58	19.0	230	75.4	.139
	Office	147	89.6		17	33	33	20.0	114	69.5	
Lens type	Daily	95	94.1	.786	6	5.9	16	15.8	79	78.2	.306
	Weekly	18	94.7		1	5.3	3	15.8	15	78.9	
	Monthly	199	93.4		14	6.6	36	16.9	163	76.5	
	Yearly	143	91.1		14	8.9	39	24.8	104	66.2	
	More than 1 type	7	100.0		0	0.0	3	42.9	4	57.1	
Wearing frequency	Regular	140	92.7	.870	11	7.3	25	16.6	115	76.2	.571
	Irregular	325	93.1		24	6.9	72	20.6	253	72.5	
Usage purpose	Cosmetic	219	91.6	.251	20	8.4	46	19.2	173	72.4	.516
	Therapeutic (+/-cosmetic)	246	94.3		15	5.7	51	19.5	195	74.7	
Cost (SAR per pair)	Up to 150	93	93.9	.389	6	6.1	22	22.2	71	71.7	.150
	151-300	168	97.1		5	2.9	22	12.7	146	84.4	
	> 300	30	93.8		2	6.3	6	18.8	24	75.0	

Because of missing data, all frequencies do not sum up to the total; * statistically significant result (*P*<0.05);
[F]statistical significance calculated using Fisher's exact test;

Table 5: Correlation of eye outcomes with compliance with hygiene rules among contact lens wearers.

Parameter	Category	Eye complaints			Number of eye symptoms						
					0		1		2 or more		*P*
		Freq.	%	*P* value	Freq.	%	Freq.	%	Freq.	%	value
Sterile solution used	Specific	279	92.1	0.317	24	7.9	62	20.5	217	71.6	.409
	Generic	186	94.4		11	5.6	35	17.8	151	76.6	
Frequency of solution change	Everyday	107	95.5	0.233	5	4.5	22	19.6	85	75.9	.178
	Every 2 days	46	95.8		2	4.2	6	12.5	40	83.3	
	Every 3 days	76	95.0		4	5.0	12	15.0	64	80.0	
	>3 days	234	90.7		24	9.3	57	22.1	177	68.6	
Frequency of lens box change	Monthly	73	92.4	0.440	6	7.6	15	19.0	58	73.4	.491
	Every 2 months	53	98.1		1	1.9	7	13.0	46	85.2	
	Every 3 months	90	93.8		6	6.3	22	22.9	68	70.8	
	>3 months	244	92.1		21	7.9	52	19.6	192	72.5	
Frequency of solution can change	< 3 months	150	94.9	0.027*	8	5.1	25	15.8	125	79.1	.008*
	3-6 months	154	95.1		8	4.9	42	25.9	112	69.1	
	>6 months	140	88.1		19	11.9	27	17.0	113	71.1	
	Never	17	100.0		0	0.0	1	5.9	16	94.1	

Lens wetting	**Always**	52	98.1	0.187	1	1.9	9	17.0	43	81.1	.292
	Sometimes	30	88.2		30	7.3	83	20.2	298	72.5	
	No	381	92.7		4	11.8	4	11.8	26	76.5	
Hand washing	**Yes**	378	93.1	0.587	28	6.9	79	19.5	299	73.6	.462
before lens	**No**	28	96.6		1	3.4	3	10.3	25	86.2	
wearing	**Sometimes**	59	90.8		6	9.2	15	23.1	44	67.7	
Lens washing	**Yes**	418	93.3	0.362F	30	6.7	88	19.6	330	73.7	.487
before use	**No**	42	89.4		5	10.6	7	14.9	35	74.5	
Lens washing	**Correct**	173	93.0	0.596	13	7.0	44	23.7	129	69.4	.228
method	**Incorrect**	244	93.5		17	6.5	42	16.1	202	77.4	
	Not wash	42	89.4		5	10.6	7	14.9	35	74.5	
Lens washing	**Regularly**	158	95.2	0.875	8	4.8	33	19.9	125	75.3	.347
after usage	**Sometimes**	57	96.6		2	3.4	8	13.6	49	83.1	
	No	75	96.6		3	3.8	8	10.3	67	85.9	
Sleep with lens	**Yes**	13	76.5	0.015*	4	23.5	1	5.9	12	70.6	.017*
	No	393	93.1		29	6.9	88	20.9	305	72.3	
	Sometimes	59	96.7		2	3.3	8	13.1	51	83.6	
Using make-up	**Before lens wearing**	134	90.5	0.115	14	9.5	31	20.9	103	69.6	.215
	After lens wearing	307	94.5		18	5.5	61	18.8	246	75.7	
Swimming with	**Never**	59	93.7	0.670	4	6.3	7	11.1	52	82.5	.253
lens	**Sometimes**	372	93.2		4	10.5	5	13.2	29	76.3	
	Yes	34	89.5		27	6.8	85	21.3	287	71.9	
Long nails	**Yes**	219	93.2	1.000	16	6.8	40	17.0	179	76.2	.411
	No	245	92.8		19	7.2	57	21.6	188	71.2	
Lens-induced	**Yes**	91	96.8	.000089	3	3.2	18	19.1	73	77.7	.0000
irritation	**No**	120	85.1	*	21	14.9	34	24.1	86	61.0	74*
	A little	251	95.8		11	4.2	44	16.8	207	79.0	

Because of missing data, all frequencies do not sum up to the total; * statistically significant result (P<0.05);

DISCUSSION

The present study investigated the compliance with hygiene rules among contact lens users and reported the high percentage of noncompliance (up to 89.0%, as per the rule), resulting in a high prevalence (93.0%) of self-reported eye complications.

Demographic characteristics showed clear females predominance (95.8%) and relatively young age (97.2% aged ≤40 years) among the participants. This is concordant with the demographic picture of contact lens users in literature; such as Cope et al., Bhandari & Hung, and de Oliveira et al., who reported 82%, 74% and 69.2% of females among contact lens wearers, respectively.[3,13,15] While Wu et al. showed only 55% of females.[16] Regarding age, there is a significant discrepancy in available literature. Oliveira et al. reported young mean age 23.5 years, while Wu et al., reported 33.8 years. Moreover, in the study by Bhandari & Hung, 75% of the participants were age between 20-29 years; while 62% of the participants were older (aged>40 years) in the study by de Oliveira et al.[3,13,15,16] These observations indicate that the young females of the Saudi population are the most interested candidates for contact lens use.

Regarding the pattern of wearing lenses, most of the participants were irregular users (69.8%), and cosmetic purpose accounted for 47.8% of the usage. These figures are fairly comparable with Abahussin et al., who reported 50% of part-time users and 63.3% of cosmetic use.[2] However, Abahussin et al. included only female university students aged between 16 and 31 years.

In the study by Bhandari and Hung, 70% of respondents used contact lens to correct myopia.[15] Other pattern of use showed that majority of participants used lenses monthly (42.6%) or yearly (31.4%) disposable lenses, while only 20.2% used daily. This pattern is somewhat different from that reported by Bhandari and Hung, showing 53% of monthly disposable lens users and 35% of daily lens users.[15] A study by Dart et al. demonstrated that risk of microbial keratitis was significantly increased among daily disposal users,[4] probably because of relatively higher risk of forgetting to change the lenses. Compliance was best for regular washing of lenses before wear, which was reported in 89.6% of the cases followed by removal of lenses before sleep in 84.4% and washing of hands before wear in 81.2%. These three actions constitute the basic hygiene rules and may be intuitively perceived as important and easy to implement in the daily practice, regardless of the level of awareness of the individual. Literature has shown a high compliance with these three rules. According to Abahussin et al., 89.4% of the respondents declared adequately washing their hands before handling contact lenses, and 92.3% declared removing the lenses before sleep.[2] Similarly, study by WU et al. reported adequate hand hygiene and adequate lens cleaning among 89% and 87% of the participants, respectively. In study by Bhandari & Hung, compliance with hand washing before handling lenses was as high as 98%, while adequate lens rinsing was reported in 73.8%.[15]

Levels of compliance were lower for other hygiene rules including the use of specific lens solution (60.6%), washing lenses after use (33.2%), regular change of sterile solution (22.4%), lens box change (15.8%) and lens wetting (11.0%). According to Abahussin et al., better compliance regarding sterile solution change was reported in 72.7% of the cases.[2] Data reported in the study by Bhandari & Hung showed higher compliance with lens washing after use (75.4%), whereas compliance with lens box change was only 6.2%.[15] Cope et al. reported a compliance with the use of specific lens solution in 64.5%, which is similar to the observations of our study, while the remaining 35.5% declared using tap water to rinse the lens. However, the previous study reported that 50.1% replaced the lens box at recommended replacement frequency, which represents a higher compliance rate than that observed in our study.[3]

Other risk behaviors reported in literature such as swimming or showering in contact lenses, returning for aftercare, and sharing the contact lens with other persons were not investigated in the present study.[2,3,15,16] Nevertheless, all these studies reported insufficient level of compliance, which represents a great risk of eye complications. Commmonly, noncompliance with contact lens-related hygiene rules have been demonstrated to be superior to that with other medical recommendations. Statistics report up to 99% of noncompliance in some cases,[17] or at least one hygiene-related risk behavior found in almost 100% of the participants.[3,18]

Male gender was demonstrated to be the only factor significantly associated with poor compliance; however, the difference between the respective compliance scores was moderate (-0.75/10 points). Age, educational level, or pattern of wearing lenses were not significant factors of noncompliance with hygiene rules in the present study. These results are similar to those observed by Bhandari and Hung, who reported no significant association of compliance to hygiene rules with demographic factors.[15] Absence of impact of demographics may be explained by the homogeneity of the population of contact lens users; which is essentially composed of young, highly educated women, as previously demonstrated.

The second important finding of the present study is the very high prevalence of eye complaints, reported in 93% of the participants, and 73.6% of them had 2 or more concomitant symptoms. However, association of eye complication with compliance could not be demonstrated using compliance score, although it was only established with two hygiene rules (frequency of solution replacement and sleeping with the lenses). In the first association, the highest prevalence of eye complications (100%) was observed in participants who declared never changing the can; while the second one showed a paradoxical result, as participants who declared sleeping with their lenses had the lowest prevalence of eye complications.

Although symptoms investigated in this study do not accurately inform about the nature of the eye affection, the correlation between eye complications and noncompliance with a number of hygiene rules such as frequency of lens replacement, adequate storage and use of sterile solution, exposure to tap water or swimming with lens, sleeping with lens, etc., is established through several studies.[4,10,19,20] In addition, the low levels of compliance with hygiene rules are probably a major cause of the rise of atypical lens-related infections, such as *Acanthamoeba* keratitis and *Fusarium* keratitis.[6] Furthermore, contact lens-related infection outbreaks were demonstrated to be associated with the use of inadequate contact lens disinfection system.[7]

In view of the potential severity of eye complications, practitioners should emphasize on compliance with hygiene rules as a pillar in the prevention and aftercare of contact lens users. Compliance to medical regimens is a complex behavior that depends on several factors including patient's awareness level, knowledge, perception, and attitudes, in addition to personality factors like risk-taking, which is likely to explain 24% of noncompliance.[17,21] However, patient's education to standard hygiene rules are generally sufficient to ensure the adequate levels of compliance.[22] This indicates that practitioners should keep an awareness-raising attitude by means of simple recommendations. In addition, contact lens-related hygiene rules and lens care regimen may be perceived as inconvenient by a number of individuals and can constitute a reason for discontinuation of contact lens use.[23] This urges manufacturers to invest in designing of contact lenses with less constraining care regimen to enhance compliance and help in the prevention against eye complications.

The major limitation of this study is the subjective measurement of eye complaints relying only on self-reported symptoms, which may result in over- or underestimation of the eye morbidity among some participants. This may also explain the absence of statistical significance with noncompliance. Assessment of eye complication should be carried out using clinical examination and appropriate diagnostic methods for each affection.

CONCLUSION

There is poor compliance with hygiene rules among contact lens users in Western Saudi Arabia, ranging between 11% and 89.6% per hygiene rule, along with a high prevalence of eye complaints reported by 93% of the participants. Failure to replace the lenses was associated with higher prevalence of eye complications, whereas no significant correlation was demonstrated with the other hygiene rules or with overall compliance. There is urgent need to educate contact lens users to prevent serious eye complications, by means of providing optimal aftercare with simple awareness raising strategy. Further studies are warranted to assess the clinical significance of the reported eye complaints among contact lens users, using objective methods to accurately measure the associated eye morbidity.

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