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Impact of Remote Monitoring During the Interstage Period on Outcomes in Single Ventricle Patients Across Socioeconomic Groups

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Background

- Despite improving outcomes, morbidity and mortality for single ventricle (SV) infants remains high.
- Infants of low socioeconomic status (SES) are known to be particularly vulnerable following stage 1 palliation.
- Aim:** To investigate whether use of a novel remote monitoring program, CHAMP® (Cardiac High Acuity Monitoring Program), would mitigate the known disparate outcomes for lower SES SV infants during the interstage period (ISP).
- Hypothesis:** Interstage outcomes for SV infants are the same across differing SES tertiles.

Methods

- Data Source:** CHAMP® Database
 - 607 SV interstage infants, across 11 institutions (2014-2021) were included in the analysis.
 - Enrollees download CHAMP app to their own device or were provided an iPad or tablet (with built in cellular and video capability) for instantaneous transfer of input data to the care team.



- Outcome:** Death or transplant listing during the interstage period.
- Patients were divided into SES tertiles based on a neighborhood summary score (Table 1) which is derived from six unique variables relating to SES.
- Statistical Analysis:** Baseline characteristics between tertiles were compared using Kruskal-Wallis tests for continuous variables and chi-square or Fisher's exact tests for categorical variables (Table 2).
 - Hierarchical logistic regression adjusted for potential confounding characteristics

Table 1

| Neighborhood Summary Score | |
|--|--|
| Median household income | |
| Median value of housing units | |
| Households with interest, dividend, or rental income | |
| Adult residents who completed high school | |
| Adult residents who completed college | |
| Employed residents with executive, managerial, or professional occupations | |

Table 2

| | Tertiles | | | P-value |
|---------------------------------------|-------------------|-------------------|------------------|---------|
| | Lowest N = 198 | Middle N = 213 | Upper N = 198 | |
| Demographic Characteristics | | | | |
| Female, n (%) | 74 (37.6) | 76 (35.7) | 70 (35.7) | 0.905 |
| Non-White race, n (%) | 40 (20.2) | 39 (18.3) | 41 (20.7) | 0.811 |
| Hispanic/Latino, n (%) | 41 (21.2) | 27 (13) | 24 (12.4) | 0.027 |
| Private Insurance, n (%) | 53 (27.6) | 96 (47.1) | 110 (57.3) | <0.001 |
| Neighborhood Summary Score (range) | -10.84 to -1.56 | -1.55 to 1.23 | 1.25 to 13.53 | |
| Birth Characteristics | | | | |
| Prenatal Diagnosis, n (%) | 162 (81.8) | 174 (82.5) | 170 (86.7) | 0.356 |
| Gestational Age (mean, weeks), n | 38.13 | 38.18 | 38.09 | 0.379 |
| Birth Weight (mean, kg), n | 3.19 | 3.13 | 3.17 | 0.530 |
| Clinical Characteristics | | | | |
| Anatomy – HLHS, n (%) | 63 (32) | 81 (38.2) | 77 (39.3) | 0.265 |
| Genetic Syndrome, n (%) | 160 (80.8) | 172 (80.8) | 158 (80.6) | 0.999 |
| Other Anomalies, n (%) | 172 (86.9) | 186 (87.3) | 172 (87.8) | 0.966 |
| Predischarge AVVR*, n (%) | 86 (43.6) | 91 (42.9) | 97 (50) | 0.723 |
| Predischarge Function – normal, n (%) | 183 (93.4) | 198 (93.8) | 179 (91.8) | 0.942 |
| Interstage Period (mean, days), n | 165.46 | 155.15 | 146.66 | 0.104 |
| Outcome | | | | |
| Glenn, n (%) | 187 (94.4) | 192 (90.1) | 184 (93.9) | 0.298 |
| Death, n (%) | 8 (4) | 15 (7) | 6 (3.1) | |
| Transplant Listing, n (%) | 3 (1.5) | 6 (2.8) | 6 (3.1) | |

*AVVR = Atrioventricular valve regurgitation that was mild or greater on predischarge echocardiogram.

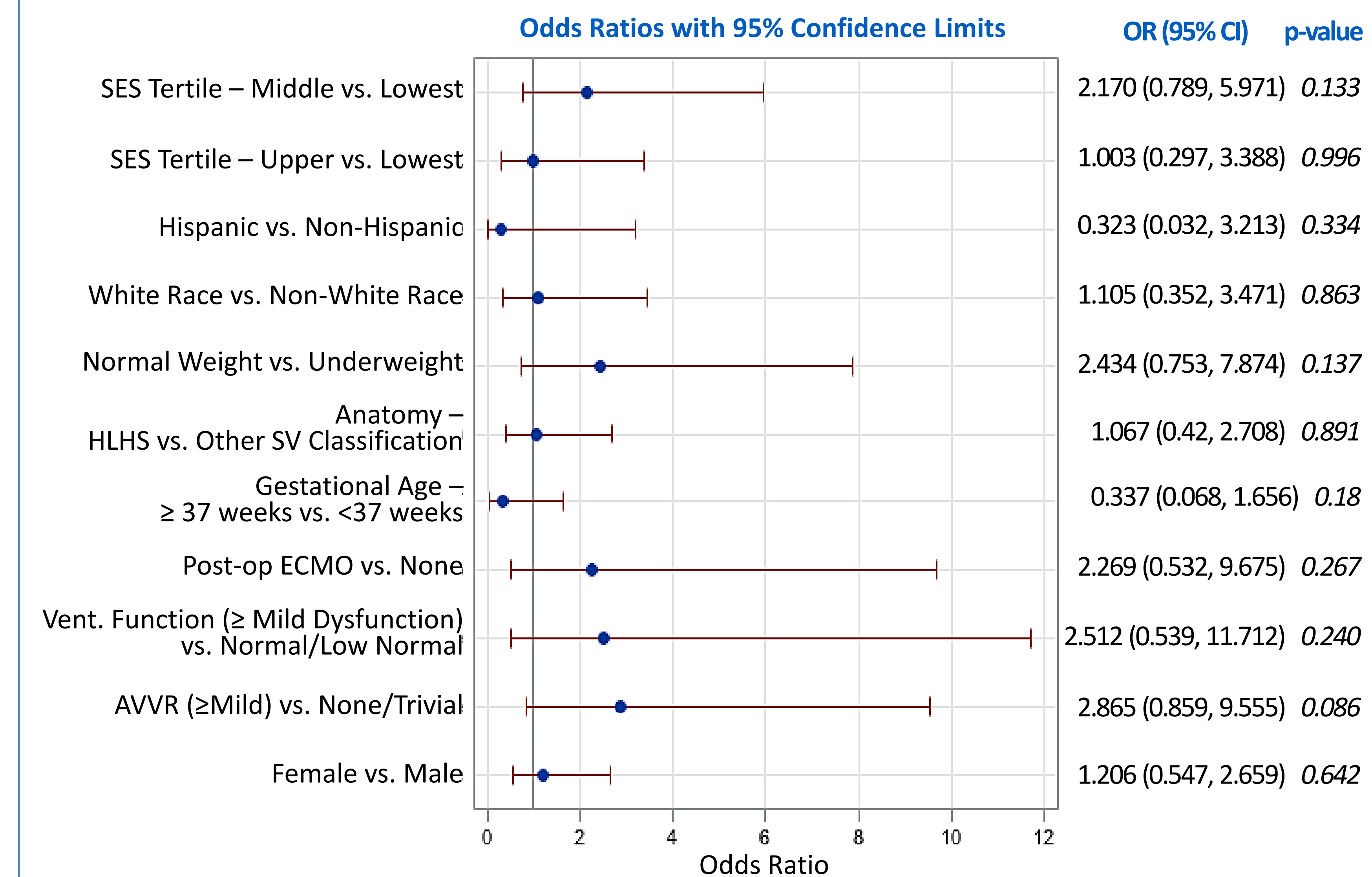
Table 3

| | Outcome N = 44 | Glenn N = 563 | P value |
|---|-------------------|------------------|---------|
| Non-Hispanic/Non-Latino, n (%) | 42 (95.5) | 460 (83.6) | 0.037 |
| Renal failure following stage 1 palliation, n (%) | 2 (4.5) | 2 (0.4) | 0.028 |
| Ventricular dysfunction predischarge, n (%) | 7 (16.2) | 32 (5.8) | 0.034 |
| Predischarge AVVR*, n (%) | 30 (69.8) | 244 (43.5) | <0.001 |
| Lowest tertile, n (%) | 11 (25) | 187 (33.2) | |
| Middle tertile, n(%) | 21 (47.7) | 192 (34.1) | 0.185 |
| Upper tertile, n (%) | 12 (27.3) | 184 (32.7) | |

Results

- Of the 607 SV infants included, 44 (7.2%) met the primary outcome.
- Univariate Analysis:** Non-Hispanic/Non-Latino patients, patients with pre-discharge ventricular dysfunction, post-op renal failure, or post-op AVVR were more likely to experience the primary outcome (Table 3). Rate of reaching outcome did not correlate with SES tertile (Table 3).
- Multivariable Analysis:** Even after multivariable adjustment for potentially confounding factors, SES was not associated with death/needing transplant.
- The odds of reaching the outcome were no different for those in the middle or upper tertile when compared to the lowest (Figure 1).

Figure 1



Conclusion

- In this large cohort of SV infants enrolled in a digital remote monitoring program during the ISP, we found no difference in outcomes based upon SES.
- These findings differ from prior studies showing worse outcomes for SV patients of lower SES.
- Our study suggests this novel technology could help mitigate differences in outcomes for this fragile population of patients.