

1 **Contact lens wear and care in Spain during the COVID-19 pandemic**

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22

23 **Abstract**

24 **Aim:** To establish contact lens wear and care practices during the COVID-19 pandemic in
25 Spain.

26 **Method:** A 58-item anonymous online survey was distributed during the period 30th April to
27 10th May via Qualtrics. The survey explored: a) demographic characteristics (age, sex, general
28 health and where they were living during lockdown), b) changes in their contact lens use
29 during lockdown, c) hygiene and contact lens compliance and d) concerns associated with
30 contact lens wear and ways to support wearers during the pandemic.

31 **Results:** Two hundred and sixty responses were analysed (38.8 ± 11.4 years old, 75%

32 female). Three-quarters of participants reported that they were self-isolating or rigorously
33 following social distance advice. Sixty-seven percent of participants reported using
34 their contact lenses less during the pandemic. Respondents were found to be compliant with
35 handwashing prior to inserting and removing contact lenses (in both cases 97% doing this
36 'most times' or 'every time'). However, only 44% complied with the '20 second rule' and 48%
37 used a shared towel to dry their hands. A higher proportion of hydrogen peroxide users
38 replaced the lens case monthly compared to multi-purpose users (64% vs.49%; $p<0.001$).
39 Twenty-four percent admitted wearing lenses whilst showering and 16% did not consider
40 ceasing lens wear if feeling unwell with flu/cold symptoms.

41 **Conclusion:** Eye care practitioners should continue to educate contact lens wearers to ensure
42 safe contact lens wear to minimise the chance of developing contact lens related
43 complications during the pandemic. Modifiable factors that need particular attention in Spain
44 include: handwashing for at least 20 seconds before lens handling, drying hands with single
45 use paper towels, including a rub-and-rinse step for reusable lenses, lens case cleaning and
46 renewal, avoidance of water exposure and when to cease lens wear during the pandemic.

47 **Keywords:** contact lens, COVID-19, compliance, education, complications, microbial keratitis,
48 acanthamoeba

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53 **Introduction**

54 Coronavirus disease 2019 (COVID-19) has experienced a rapid spread globally since December
55 2019 [1], with the World Health Organisation (WHO) declaring it a pandemic on 11th March
56 2020. Spain was one of the first European countries affected by the COVID-19 outbreak [2]
57 leading to one of Europe's strictest and longest lockdowns (state of alarm started on 14th
58 March and ended on 21st June). Spanish residents were mandated to stay at home except to
59 purchase food/medicines, to travel to work or to attend emergencies. Non-essential shops
60 and businesses (including optical/optometric practices) were closed. Stress and anxiety
61 increased significantly during lockdown[3], promoted by concerns about how to avoid
62 infection and the continuously increasing number of deaths. This was exacerbated by

63 significant amounts of misinformation and speculation[4] including inaccurate information
64 around the increased risk of COVID-19 associated with contact lens wear[5].

65 The COVID-19 pandemic has highlighted the importance of optimal hygiene and lens care to
66 avoid contact lens related complications [5]. The aim of the current study was to evaluate by
67 means of a survey the behaviours associated with contact lens wear (compliance with hand
68 hygiene and adherence to contact lens wear and care recommendations) as well as to
69 elucidate the best ways to support wearers during the COVID-19 pandemic in Spain. To date,
70 limited information exists about contact lens compliance in Spain before [6] and during the
71 COVID-19 pandemic [7]. Similar work related to contact lens compliance during the COVID-19
72 pandemic has been conducted in the UK [8]. Given the prescribing differences between
73 markets, with a larger number of reusable and rigid/orthokeratology wearers in Spain
74 compared with the UK, [9] and different government approaches to control the virus impact,
75 it is important to identify country-specific wearer behaviours that need addressing during
76 these challenging clinical times.

77

78 **Materials and methods**

79 The study was conducted in agreement with the tenets of the Declaration of Helsinki. The
80 Faculty of Science and Engineering Research Ethics Panel at Anglia Ruskin University (ARU)
81 reviewed and approved the study protocol. Qualtrics software (Qualtrics, Provo, UT) was used
82 to collect data via an online questionnaire. Only one submission from each IP address was
83 permitted by the survey software. Non-identifiable data were collected, and all participants
84 gave their informed consent online after reading a participant information sheet at the start
85 of the survey. The inclusion criteria included adults older than 18 who were using contact
86 lenses and living in Spain during the lockdown due to the COVID-19 pandemic.

87

88 **Survey characteristics and distribution**

89 The survey used was translated and adapted to accommodate for the Spanish lockdown
90 characteristics from a survey distributed in the UK [8]. The survey had 58 questions divided
91 into 4 sections. The first section focused on assessing the demographic characteristics of the
92 participants such as age, sex, general health, and where they were living during the lockdown.
93 The second section asked about potential changes in their habits related to the use of contact
94 lenses (CLs) due to the lockdown. The third section focused on hygiene and contact lens

95 compliance during the COVID-19 pandemic (e.g. washing hands, lens care, lens case
96 replacement). The questions related to lens care disinfection and lens case care were only
97 displayed if the participant used reusable CLs. The final section focused on assessing concerns
98 associated with contact lens wear and ways to best support wearers during the COVID-19
99 pandemic. Respondents were also asked about compliance with recommendations regarding
100 safe contact lens wear given by their ECP.

101 The translation into English followed a multi-step process to ensure optimal accuracy. Initial
102 drafts were compared to the original English questionnaire to ensure the meaning of the
103 questions were kept. The survey was then reviewed by a team of four Spanish optometrists
104 (all authors of this manuscript, NG-P, MV-E, DP and LSM) as a final step during the translation
105 process to refine the final wording of the questions. The final version was inputted into
106 Qualtrics (Qualtrics, Provo, UT) and then reviewed by team members to ensure functionality.
107 The survey was distributed using social media and was open from 30th April to 10th May 2020
108 when optical/optometric practices in Spain were either closed or only offered
109 urgent/emergency care. A copy of the full questionnaire can be requested by contacting the
110 corresponding author.

111

112 **Data analysis**

113 The Statistical Package for Social Sciences version 26.0 (SPSS Inc., Chicago, IL, USA) was used
114 to carry out the statistical analysis. Chi-square statistics for categorical variables (or Fisher's
115 exact test if the number of participants in any group was 5 or less) was used to assess
116 differences between lens types (daily disposable vs reusable CL) and between lens care
117 products (multi-purpose disinfecting solution vs hydrogen peroxide). A significant level of
118 $p \leq 0.05$ was used for all analyses.

119

120 **Results**

121 **Patient demographics**

122 A total of 396 participants completed the anonymous online survey. Before data analysis,
123 responses were removed under the following circumstances: those living outside of Spain
124 ($n=38$), those not consenting to take part in the study ($n=19$), when only some initial questions
125 regarding sex and location were completed ($n=78$) and those younger than 18 years ($n=1$). A
126 total of 260 respondents were suitable for analysis. The mean age of the respondents was

127 38.8 ± 11.4 years old (range 18-72 years) and 75% were female. Respondents' demographics
 128 and COVID-19 symptomatology are shown in Table 1.
 129

	Characteristics	Percentage (n)
Sex	Female	75 (196)
	Male	25 (64)
Do you suffer from any chronic disease?	Yes	17 (45)
	No	83 (215)
Do you have any COVID-19 symptoms?	Yes	7 (17)
	No	94 (243)
Does anyone in your household have symptoms of COVID-19?	Yes	10 (27)
	No	90 (233)
Are you a smoker?	Yes	14 (37)
	No	86 (223)
Where do you live?	City	71 (185)
	Village or rural area	29 (75)
Does your house/flat have outdoor space (garden/patio)?	Yes	50 (131)
	No	50 (129)
To what extent are you following social distancing advice?	Self-isolating or rigorously following advice	75 (196)
	Going to work	25 (64)

130 **Table 1:** Demographics characteristics of the respondents (n=260)

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132 **Contact lenses and lens care products used during the pandemic**

133 The reported frequency of contact lens modality and use of lens care products for lens
 134 disinfection is presented in Table 2 and Table 3.

135

Lens modality	n	Percentage
Daily disposable	82	32%
Soft reusable	161	62%
Rigid (including OK)	17	7%

136 **Table 2:** Reported frequency of contact lens modality worn by the respondents (n=260); OK
137 = orthokeratology

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Lens care disinfection method used with SOFT REUSABLE CLs (n=161)	n	Percentage	Lens care disinfection method used with RIGID/OK CLs (n=17)	n	Percentage
Multi-purpose solution	144	90%	Multi-purpose solution	8	47%
Hydrogen peroxide	6	4%	Hydrogen peroxide	5	29%
Saline	9	6%	Saline	1	6%
Not provided	2	1%	Cleaner & conditioner solutions	3	18%

140 **Table 3:** Reported frequency of lens care disinfection used by the respondents ; OK =
141 orthokeratology

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144 **Contact lens wear before and during the COVID-19 pandemic**

145 Sixty-seven percent of respondents reported using their contact lenses less during the
146 pandemic, 30% about the same amount of time and only 2% more during the pandemic. The
147 most common reason for reduced wearing time was 'less need at home' (56%) followed by
148 'less effort to wear specs' (20%) and 'fear of infection/touching eyes' (10%). At the time of

149 the survey, 65% of the respondents had not needed to buy any contact lenses during the
150 lockdown period, 28% were purchasing them from their optometrist, 4% from the internet
151 and 3% through eye clinics or hospital departments. There were no statistically significant
152 differences in wearing time between daily disposable wearers and reusable contact lens
153 wearers (p=0.143).

154

155 **Handwashing**

156 Seventy-five percent of respondents reported a change in their handwashing routine during
157 the pandemic. Self-reports of hand washing prior to inserting and after removing contact lens
158 with either 'most times' or 'every time' were similar (both 97%). In addition, 97% also
159 responded using soap and water during handwashing. In contrast, only 44% reported
160 following the 20-second rule 'every time' (with a further 43% doing it 'most times') and 25%
161 reported washing their hands 'every time' after coughing, sneezing or blowing their nose
162 (with a further 43% doing it 'most times'). When asked about how they dried their hands, the
163 responses included: cloth towel shared with other family members (48%), cloth towel only
164 used by themselves (39%), paper towel (12%). There were no statistically significant
165 differences between daily disposable and reusable lens wearers for handwashing before
166 inserting and removing contact lenses (p=0.716 and p=0.214 respectively), handwashing
167 method (i.e. using soap and water, water only, antibacterial wipes/solutions p=0.214) and for
168 drying habits (as per above options, p=0.151).

169

170 **Compliance with the cleaning routine of lenses and lens cases for wearers of soft reusable** 171 **contact lenses (n=144)**

172 As shown in Table 3, the majority of respondents used a multi-purpose lens solution for
173 disinfection of their reusable contact lenses. First, the survey assessed aspects related to the
174 cleaning of the lenses after use (Figure 1a-b). The survey found that 54% of respondents
175 'never' rubbed the lenses before soaking and 18% either topped up the lens care solution
176 'most times' or 'occasionally' (rather than filling up the case with fresh solution). The survey
177 also evaluated aspects related to the care of the lens case. Figure 2a-b summarises the
178 findings pertaining to cleaning routines for lens cases. Eighty-six percent of respondents
179 admitted to cleaning the lens case less often than daily. The frequency of replacement of lens
180 cases during the pandemic varied ranging from monthly (49%), 3-monthly (36%), 6-monthly

181 (11%) and annually (4%). Respondents also reported their daily routine for cleaning the lens
182 case which included the following non-optimal behaviours: 46% rinsed with tap water (with
183 2 respondents specifically using boiled water) and 8% not cleaning the lens case at all. The
184 remaining responses included: 26% rinsing with lens solution, 7% rinsing the case with contact
185 lens solution and wiping it with a clean tissue (optimal technique [10]), 2% wiping with a tissue
186 only and 9% replacing the solution only without rinsing/wiping .

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188 **Figure 1a-b**

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190 **Figure 2a-b**

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192 **Compliance with the cleaning routine of lenses and lens cases for wearers of rigid contact**
193 **lenses (n=11)**

194 Similar analyses were conducted to establish the cleaning routine of wearers of rigid lenses,
195 using either a multi-purpose solution or two-step cleaning routine (cleaner and conditioner,
196 Table 3). When asked about rubbing prior to soaking, 45% of respondents admitted they
197 'never/almost never' did this step and a further 18% did it only once a week (with the
198 remaining doing it 'daily'/'almost every day'). Respondents showed a more compliant
199 behaviour with regards to topping up the solution, 82% indicated they 'never' topped up and
200 the remainder only did it 'occasionally'. With regards to the care of the lens case, 30%
201 reported cleaning the case 'daily' with a further 20% cleaning it 'most days' and the remaining
202 respondents cleaning less frequently or never. In addition, 50% of the respondents admitted
203 using tap water. Only one respondent used the optimal method (rinsing and drying with paper
204 tissue). During the pandemic, the majority of respondents were planning on replacing the lens
205 case monthly (40%) or 3-monthly (30%) with the remaining planning on changing it less often.

206

207 **Compliance with Hydrogen Peroxide solutions for soft and rigid lens wearers (n=11)**

208 A separate analysis was conducted with all reusable lens wearers using hydrogen peroxide as
209 part of their lens disinfection in this study (n=11 for both soft and rigid lens wearers as shown
210 in Table 3). Around half (55%) of the respondents rubbed their lenses prior to soaking
211 'daily'/'almost daily' (remaining respondents 'never/almost never' included this step as part
212 of their cleaning routine). In addition, 73% 'never' topped up the used solution, with the

213 remaining respondents doing this 'always' (9%) or 'frequently' (18%). Non-compliance was
214 observed with aspects relating to the care of the lens case including 64% cleaning the lens
215 case 'weekly' or 'monthly' or 'not at all'. A further 50% admitted using tap water whilst
216 cleaning the contact lens case and 64% were planning on replacing the case monthly during
217 the pandemic (with the remaining 36% planning on replacing it yearly).

218

219 A statistically significant difference was found between the lens case replacement frequency
220 of contact lens wearers using hydrogen peroxide and those using multi-purpose solutions
221 ($p < 0.001$). Sixty-four percent of peroxide users replace their lens case monthly whilst only
222 49% of multi-purpose solution users reported doing this.

223

224 **Compliance with general Eye Care Professional (ECP) recommendations for safe contact** 225 **lens wear**

226 Ninety-seven percent said that they were not exceeding the wearing time during the
227 pandemic (e.g. sleeping in lenses if not previously recommended) and 88% also followed the
228 recommendations regarding disposal of their contact lenses. The main reasons given by the
229 31 respondents that did not follow recommendations on disposal included 'forgetting when
230 to replace', 'to save money' and 'doesn't hurt my eyes' (28%, 21% and 21% respectively).

231

232 The survey explored if wearers wore contact lenses whilst showering, with 76% responding
233 negatively to this question. Finally, the survey explored if users checked the health of their
234 eyes daily before inserting lenses with 28% admitting skipping this health check. A further
235 16% responded that they would not consider ceasing lens wear during the pandemic if feeling
236 unwell with cold or flu symptoms. Of all respondents, 6% did not own a pair of up to date
237 spectacles. The survey also asked how often respondents cleaned their spectacles with soap
238 and water: 33% admitted doing this 'hardly ever' or 'never', 24% 'daily/almost daily' and 44%
239 'frequently'.

240

241 Finally, 80% had not sought any form of additional support for managing their contact lens
242 wear during the pandemic, but 13% consulted with their
243 optometrist/ophthalmologist/medical practitioner and 7% searched for information online.
244 Respondents were given space to add free texts regarding ways in which they would like to

245 receive support regarding contact lens wear during the pandemic. Of those that responded,
246 the preferred method was online (n=116), via telehealth (phone or video call, n=78) or both
247 (n=6). They also expressed videos and links to relevant sites through a health portal would be
248 useful to support relevant aspects of contact lens wear, such as the cleaning of contact lenses
249 and the impact of COVID-19 on lens wear (n=6).

250

251 **Discussion**

252 Since the start of the COVID-19 pandemic, the contact lens community has been interested
253 in how to best support wearers [7, 8, 11]. The demographics of the respondents in this study
254 are in agreement with data for the Spanish market in terms of sex, age of wearers and types
255 of lenses worn [9], and so are representative. In this study, 75% of respondents were socially
256 distancing and or self-isolating when responding to the survey. The current study is in
257 accordance with other work conducted during the COVID-19 pandemic and shows a reduction
258 in lens wear during lockdown [7, 8, 11].

259

260 Optimal handwashing before contact lens application and removal is essential [5, 7]. Effective
261 handwashing with soap and water should take a minimum of 20 seconds [12, 13]. However,
262 less than half of respondents admitted to complying with this rule. Garcia-Ayuso et al. [7] also
263 found 27.6% of participants were unaware or did not follow this rule. During the pandemic,
264 Spain emphasised good handwashing technique rather than duration in their public health
265 campaigns [14]. The greater awareness of hand hygiene created by the pandemic may have
266 increased hand washing prior to lens handling as only 2% of respondents admitted to not
267 washing their hands prior to application/removal of lenses. Interestingly, only a quarter of
268 respondents admitted washing their hands after coughing, sneezing or blowing their nose.
269 The use of paper towels does not seem to be an established method for drying hands in this
270 study (only 12% of respondents used this method). Despite recommendations to dry hands
271 with a single use paper towel [5, 12], 39% of participants admitted to using their own reusable
272 towel and 48% admitted to sharing a towel. In view of these non-optimal behaviours, ECP are
273 encouraged to discuss optimal handwashing and drying techniques and ensure wearers do
274 not become complacent as inadequate handwashing is a risk factor for contact lens related
275 microbial keratitis and corneal inflammatory events [15].

276

277 Despite the known benefits of rubbing contact lens prior to soaking [16, 17], reusable lens
278 wearers using multi-purpose solution in this study often skipped this cleaning step. In
279 addition, 27% admitted topping up multi-purpose lens solution frequently or always. In
280 contrast, 67% of soft reusable lens wearers in the UK were non-compliant with topping up
281 highlighting differences between countries during early periods of lockdown in the COVID-19
282 pandemic [8]. Although the present study asked about rubbing, the survey did not include a
283 specific question about rinsing. Interestingly, there is no specific mention of rinsing in the
284 recommendations for cleaning contact lenses [18]. ECPs in Spain will need to reinforce the
285 importance of rub-and-rinse during the pandemic. Jones et al. [5] indicated that in principle
286 the presence of surfactants in multi-purpose solutions together with rubbing/rinsing steps
287 are likely to be effective against SARS-CoV-2 but further work in this area is required. While a
288 recent review suggested (with no cited evidence) that no rubbing/rinsing is required prior to
289 lens disinfection when using hydrogen peroxide solutions [19], the cleanliness (which is linked
290 to comfort and risk of infection) of RGP and soft lenses soaked in multi-purpose or hydrogen
291 peroxide solution is better after rubbing and rinsing [20-23]. The survey data showed that
292 55% of the respondents rubbed their lenses prior to soaking with hydrogen peroxide solution.
293 The survey did not capture how respondents were instructed on lens care procedures when
294 using hydrogen peroxide solutions but ECPs need to be careful to only adopt evidence-based
295 recommendations. Nichols et al. [19] suggested that peroxide systems should be the first-line
296 recommendation for most wearers of reusable lenses and several organizations [16, 17]
297 indicate that peroxide-based solutions should be effective against the virus that causes
298 COVID-19. Finally, Garcia-Ayuso et al. [7] noticed that Spanish wearers changed their
299 frequency of wear to occasional use during the pandemic. Therefore, when providing
300 instructions about the correct use of solutions ECP will also need to include advice regarding
301 storage of irregularly worn reusable lenses and how frequently solutions need to be changed.

302 Previous studies have found that lens cases receive much less cleaning attention than contact
303 lenses [24, 25]. In fact, in this study, 64% of users (the same percentage was found for soft
304 multi-purpose users and peroxide users) admitted cleaning the lens case either 'weekly',
305 'monthly' or 'never/almost never'. In contrast, Wu et al. [10] reported that an effective lens
306 case cleaning process should include rubbing the lens case, rinsing it with contact lens
307 disinfecting solution, wiping it with a tissue and drying it face down with air. Current advice

308 suggests regular case replacement [5, 10] as infrequent lens case replacement increases the
309 risk of suffering ocular infection [26, 27]. Nichols et al. [19] noted that peroxide-based systems
310 improve compliance with lens case replacement. In agreement with this, a statistically
311 significant difference was found in the present work between lens care types (peroxide users
312 were more likely to replace their cases monthly than multi-purpose users). As wearers'
313 behaviours are clearly sub-optimal with regards to lens case cleaning and replacement, ECPs
314 and the research contact lens community are encouraged to find strategies to further educate
315 wearers on these aspects during the pandemic.

316 Finally, the survey explored how well respondents were adhering to contact lens
317 recommendations for safe contact lens wear. Overall, wearers adhered to recommendations
318 regarding wearing time and disposal of contact lenses, however, 28% did not check their eyes
319 daily before inserting lenses and 16% would not consider stopping lens wear if feeling unwell
320 with flu/cold symptoms. Twenty four percent admitted wearing lenses whilst showering.
321 Exposure to water during handling (rinsing contact lenses or lens cases with tap water) and/or
322 wearing contact lenses whilst showering has shown to be a risk factor for infection [27].
323 Unfortunately, respondents of this study showed both behaviours (showering as well as use
324 of tap water during lens case cleaning). Similarly, Vianya-Estopa et al. [8] reported 26% of UK
325 wearers showered with contact lenses during the pandemic. Arshad et al. [28] has
326 demonstrated an improvement in water-contact behaviours with the use of a no-water
327 infographic and similar work should be attempted in countries like Spain (where swimming is
328 a popular activity, especially during the summer months).

329

330 The present work highlights modifiable behaviours that need to be improved in contact lens
331 compliance during the COVID-19 pandemic. Respondents indicated their preferred ways to
332 be supported during lockdown which includes telehealth (either phone and/or video
333 consultations) and access to educational tools online. Since the end of the lockdown in June,
334 Spain has already experienced a resurgence of new infections and the affected regions have
335 experienced further restrictions in an attempt to control the spread of the infection [29]. As
336 access to clinical care might continue to be limited over the coming months, ECPs are
337 encouraged to review patient education on safe contact lens wear and care to minimise the
338 chance of contact lens related complications. Daily disposables offer an advantage over

339 reusable lenses in terms of non-compliance with cleaning and care procedures (relying on
340 optimal handwashing only) [30-31]. Nagra et al. [32] highlight that aftercare appointments
341 had traditionally offered an ideal opportunity to assess contact lens compliance, but in the
342 current times ECPs are encouraged to also use alternative ways (e.g. videos or patient
343 information sheets, raising awareness of lens care phone apps). The latter will be necessary
344 particularly if optometric practices need to prioritise face-to-face appointments for urgent
345 and emergency contact lens related complications where non-symptomatic wearers may
346 attend aftercare appointments less regularly.

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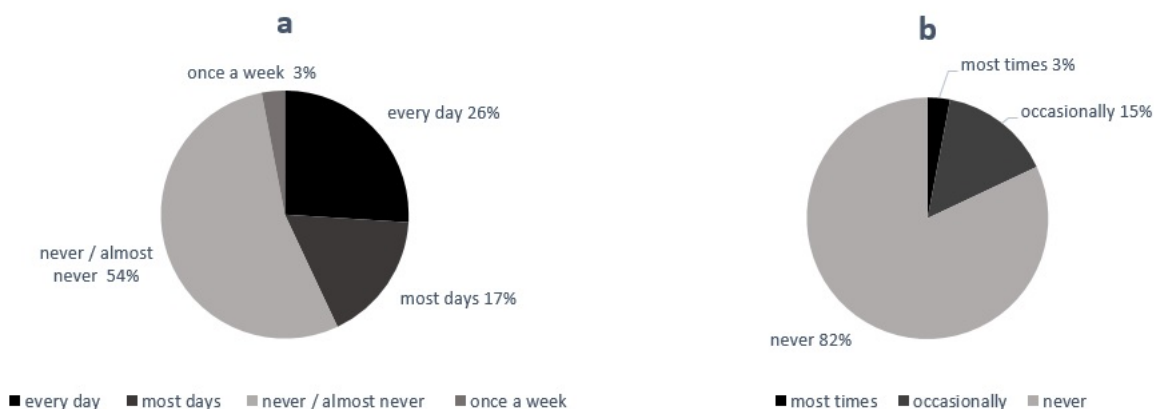
493 **Figure 1a-b:** Reported frequencies of multi-purpose solution users (n=144): **a)** rubbing soft
494 reusable contact lenses after each use and **b)** topping up solution.

495 **Figure 2a-b:** Reported frequencies of: **a)** contact lens case cleaning and **b)** contact lens case
496 replacement for soft reusable lens wearers using multi-purpose solution (n=144).

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498 **Figure1ab:**

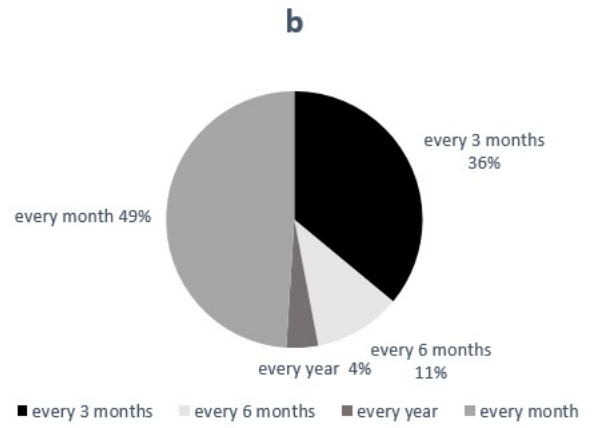
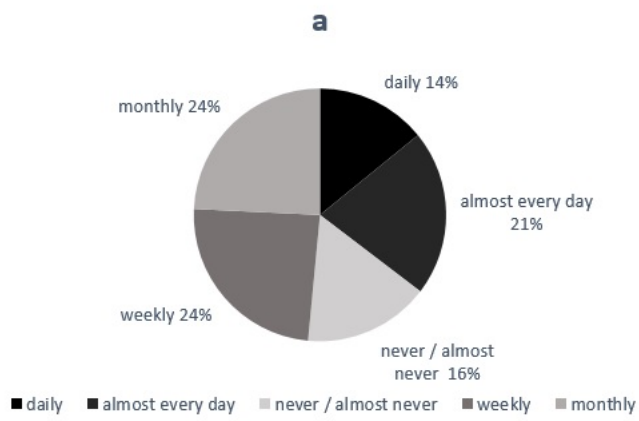
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502 **Figure 2ab:**



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