Design and Methods of the Apple Women’s Health Study: A Digital Longitudinal Cohort Study

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Introduction

- Multiple factors influence menstruation, including stress, nutrition, body weight, and physical activity
- Irregular patterns or absence of menstrual cycles can serve as indicators of underlying health problems
- Abnormalities in bleed length and amount affect up to 30% of those who menstruate
- However, an understanding of population-based variation in menstrual cycle characteristics is lacking and menstruation is under-represented in research

Methods – Materials and Data Collection

- Research app Platform: Mobile-app based digital longitudinal cohort study
- Surveys: Ascertain demographics, menstrual status, health status, medical history, and reproducibility
- Questions derived from: National Health and Nutrition Examination Survey (NHANES); Perceived Stress Scale (PSS-4); All of Us Study; Nurses’ Health Study 2; Ovarian and Menstruation (OM) Health Study
- Enrollment began: November 14, 2019
- Duration: 10 years, with potential for extension

Results – Baseline Characteristics of the First 10,000 Participants

<table>
<thead>
<tr>
<th>Eligibility Criteria</th>
<th>Number</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having ever menstruated</td>
<td>9,885</td>
<td>98.9%</td>
</tr>
<tr>
<td>Living in USA</td>
<td>9,885</td>
<td>98.9%</td>
</tr>
<tr>
<td>Age of 18 years or older in most states</td>
<td>9,885</td>
<td>98.9%</td>
</tr>
<tr>
<td>Proficiency in written and spoken English</td>
<td>9,857</td>
<td>98.6%</td>
</tr>
<tr>
<td>Uses iPhone with iOS version 13.2 or later</td>
<td>9,885</td>
<td>98.9%</td>
</tr>
<tr>
<td>Installing Apple Research app on iPhone</td>
<td>9,885</td>
<td>98.9%</td>
</tr>
<tr>
<td>Sole user of an iCloud account or iPhone</td>
<td>9,885</td>
<td>98.9%</td>
</tr>
</tbody>
</table>

Results – Monthly Menstrual Survey Response Rate

- Majority (54%) did not respond to monthly menstrual survey after enrollment
- 73% of participants responded to the MMS consecutively over six-months follow-up period
- Non-White participants were slightly more likely to drop out than White participants
- Participants remaining at six months were otherwise similar in demographics to enrollment group

Discussion

- First app-based study of this scope with the goal of collecting longitudinal data for at least ten years
- Inclusive eligibility criteria
- Obtains expanded demographic, anthropometric, lifestyle, and behavioral data elements
- Novel opportunities to examine variations in reproductive physiology using passively collected data

Opportunities

- Improving study retention to reduce drop-out
- Continued focus on increasing diversity of cohort
- HealthKit data to be used to address missingness of menstrual cycle data due to nature of surveys

Conclusion

- The Apple Women’s Health Study has strong potential to contribute to new knowledge about long overlooked and understudied women’s health issues.

References

(5) 2017:1002.