

Significance:

- Clinically, refractive error degrades visual acuity in the feline veterinary patient. The cat is an important historical and current model of ophthalmic disease, especially disorders of refractive error.
- Refraction by streak retinoscopy, while the gold standard, requires advanced training and practice.
- Objective autorefraction, such as with the Welch Allyn SureSight™ autorefractor, could offer a faster, more practical, and accurate method of refraction in the cat.

Objective:

To compare the results of streak retinoscopy (SR) vs. the Welch Allyn SureSight™ autorefractor (WASS) in normal cats and determine the appropriate WASS setting (WASS_{adult} vs. WASS_{pediatric}) for use in the domestic cat.

Hypothesis:

Refractive error as measured by automated vs. manual methods in the domestic cat will not significantly differ.

Methods:

- Refractive error determined in 30 young adult domestic short haired cats (60 eyes) with normal, non-cyclopleged eyes via SR in the horizontal and vertical meridians.
- Refractive error also determined via WASS_{adult} (n=28 cats (56 eyes)) and WASS_{pediatric} (n=8 cats (16 eyes)).
- Refractive error determined by both WASS_{adult} and WASS_{pediatric} in 6 cats (12 eyes).
- Animals handled in compliance with guidelines of CSU's Institutional Animal Care and Use Committee. All procedures carried out according to ARVO Statement for the Use of Animals in Ophthalmic and Vision Research.

Analysis:

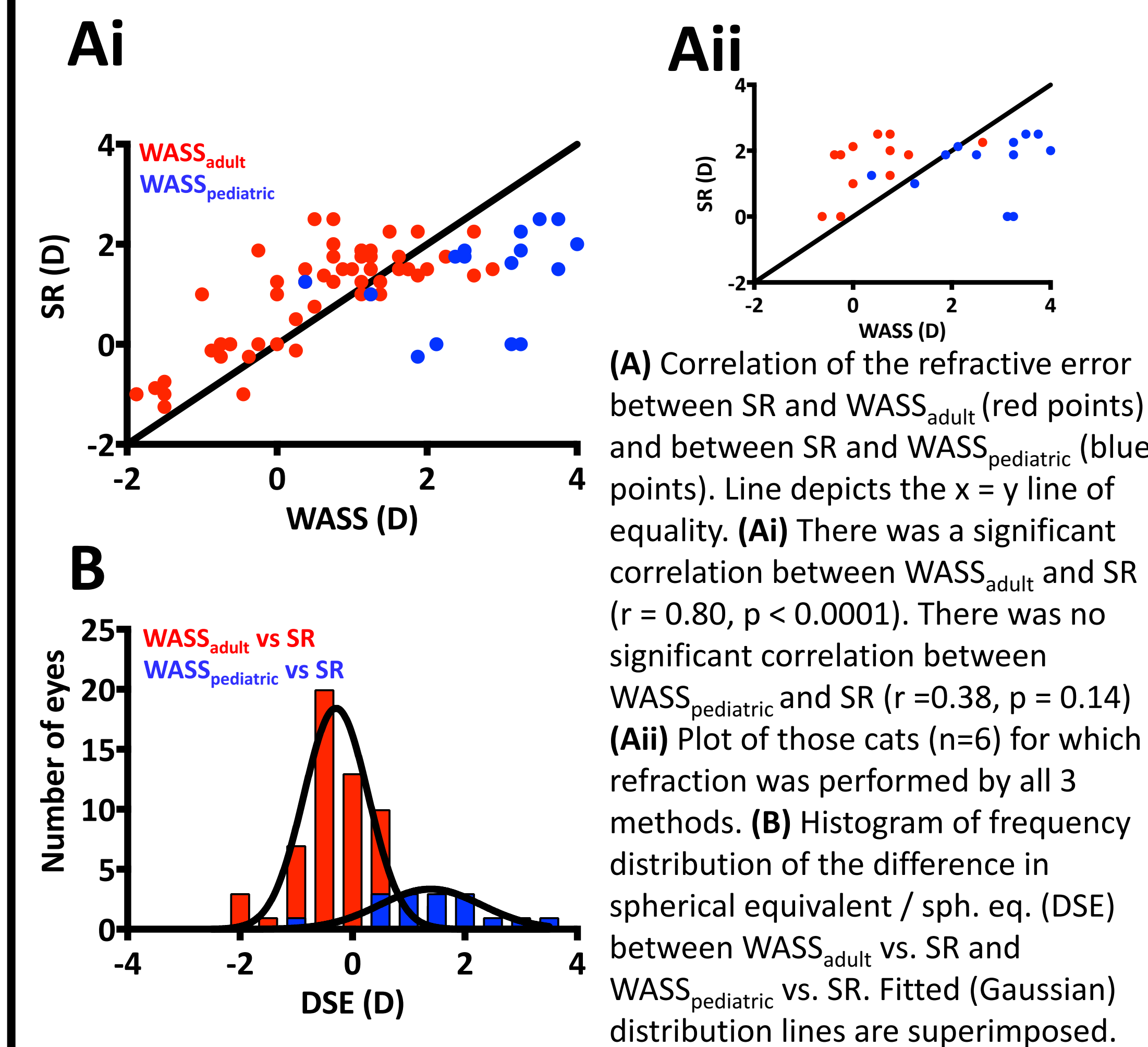
- Limits of Agreement: Calculated as outlined in Bland & Altman 2007 - "Method where the true value varies". Maximal inter-method discrepancy of 0.50 D and variability of 2.30 D considered a priori to be clinically acceptable based on prior literature. (Bonds 1974, Sivagurunathan 2011, Paff et al. 2010; Akil et al. 2015; Prabakaran et al. 2009)
- Difference between methods: Random effects model fit using lme4 package. Analysis done separately for adult or pediatric WASS values. Response variable was difference between methods (WASS - SR). Cat included as a random effect to account for multiple observations (2 eyes) on most cats.
- Data presented as mean ± SD.

Results: 1. What degree of refractive error is present?

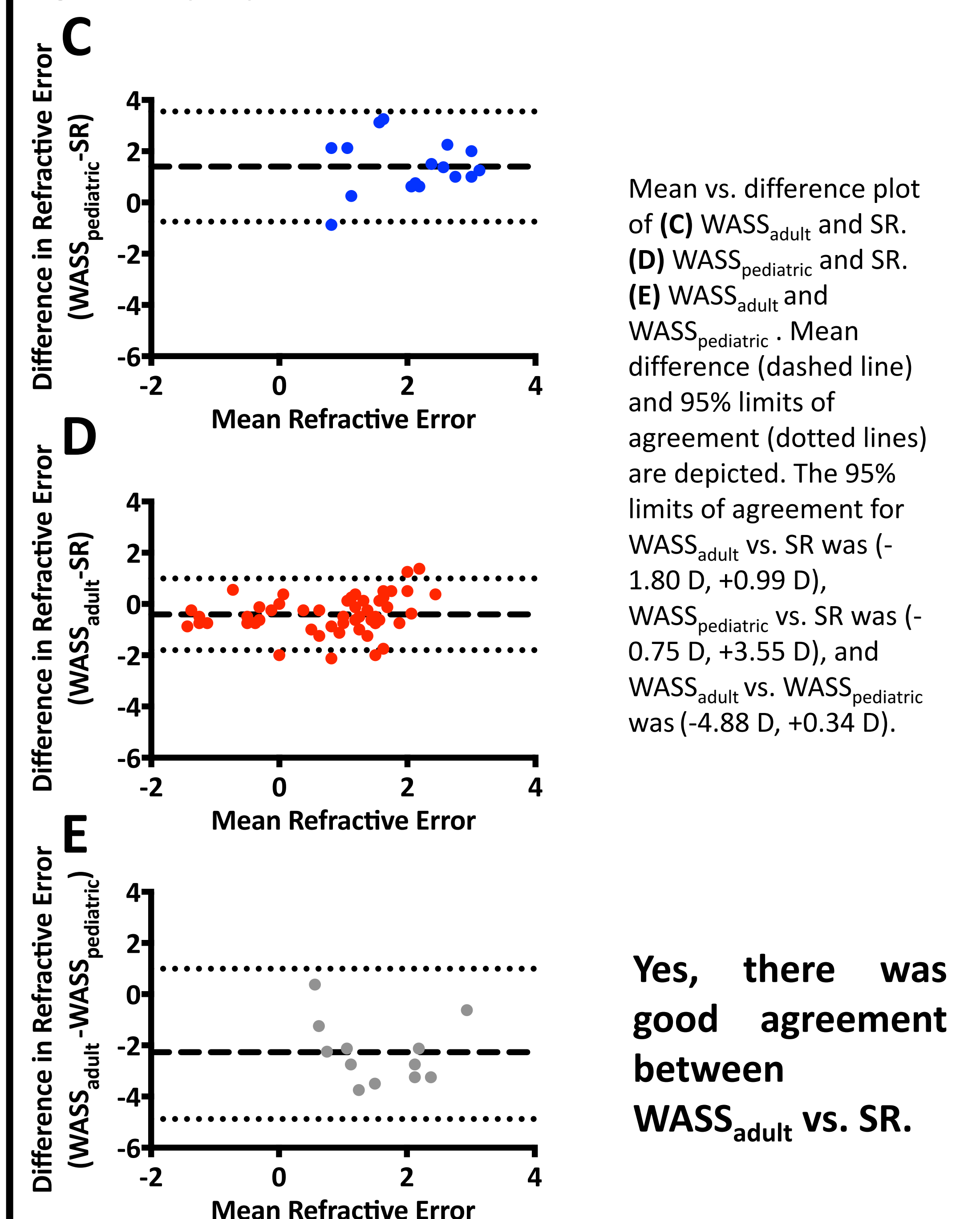
	n	SE (D)	Astigmatism (D)	Astigmatism <1D (%)	WTR (% eyes)	ATR (% eyes)	Oblique (% eyes)
SR	60 eyes 30 cats	+1.05 ± 0.97	-0.47 ± 0.59	73.33 (eyes) 66.67 (cats)	tendency toward ATR		
WASS SE _{adult}	56 eyes	+0.60 ± 1.15	-0.75 ± 0.58	66.07 (eyes) 42.86 (cats)	35.71	37.50	26.79
SR - same cohort	28 cats	+1.00 ± 0.99	-0.44 ± 0.59	71.43 (eyes) 67.86 (cats)	tendency toward ATR		
WASS SE _{pediatric}	16 eyes	+2.75 ± 0.98	-0.88 ± 0.35	50.00 (eyes) 37.50 (cats)	25.00	25.00	50.00
SR - same cohort	8 cats	+1.35 ± 0.93	-1.08 ± 0.69	31.25 (eyes) 12.5 (cats)	tendency toward ATR		

2. Is there good agreement between methods?

The difference between methods was statistically significant for WASS_{adult} vs. SR ($p \leq 0.001$, $n=56$ eyes), WASS_{pediatric} vs. SR ($p = 0.01$, $n=16$ eyes), and WASS_{adult} vs. WASS_{pediatric} ($p \leq 0.001$, $n=12$ eyes). For both comparisons (WASS_{adult} vs. SR and WASS_{pediatric} vs. SR), there was not a significant difference between eyes ($p > 0.05$) and there were no significant sex differences ($p > 0.05$).

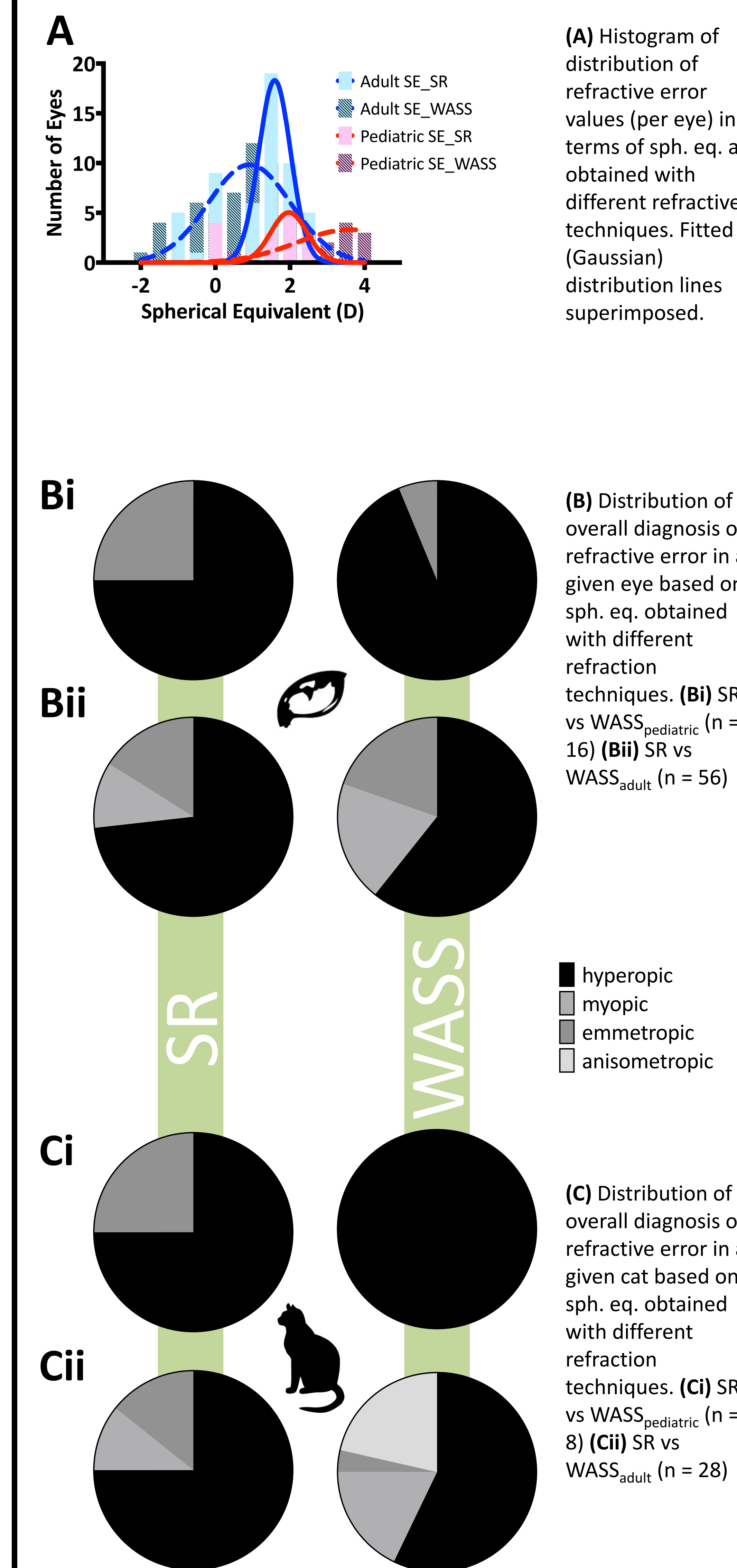


Significant correlation exists between refractive error measurements by WASS_{adult} and SR. WASS_{adult} results in a greater proportion of DSE values centered around 0.



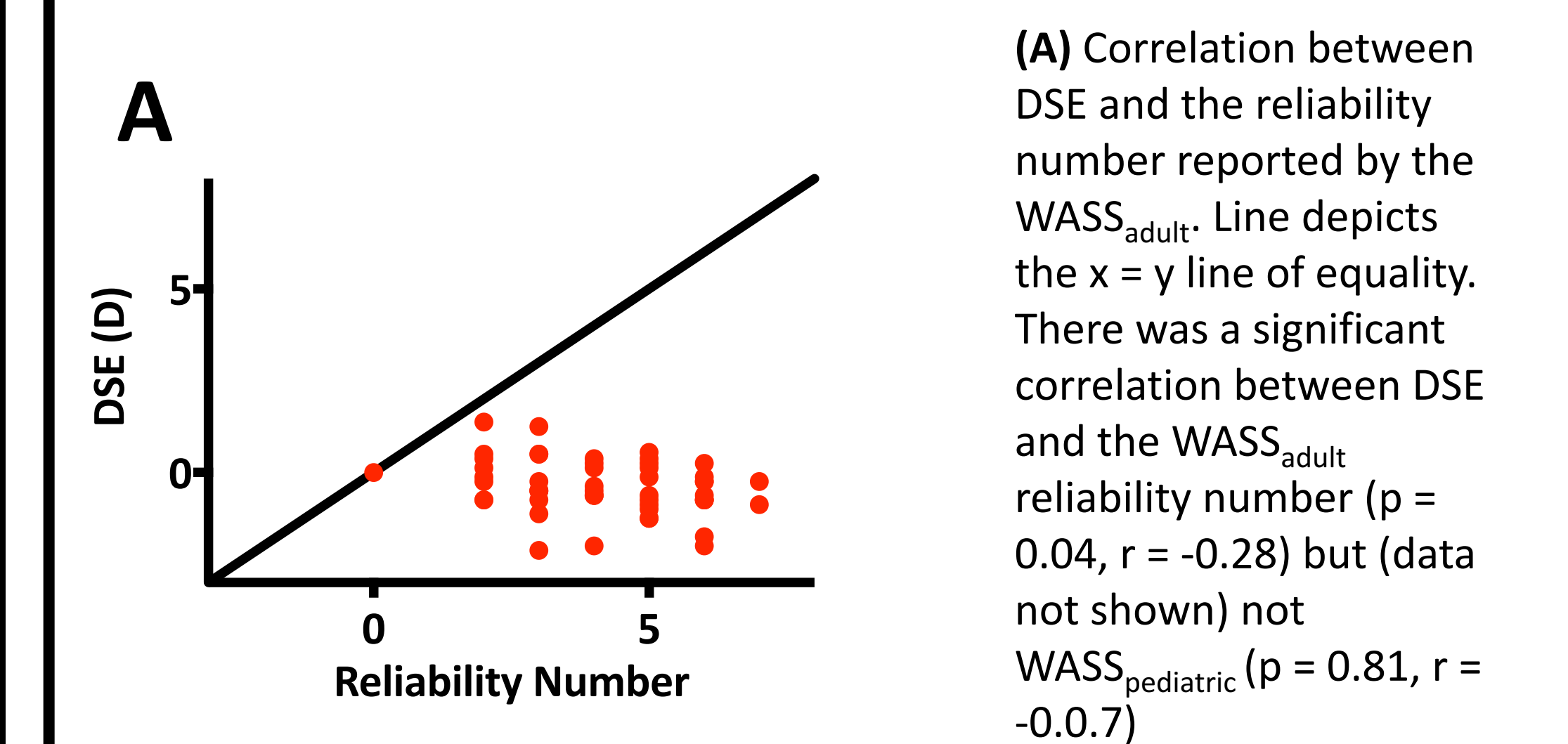
Yes, there was good agreement between WASS_{adult} vs. SR.

3. Does the method of refraction change the diagnosis for the overall refractive state of the eye or patient?



Yes, the method of refraction can change the diagnosis for the eye or patient's overall refractive state.

4. Which setting is recommended for the Welch Allyn SureSight™ autorefractor?



Given the above and that there was an intermethod discrepancy of 0.41 D and variability of 1.40 D for WASS_{adult} vs. SR, WASS_{adult} is the recommended setting for clinical use of the WASS refractometer.

Discussion:

- Comparison to prior studies: A report indicated that outdoor cats have mean refractive error of $+1.15 \pm 0.18$ D and indoor cats -0.81 ± 0.20 D; cats were refracted at each meridian. (Belkin et al. 1977) A more recent study reported a refractive error of -0.78 ± 1.37 D, but cats were strictly refracted along the horizontal meridian. (Konrade et al. 2012)
- SR is routinely performed in clinical veterinary medicine along the horizontal and vertical meridians.
- In human optometry and ophthalmology, SR is performed along the principal meridians.
- Given the results of the present study, there may be more oblique astigmatism in the domestic cat than assumed.
- Limitation: there was a greater range of refractive errors in the WASS_{adult} vs SR cohort, including myopic eyes, and this may result in data skew.

Conclusions:

Routine measurement of refractive error by streak retinoscopy in more than just the horizontal and vertical meridians should be further investigated in clinical veterinary medicine.

While there was a significant difference between methods, the level of agreement between SR and WASS_{adult} for measurement of refractive error in the adult domestic cat is good. For WASS, adult setting is recommended for clinical use.

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