**Antibody Response Patterns Across Multiple Studies and Groups**

**Abstract**

This study analyzes vaccination data from five studies conducted over five years to understand patterns in antibody responses. Antibody levels were measured before and after vaccination, and the data were categorized by study year, subject participation (one-year vs. multi-year), age groups, and cross-reactivity. Key questions addressed include improvement rates in antibody response, the impact of multiple study participation, age-group differences, and cross-reactivity trends. Results revealed that 79.84% of subjects improved, with higher improvement in one-year participants (84.67%) compared to multi-year participants (77.23%). Improvement patterns varied across age groups, and the highest cross-reactivity was observed in the 2021 study.

**Introduction**

Vaccination is a critical tool in combating infectious diseases, with its effectiveness often assessed through antibody response studies. This report investigates antibody response improvements using data from five studies conducted over five years. The analysis focuses on improvement rates, the impact of repeated participation, age-based differences, and cross-reactivity patterns. Such insights can guide vaccine development and deployment strategies.

**Methods**

**Data Overview:**  
The dataset comprises five studies conducted over five years, with antibody responses measured at various time points post-vaccination. Each subject in a study was vaccinated against a virus and their blood sample was tested against multiple viruses to assess cross-reactivity.

**Analysis Steps:**

1. **Improvement Rates:** Subjects' average antibody improvements were calculated by isolating their baseline IDs (the three numbers in the subject ID) and analyzing antibody response differences from day 0 to the last study day for each virus. A positive difference between the measurement on the last day and day 0 indicated was defined as an improvement in antibody response. Their measurement improvements were stored in an array, and the average of that improvement array was the average improvement value that was assigned to the subject. If the subject’s average improvement value was greater than 0, then the subject’s antibody response measurement was considered to have improved across all the studies that they participated in.
2. **Participation Groups:** Subjects were divided into one-year and multi-year groups based on study participation history.
3. **Age-Group Analysis:** Subjects were categorized into six age groups to assess average improvement rates. The age groups were Infants (<0), Children (1-11), Adolescents (12-17), Adults (18-44), Middle-Aged Adults (45-62), and Seniors (>63).
4. **Cross-Reactivity Assessment:** Improvement rates were averaged across studies to identify the study with the highest cross-reactivity.

**Results**

1. **Improvement Rates:**
   * **Overall:** 79.84% of subjects showed improvement in antibody response.
   * **One-Year vs. Multi-Year Groups:** Improvement rates were 84.67% for one-year participants and 77.23% for multi-year participants.
2. **Age Group Analysis:**
   * In the one-year group, improvement decreased as age increased.
   * In the multi-year group, improvement increased with age but declined in seniors.
3. **Study-Wise Cross-Reactivity:**
   * The lowest improvement was in the 2018 study, indicating low cross-reactivity.
   * The highest improvement was in the 2021 study, suggesting the highest cross-reactivity.

A screenshot of a computer

Description automatically generated**Improvement of Each Age Group in One-Year and Multi-Year groups**

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**Improvement Across Studies**