

# Use and misuse of cosmetic contact lenses among US adolescents in Southeast Texas

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**Background:** Cosmetic contact lenses (CCL) are popular among adolescents, but incorrect use can harm the eye.

**Methods:** This study assessed CCL hygiene behaviors among adolescents attending a Texas pediatric clinic. Anonymous surveys about CCL hygiene practices were administered to adolescents 13–18 years old.

**Results:** We found that 14% (53/392) of respondents had worn CCL, of which 83% were females. Over 70% reported first use at <15 years old. Knowledge about CCL was low and two-thirds of users had not been instructed on proper care. More than half stored them in water and did not rinse them with contact solution after removal. Over one-third wore CCL >8 hours/day. Moreover, 15% of CCL users reported borrowing someone else's CCL. Complications resulting from wearing CCL were common.

**Conclusion:** This study highlights poor CCL hygiene among adolescents. These data demonstrate the need to develop interventions to educate adolescents on proper care and risks associated with CCLs.

**Keywords:** contact lens hygiene, decorative lenses, cosmetic contact lens use, contact lens complications

## Introduction

Cosmetic contact lenses (CCL), which change the appearance of the eye but do not correct vision, first appeared in the USA in the early 1980s.<sup>1</sup> These devices have become more popular over time and are often marketed to adolescents.<sup>2</sup> Wearers of CCL are typically females, may be of low socioeconomic status, and are frequently first-time contact lens users.<sup>3,4</sup>

Since they are classified as medical devices in the USA, purchasing CCL requires a prescription. However, as they are worn solely for cosmetic purposes, users may incorrectly assume that consultation with an eye care professional is not required.<sup>2,5</sup> As a result, users may purchase CCL from vendors who are not licensed to sell contact lenses or may obtain them from friends or family members.<sup>5,6</sup> Little is known about these practices, however, as almost no studies have been conducted on this topic.<sup>6</sup> The purpose of this study was to examine overall knowledge, personal use, and hygiene behaviors of adolescent CCL users to determine what type of interventions are needed.

## Methods

Adolescents 13–18 years of age receiving care in a pediatric clinic in Southeast Texas were approached between April 14, 2017 and May 16, 2018 and asked to complete an

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anonymous paper survey in English or Spanish. Survey completers received \$5. Adolescents were only approached once to take the survey. The study was presented and described to parents or guardians accompanying adolescents for their oral consent before adolescents were approached for the study. Adolescents of legal age to consent (18 years) were approached regardless of whether they were accompanied by parents or guardians. Completion of the self-administered paper was considered as consent, and written consent was waived by the Institutional Review Board (IRB) to ensure confidentiality of participants was maintained, and because the procedures were determined to be of low risk to participants. The University of Texas Medical Branch IRB approved all study procedures.

The survey described CCL as follows: “These are contacts that are used to change the look of your eyes, NOT to improve your vision. These contacts are sometimes called colored contacts, or costume contacts, or decorative contacts”. Pictures showed examples. Demographic questions included age, gender, race/ethnicity, whether born in the USA, and primary language. The survey was designed to ask about CCL knowledge and hygiene. All participants were asked about their knowledge related to CCL use, as well as whether they had seen an eye doctor in the past 12 months. Only participants who reported ever using CCL were asked to complete questions about CCL hygiene and use. The survey was 3 pages, and included 49 total questions. Age was dichotomized to compare CCL use for adolescents who are not legally allowed to drive (13–15 years) and those who are legally allowed to drive (16–18 years) according to age. This served as a proxy for increasing levels of independence. Participants were asked if they had visited an eye doctor in the last year. We compared the demographics of CCL users and nonusers to determine whether the characteristics of the two groups differed.

To assess knowledge about CCL, all participants responded to nine “true/ false” statements. Responses were scored and added to determine a knowledge score. Participants were assigned a score of 1 for each correct response or 0 for each incorrect response or a response of “not sure”. The correct responses were summed to determine each participant’s knowledge score. Participants who scored 0–2 were considered to have a low knowledge score, those with a combined score of 3–4 were considered to have a medium level of knowledge, and those scoring 5+ correct responses were considered to have a high level of knowledge about CCL. One-way ANOVA was used to determine the differences between the means of knowledge scores of CCL users and other participants. We also conducted a nonparametric Kruskal–Wallis one-way ANOVA test. We made comparisons

between CCL users and nonusers to determine whether CCL users had more knowledge about CCL than nonusers in the study. This information allows us to understand whether CCL users need more education, or if they understand important facts about CCL and do not need the information.

Those who reported prior CCL use were asked about their age at first CCL use, place of purchase, whether their parents knew they used CCL, instructions received, eye drop use, hygienic practices, and whether they had experienced CCL-related complications.

Statistical analyses were conducted using SAS Statistical Software version 9.4 (Cary, NC, USA). A *P*-value <0.05 was considered significant. Descriptive analyses included chi-square tests for bivariate analyses of categorical data. A power analysis was conducted to determine whether power was adequate to detect a clinically meaningful difference of 20% between CCL user and nonuser groups. Power analyses demonstrated that this study would achieve >80% power to detect group differences of 20%.

## Results

The response rate was 91% (395/436). We typically achieve a high response rate in our clinics, as patients are approached while they are waiting for a nurse to show them to an exam room, and are often interested in completing these types of studies. Fourteen percent (53/392) of survey completers reported wearing CCL at least once. Users were overwhelmingly female (83% vs 17%, Table 1). No differences were observed in race/ethnicity or immigrant status between CCL users and nonusers. Half of CCL users reported obtaining their lenses locally without a prescription. Only 3.9% obtained CCL from an eye doctor. Overall, only 54.6% of all respondents and 54.2% of CCL users had seen an eye doctor in the past year and only 5.7% of CCL users reported discussing CCL with an eye doctor.

About 72% (38/53) of CCL users began using CCL before 15 years of age, and 91% of parents knew about it. Only 30% (16/53) had received instructions on proper care (Table 2). Four percent (2/53) allowed others to borrow their CCL and 15% (8/53) had borrowed someone else’s lenses. Poor hygienic practices were common with 52% (27/53) sometimes or often/always using water to store their CCL and 37% not often/always washing their hands before handling the lenses. Almost 40% (20/53) never or rarely rinsed their CCL after removal with solution. Over one-third (19/53) wore their CCL >8 hours/day sometimes or always. Five slept in their CCL at least sometimes. About half (33/53) sometimes or always topped off solution in their CCL cases and 77% never/rarely replaced their CCL case every 3 months. Complications reported included eye pain/ discomfort (39.6%), itchy,

**Table 1** Characteristics of survey participants in pediatric clinic (N=392)

Characteristics	All groups (N=392), n (%)	Nonuser (n=339), n (%)	CCL user (n=53), n (%)	P-value <sup>a</sup>
Age, mean (SD)	15.5 (4.5)	15.4 (4.8)	15.8 (1.4)	0.54
Age group, years				<b>0.02</b>
13–15	213 (54.5)	192 (56.8)	21 (39.6)	
16–18	178 (45.5)	146 (43.2)	32 (60.4)	
Missing =1				
Gender				<b>&lt;0.0001</b>
Male	163 (41.6)	154 (45.4)	9 (17.0)	
Female	229 (58.4)	185 (54.6)	44 (83.0)	
Hispanic				0.07
Hispanic	146 (37.7)	120 (35.9)	26 (49.1)	
Non-Hispanic	241 (62.3)	214 (64.1)	27 (50.9)	
Missing =5				
Race				0.48
White	205 (56.5)	178 (56.9)	27 (54.0)	
Black	79 (21.8)	70 (22.4)	9 (18.0)	
Asian/Native American/Other	79 (21.7)	65 (20.7)	14 (28.0)	
Missing =29				
Immigrant status				0.66
Born in USA	381 (97.2)	329 (97.1)	52 (98.1)	
Immigrant	11 (2.8)	10 (2.9)	1 (1.9)	
Currently smoke				<b>0.008<sup>b</sup></b>
Some days	7 (1.8)	3 (0.9)	4 (7.6)	
Not at all	385 (98.2)	336 (99.1)	49 (92.4)	
In the past 12 months, have you visited the eye doctor for any reason?				0.95
Yes	192 (54.6)	166 (54.6)	26 (54.2)	
No	160 (45.4)	138 (45.4)	22 (45.8)	
Missing =40				
In the past 12 months, has an eye doctor told you anything about CCL?				0.44 <sup>b</sup>
Yes	15 (3.9)	12 (3.6)	3 (5.7)	
No	373 (96.1)	323 (96.4)	50 (94.3)	
Missing =4				

**Notes:** <sup>a</sup>Chi-square test. <sup>b</sup>Fisher's exact test. Bold values indicate significance at  $P < 0.05$ .

**Abbreviation:** CCL, cosmetic contact lenses.

watery (47.2%) or red, swollen (18.9%) eyes, trouble seeing (27.3%). Two respondents reported conjunctivitis or light hypersensitivity. One reported blindness, one had corneal abrasions, and one had a corneal ulcer.

Overall knowledge about CCL was low, and total knowledge scores were similar between CCL users and nonusers (Table 3). In particular, adolescents incorrectly thought that CCL are one-size fits all and were not aware that selling CCL without a prescription was illegal. More than half were also unaware that using CCL without a prescription can increase risk of permanent eye damage.

## Discussion

This study revealed that CCL use is popular in the USA, even among young adolescents. Almost one in six of those surveyed admitted to prior use, which often occurred before age 15 years. Even though their use is widespread among

adolescents, knowledge levels are low. The vast majority did not know that a prescription was required and >70% thought that “CCL are one-size fits all”. This could lead to harmful practices such as purchasing CCL from unauthorized vendors. Fifteen percent of users reported sharing their lenses with others, which can lead to transmission of serious infections.<sup>7</sup> To correct these common misconceptions, the American Academy of Ophthalmology and other organizations have developed content for their websites warning about the dangers of purchasing CCL without a prescription and sharing them with others.<sup>8</sup>

Similar to reports on prescription contact lenses,<sup>3,9,10</sup> CCL users reported poor hygiene habits. This may have been exacerbated by not receiving instructions on proper care. Several behaviors reported can lead to serious complications.<sup>11</sup> Failure to replace or properly clean and store lenses can contribute to development of bacterial biofilm,

**Table 2** Characteristics of CCL users among prior users (N=53)

Participant characteristics	CCL user (N=53), n(%)
Mean age at first use, years	13.6 (1.7)
Age at first use, years	
≤15	38 (71.7)
>15	15 (28.3)
Parents know CCL worn	
Yes	48 (90.6)
No	5 (9.4)
Taught how to care for CCL	
Yes	16 (30.2)
No	33 (62.3)
Not sure	4 (7.5)
Used nonprescription eye drops while wearing CCL	
Yes	19 (35.9)
No	25 (47.1)
Not sure	9 (17.0)
Allowed someone to borrow their CCL	
Yes	2 (3.9)
No	50 (96.1)
Not sure	0 (0.0)
Missing =1	
Borrowed someone else's CCL	
Yes	8 (15.1)
No	44 (83.0)
Not sure	1 (1.9)
Store CCL in water	
Never/rarely	25 (48.1)
Sometimes	6 (11.5)
Often/always	21 (40.4)
Missing =1	
Sleep while wearing CCL	
Never/rarely	47 (90.4)
Sometimes	2 (3.9)
Often/always	3 (5.7)
Missing =1	
Wash/dry hands before insert/remove CCL	
Never/rarely	8 (15.4)
Sometimes	11 (21.2)
Often/always	33 (63.4)
Missing =1	
Clean CCL with something other than solution	
Never/rarely	38 (74.5)
Sometimes	6 (11.8)
Often/always	7 (13.7)
Missing =2	
Shower or swim while wearing CCL	
Never/rarely	43 (84.3)
Sometimes	5 (9.8)
Often/always	3 (5.9)
Missing =2	
Rinse CCL with solution every time removed	
Never/rarely	20 (39.2)
Sometimes	7 (13.7)
Often/always	24 (47.1)
Missing =2	

(Continued)

**Table 2** (Continued)

Participant characteristics	CCL user (N=53), n(%)
Wear CCL >8 hours/day	
Never/rarely	33 (63.5)
Sometimes	10 (19.2)
Often/always	9 (17.3)
Missing =1	
"Top off" solution in CCL care	
Never/rarely	27 (54.0)
Sometimes	12 (24.0)
Often/always	11 (22.0)
Missing =3	
Replace CCL case every 3months	
Never/rarely	39 (76.5)
Sometimes	7 (13.7)
Often/always	5 (9.8)
Missing =2	
Complications experienced as a result of wearing CCL	
Eye pain/discomfort	21 (39.6)
Hypersensitivity to light	2 (3.8)
Red, swollen eyes	10 (18.9)
Itchy, watery eyes	25 (47.2)
Trouble seeing	9 (27.3)
Blindness	1 (1.9)
Corneal scratches/abrasions	1 (1.9)
Corneal ulcer	1 (1.9)
Conjunctivitis ("pink eye")	2 (3.8)

**Abbreviation:** CCL, cosmetic contact lenses.

increasing risk of eye infection.<sup>10</sup> Extended lens use, which causes hypoxic stress, also makes the cornea vulnerable to infection.<sup>9</sup> Hydrogel CCL may not have high oxygen transmissibility, so hypoxic stress is more of a risk. CCLs have rougher surface areas than corrective lenses, making them easily contaminated with bacteria which can be transferred to the cornea.<sup>12</sup> Using tap water as a cleaning or storage solution increases the risk of developing infection.<sup>11</sup> To reduce eye infections and negative outcomes, interventions need to be developed for adolescents using CCL to instruct them on lens hygiene.<sup>3,9</sup>

Due to low levels of knowledge about CCL and use of poor hygiene practices among adolescents, this study indicates that an education program is needed. Since these patients were approached in a pediatric clinic, this may be an ideal setting to ask adolescents about their CCL use, and refer CCL users to an ophthalmologist or optometrist, in addition to offering them tailored print information, such as a brochure, about CCL. Tailored print communications can be effective in influencing health behaviors, and may be appropriate for an intervention focused on informing and improving health behaviors related to CCL use in a primary care setting.<sup>13</sup>

**Table 3** Knowledge of adolescents about CCLs (N=392)

Knowledge true/false statements	Percentage of incorrect answer	
	CCL user (n=53)	Non-CCL user (n=339)
• CCLs are one-size fits all.	38 (71.7)	240 (72.1)
• It is okay to share CCL.	3 (5.7)	56 (16.6)
• There are no risks associated with using CCL.	16 (30.8)	142 (42.5)
• Selling CCL over-the-counter is illegal.	47 (88.7)	278 (82.7)
• CCLs are monitored by the FDA, the same as contact that correct vision.	49 (94.2)	295 (88.9)
• Buying CCL without a prescription does not increase your risk of permanent eye damage.	28 (52.8)	203 (60.8)
• If someone sells you CCL without asking to see your prescription first, they are breaking the law.	45 (84.9)	251 (74.9)
• “Circle” lenses (a.k.a “Anime” contacts) have not been approved by the FDA.	44 (84.6)	308 (92.2)
• Parasites can stick to CCL and can burrow into your eye.	30 (56.6)	214(64.3)
Total knowledge score: mean/SD = (3.28/1.52) <sup>a</sup>	3.2 (1.6)	3.0 (1.8)
Low [0, 2]	17 (32.1)	131 (38.8)
Medium [3, 4]	24 (45.3)	137 (40.5)
High [5, 9]	12 (22.6)	70 (20.7)

**Note:** <sup>a</sup>One-way ANOVA P-value: 0.32, Kruskal–Wallis: 0.27.

**Abbreviations:** CCL, cosmetic contact lenses; FDA, Food and Drug Administration.

The main strength of this study is that it was conducted on a sample of adolescent patients visiting a pediatric clinic, and captured a diverse group of adolescents with a high response rate. However, this was a convenience sample, and may not be representative of adolescents residing elsewhere in the USA. Further, self-report of hygiene and complications may have resulted in recall bias. However, it is likely that these behaviors were underreported, and thus, our estimates are conservative.

## Conclusion

In conclusion, this study demonstrated that a large percentage of CCL users did not practice good hygiene and have low knowledge about how to properly care for their lenses. Thus, interventions are needed which instruct adolescents how to care for their lenses and where they can be safely purchased. Education by primary care providers, which could include use of age-appropriate pamphlets, may be most effective as almost half the adolescents we surveyed had not seen an eye doctor in the last year and may not otherwise have access to this information. Our data indicate that a high proportion of CCL users experienced at least one complication, and providing information to these individuals could prevent more injurious complications from occurring with future CCL use. Educational programs for the general public are needed to decrease the risk of serious eye damage at a young age.

## Disclosure

The authors report no conflicts of interest in this work.

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