



Water Education and Contact Lens Storage Case Contamination

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BACKGROUND

- Microbial contamination of contact lens (CL) storage cases is associated with both sterile and microbial keratitis including bacterial and *Acanthamoeba* disease¹⁻⁵ and the causative organism in microbial disease may be recovered from the CL storage case.^{6, 7}
- Water exposure during CL handling and care can transfer environmental microorganisms, including Gram-negative bacteria to the CL storage case.^{8, 9}
- Despite the documented risks, water-related habits are common amongst CL wearers^{10, 11} and discrepancies in handling instructions by different stakeholders and water imagery on contact lens packaging may lead to confusion among CL wearers.^{12, 13}
- Unequivocal, practical, and consistent safety information to avoid water exposure may reduce CL case contamination and associated risk of CL-related adverse events.

PURPOSE

To determine the effect of water education in the form of “no water” stickers on levels of endotoxin and overall storage case contamination in community-based CL lens wearers.



“No water” sticker, concept and creation by Ms Irenie Ekkeshis (endorsed by the CCLSA)



METHODS

- A randomised, double-masked, interventional 6 weeks clinical trial; 200 CL wearers using frequent replacement lenses enrolled following informed consent (UNSW HREC approval # HC16735).
- Subjects completed the following at the baseline and 6 week follow-up visits (Figure 1):
 - Self-administered questionnaire on water contact behaviour as they last used lenses.
 - A water exposure scoring system devised to determine the overall water exposure during CL wear (0: excellent, 8: poor).
 - CL storage cases collected and analysed for total microbial contamination and endotoxin levels.

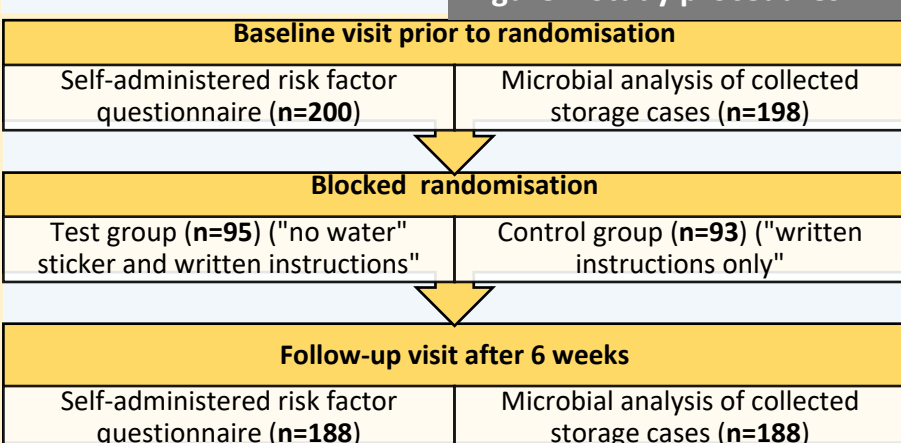
Total microbial contamination

- 1 ml of 1% Luria broth in PBS was added to one of the case wells and the biofilm removed using a magnetic stirring bar.
- An ATP assay (Bactiter-Glo™, Promega, Sydney, Australia) determined the overall microbial bioburden and a standard curve based on previous method development work.

Endotoxin levels

- 1 ml of sterile lysate reagent water was added to the other case well and the biofilms removed using a magnetic stirring bar.
- The limulus amoebocyte lysate assay (Pyrochrome™, Association of Capecod, Liverpool, UK) determined endotoxin levels and were categorized as low (≤ 2 EU/ml) or high (> 2 EU/ml).

Figure 1 Study procedures



STATISTICAL ANALYSIS

- A one-way analysis of covariance (ANCOVA) determined group differences at the follow-up visit for overall water exposure score and total CL storage case contamination.
- Logistic regression (baseline measures as covariates) determine the effect of water education on the endotoxin levels.

RESULTS

- 188 CL wearers including 128 females (68%) and 60 males (32%) completed the study; average age 29 ± 13 (range 18 to 78 years); 95 participants in the test and 93 in control group.
- The endotoxin levels were significantly reduced in the test group participants at the follow-up visit, compared to the control group when controlling for the baseline measurements ($p=0.020$) (Figure 2)
- The overall water exposure score was significantly lower in the test group compared to the control group at the follow-up visit, controlling for the baseline measurements ($p=0.005$; one-way ANCOVA) (Table 1)
- Average microbial contamination level of CL storage cases were reduced for both groups at the follow up visit with non-significant group differences ($p=0.173$; one-way ANCOVA) (Table 1).

Figure 2 Change in endotoxin level by group and visit

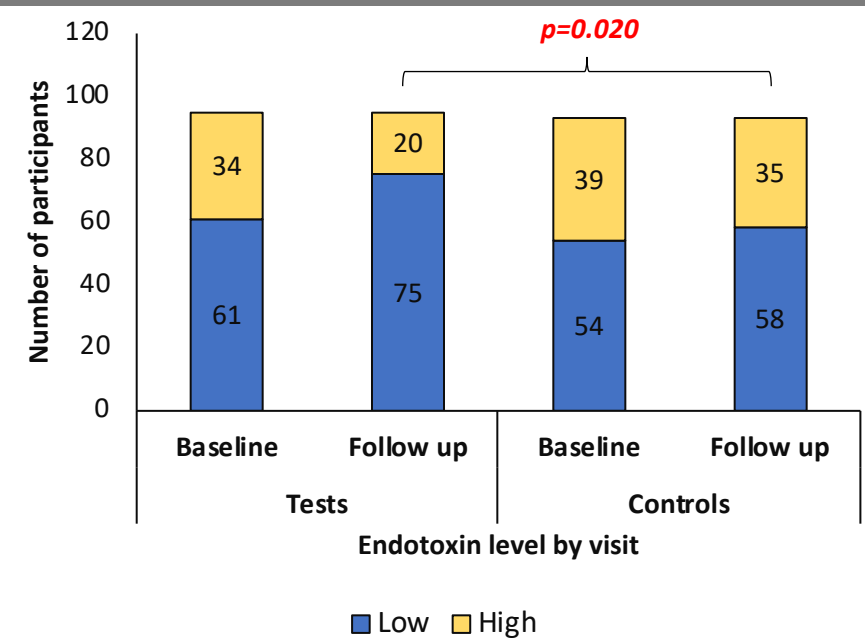


Table 1 ANCOVA to determine the impact of “no water” stickers on overall water exposure and case contamination

Variable	Mean at the follow-up visit, adjusted for the covariate (baseline)		Mean difference	ANCOVA statistics	
	Test	Control		F	P
Overall water exposure score ^a (0-8)	0.94	1.36	0.41	7.99	0.005
Overall storage case contamination ^b (Log CFU/mL)	2.76	2.96	0.19	1.87	0.173

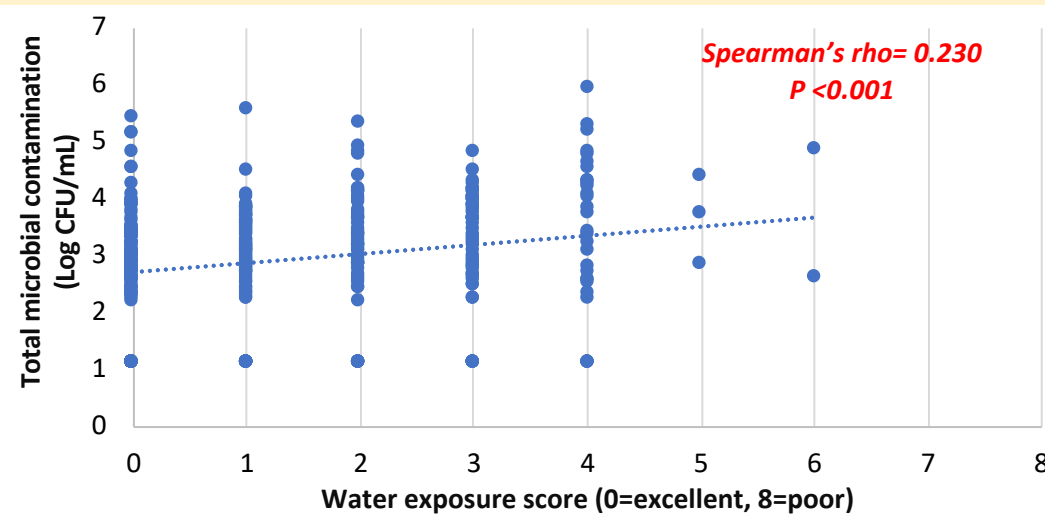


Figure 3 Association between overall water exposure and case contamination

Water exposure score was moderately associated with overall lens case contamination (Spearman's rho = 0.230 and $p < 0.001$) (Figure 3).

DISCUSSION

- Participants using the “no water” stickers on the lens storage case had lower endotoxin contamination of the storage cases, compared to those using only the written instructions, suggesting a link between water exposure and Gram-negative storage case contamination, as described in previous studies.^{8, 9}
- Overall water contact behaviour was improved in those participants using the “no water” stickers, compared to those using only the written instructions. These findings agree with previous studies reporting a positive impact of visual infographics on health compliance.^{14, 15}
- Higher microbial case contamination was moderately associated with higher water contact. Increased tap water exposure has been previously associated with increased Gram-negative storage case contamination.⁹

CONCLUSION

- The inclusion of “no water” stickers on contact lens storage cases reduced the endotoxin levels in storage case contamination and improved the overall water-contact behaviour of contact lens wearers.
- There were no significant changes in the overall level of storage case contamination.
- It is critical to understand the impact of these visual infographics on long term behavioural modifications, to reduce the risk of contact lens-related adverse events.

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References: 1: Richdale K, et al. *Invest Ophthalmol Vis Sci* 2016. 2: Radford CF, et al. *Br J Ophthalmol* 2002. 3: Kilvington S, et al. *Invest Ophthalmol Vis Sci* 2004. 4: Stapleton F, et al. *Epidemiol Infect* 1995. 5: Wiley L, et al. *Invest Ophthalmol Vis Sci* 2012. 6: Mayo MS, et al. *J Clin Microbiol* 1987. 7: McLaughlin-Borlace L, et al. *J Appl Microbiol* 1998. 8: Ustunturk M, et al. *Wien Klin Wochenschr* 2012. 9: Tilia D, et al. *Optom Vis Sci* 2014. 10: Zimmerman AB, et al. *Cornea* 2017. 11: Bui TH, Cavanagh HD, et al. *Eye Contact Lens* 2010. 12: Arshad M, et al. *Cornea* 2019. 13: Legarreta JE, et al. *Eye Contact Lens* 2013. 14: Dowse R, et al. *Patient Educ Couns* 2005. 15: Ebrahimabadi M, et al. *J Asthma* 2018.