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Effect of Low-Dose Atropine on Binocular Vision in Children Aged 6 to 17 Years

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PURPOSE

To determine the effect of 0.01%, 0.03%, and 0.05% atropine on pupil size and binocular vision function in children aged 6 to 17 years.

METHODS

Forty-six children (28 girls and 18 boys) aged 6 to 17 years were randomized into 4 groups: placebo (n=10), or 0.01% (n=13), 0.03% (n=11), 0.05% (n=12) atropine. One drop of atropine was administered into each eye. The following measurements were collected before drop instillation and 30 minutes, 60 minutes, and 24 hours following application of atropine: pupil size in bright and dim illumination, associated phoria by cover test at distance and near, near point of convergence (NPC) break and recovery, 5 times repeat of NPC (stamina), NPC through red and green glasses (fragility), negative fusional vergence at near, and positive fusional vergence at near. Repeated measures ANOVA was performed to determine the effect of 0.01%, 0.03%, and 0.05% atropine eye drops on binocular vision measurement at each time point . Cycloplegic refractive error was collected from each participant's last exam at the Illinois Eye Institute within the last two years. The spherical equivalents of cycloplegic refractive error means OD, OS for each atropine concentration group are presented in Figure 1.

FIGURE 1

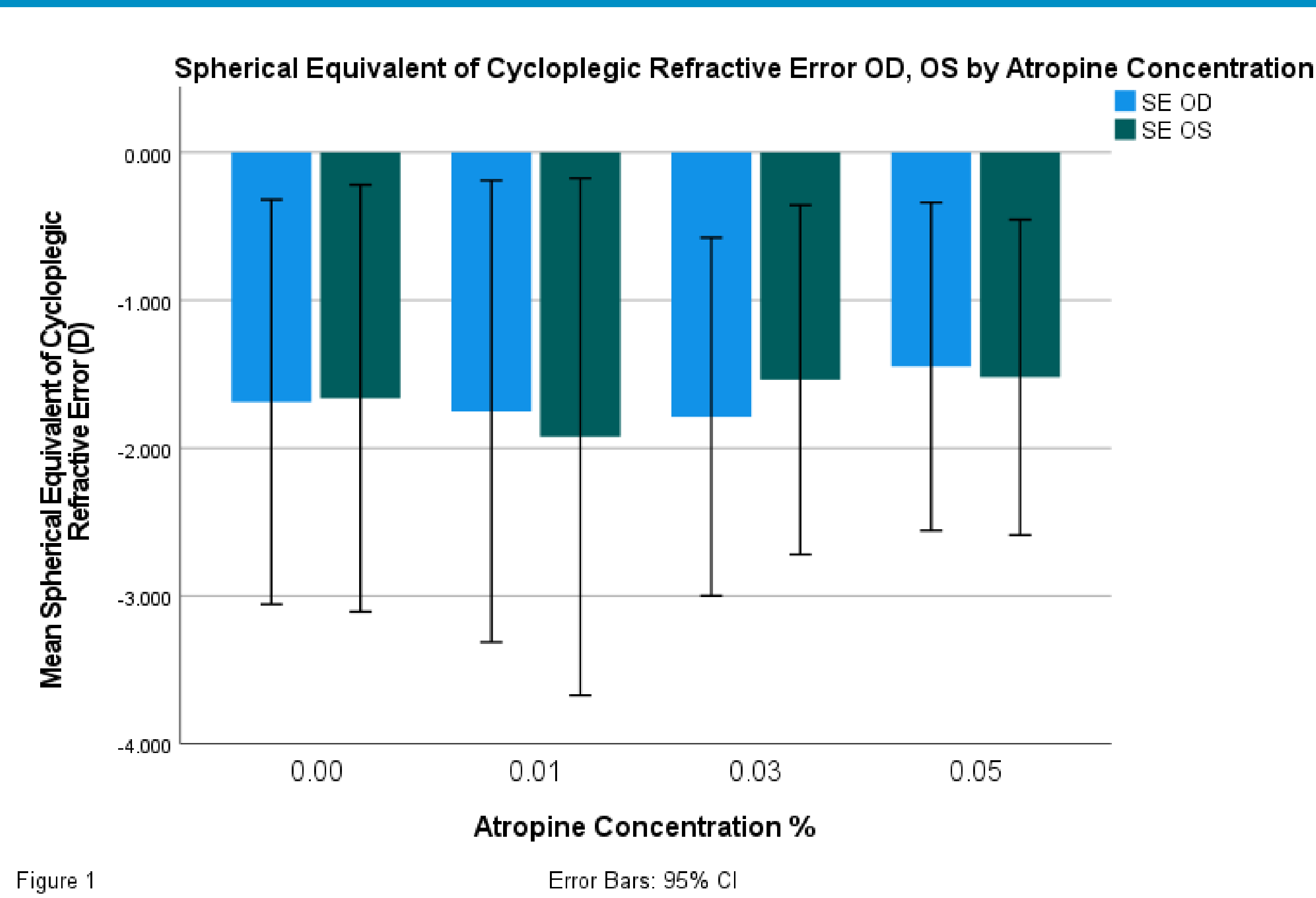


Figure 1

FIGURE 2

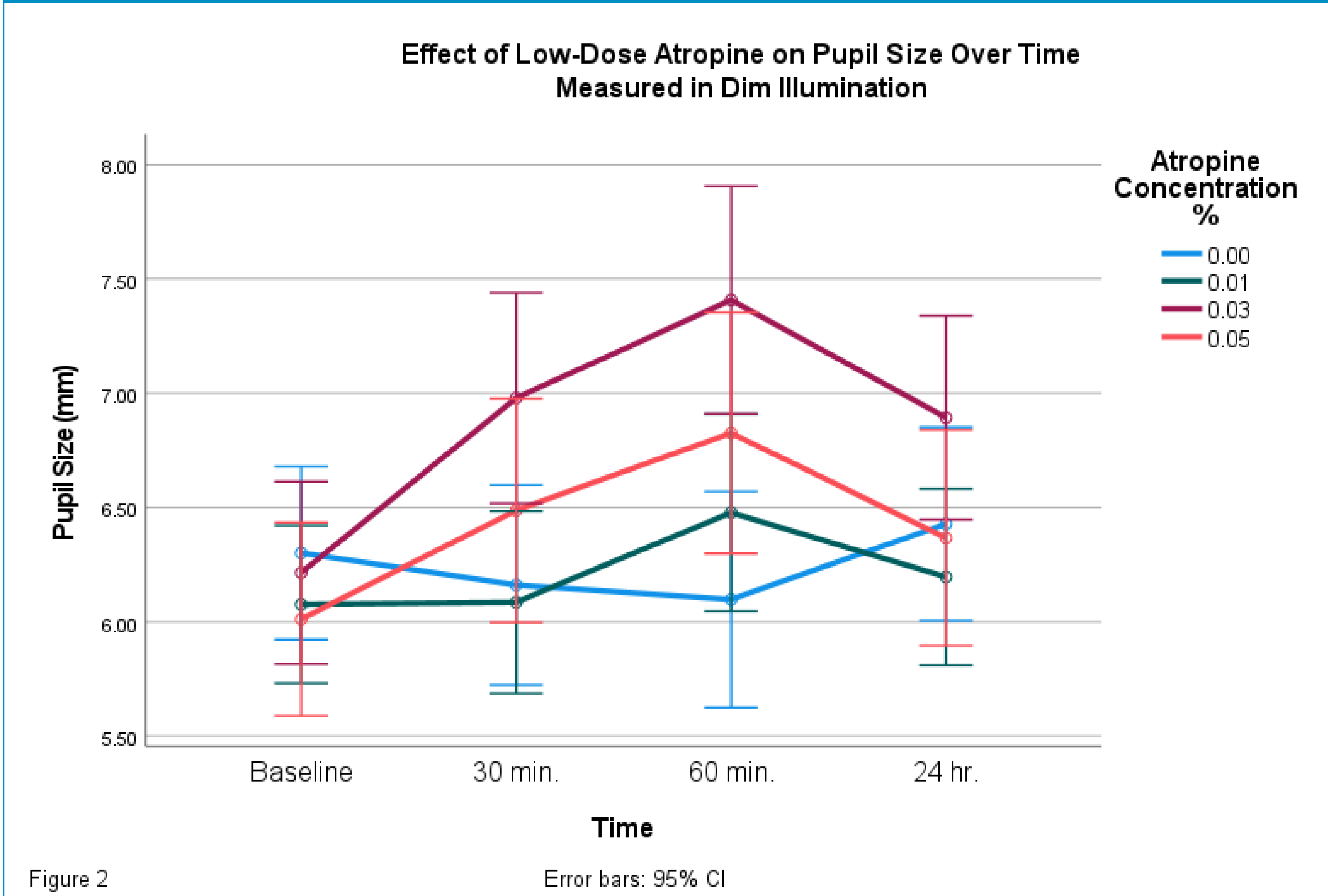


Figure 2

FIGURE 3

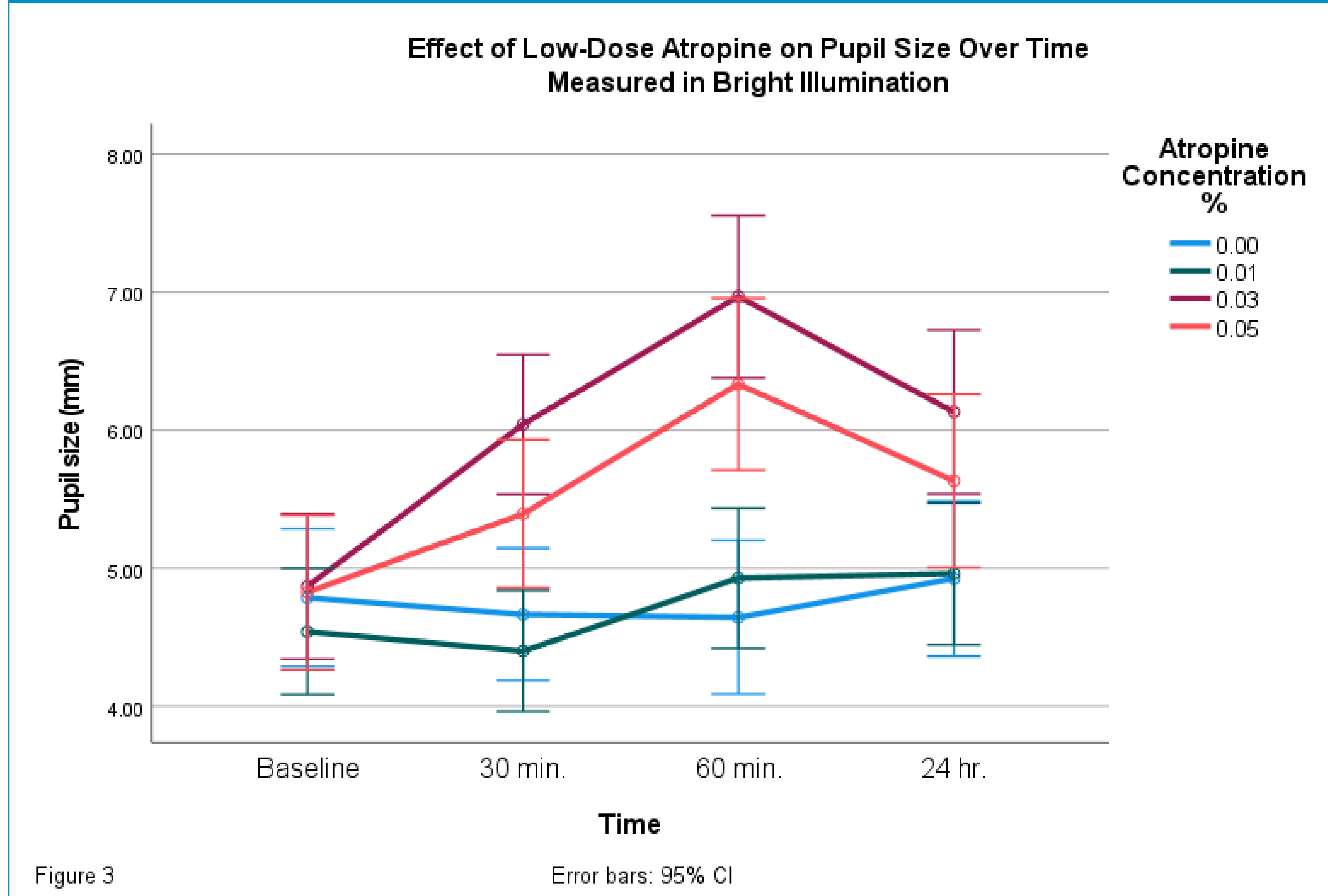


Figure 3

RESULTS

The mean age of participants was 10.7 ±3.0 years. Average spherical equivalent refractive error by cycloplegic refraction was -1.70 ± 1.98 D and -1.72 ± 2.10 D (range = +1.50 to -8.75 D and +0.50 to -6.38 D), OD and OS, respectively. Difference in pupil diameters in bright and dim illumination was statistically significant when comparing all 3 atropine groups to placebo group over time (P< 0.001). Atropine eye drops had the most effect on pupil diameter 60 mins after instillation (Ps<0.05). After 24 hours, pupil diameters had return to baseline levels (P>0.05) for the 0.01% and 0.05% groups, but statistically significant differences persisted for the 0.3% group (P=0.002) (see Figure 2 and Figure 3). There was no significant difference in binocular vision measurements including associated phoria , NPC, NPC stamina and fragility, negative fusional vergence, and positive fusional vergence (all Ps >0.05). Figure 4 and Figure 5 depict associated phoria at distance and at near, with positive values indicating esophoria and negative values indicating exophoria.

CONCLUSIONS

Pupil size was significantly enlarged by 0.01%, 0.03%, and 0.05% atropine in both dim and bright illumination with greatest effect at 60 minutes after application. However, low-dose atropine eye drops had no significant effect on associated phoria by cover test at distance and near, near point of convergence (NPC) break and recovery, 5 times repeat of NPC (stamina), NPC through red and green glasses (fragility), negative fusional vergence at near, or positive fusional vergence at near. These results suggest that low-dose atropine can be safely used to treat myopia progression in children aged 6 to 17 years, without having significant untoward effects on binocular vision function.

DISCUSSION

Some of the strengths presented in our study include the testing of several atropine concentrations (0.01%, 0.03%, and 0.05%), the variety of tests performed at each time point, and the objectivity of the tests selected. Our study was limited primarily by sample size, as well as study drop-out at the 24-hour time point of 6 participants (13.04%). Further investigation must be conducted to explore the effect of low-dose atropine on binocular vision function.

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FIGURE 4

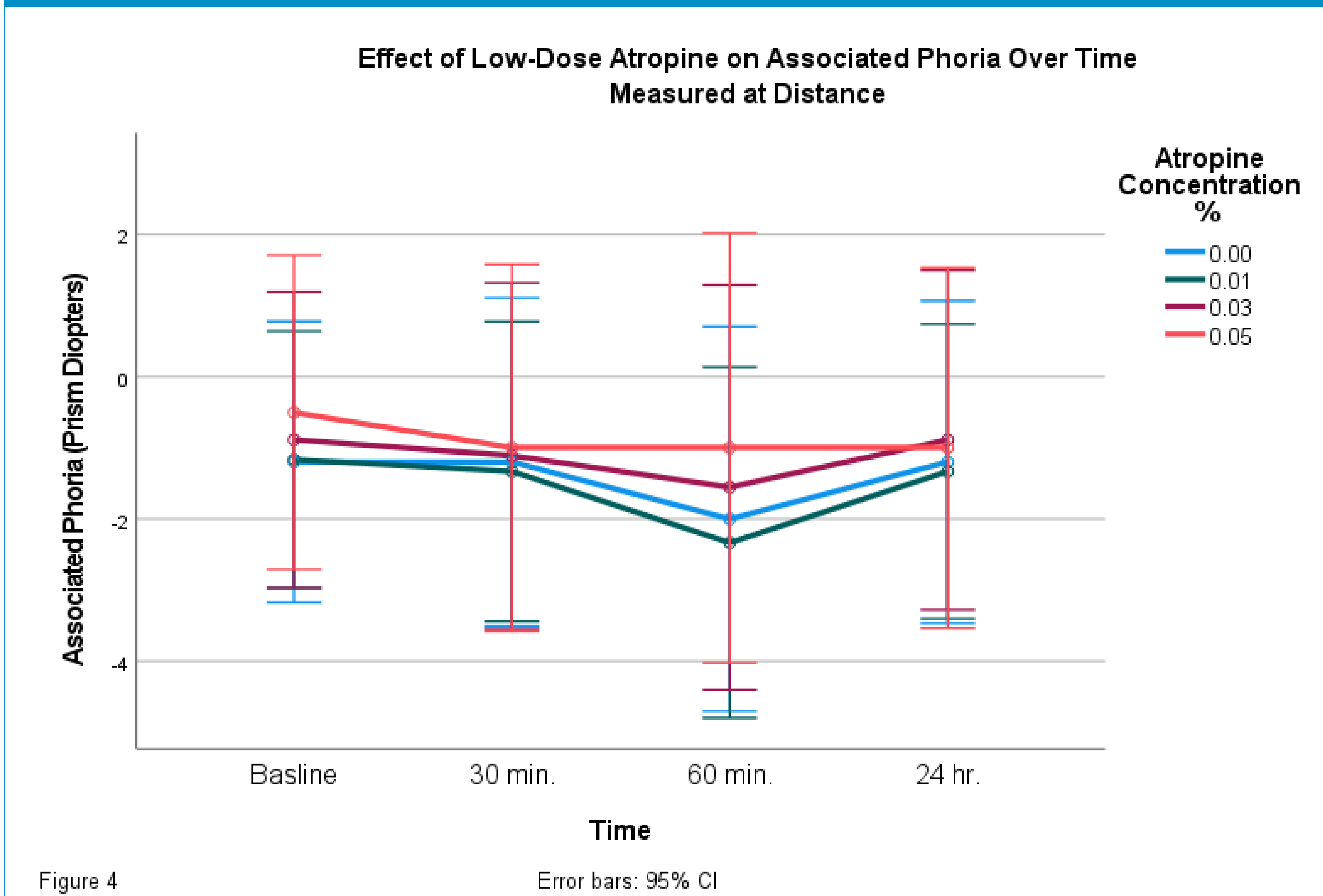


Figure 4

FIGURE 5

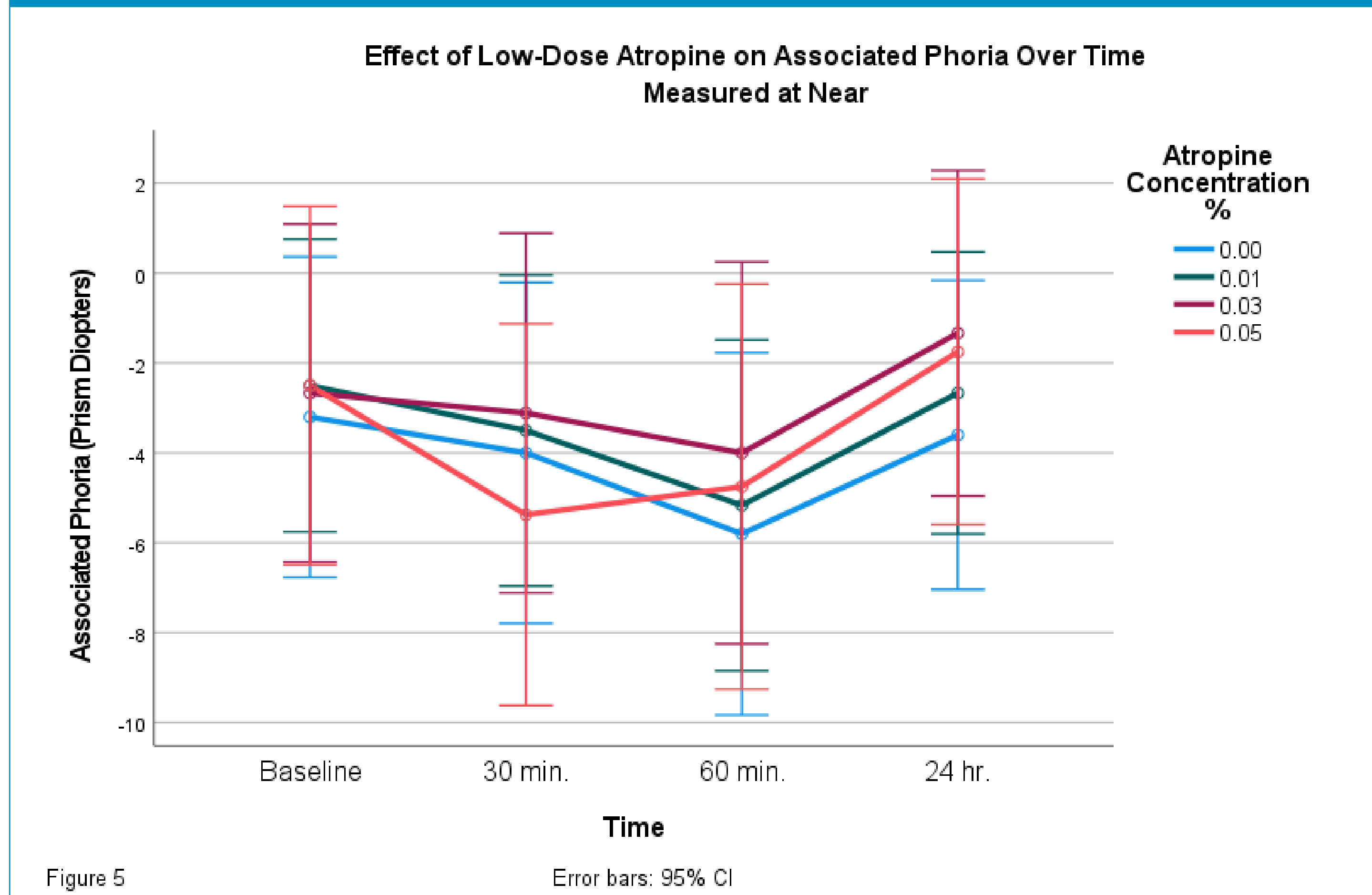


Figure 5