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AAO Foundation Final Report

Type of Award: Biomedical Research Award

Name(s) of Principal Investigator(s): Giseon Heo

Title of Project: Early Detection of Pediatric Obstructive Sleep Apnea: Investigating the Potential Role of Orthodontists

Period of AAOF Support: 07-01-17 to 06-30-18

Amount of Funding: USD$30,000.00

Summary/Abstract (250 word maximum)

196 subjects have been recruited from the Children's University Hospital and Pediatric Dental Clinic, School of Dentistry, University of Alberta. Questionnaires, craniofacial index, 3D photographs were collected for 196 subjects and 100 subjects took polysomnography tests. Ten participating clinicians classified subjects' severity of obstructive apnea (OSA) into four categories (*none, mild, moderate, or severe*). Clinicians determined classification twice; based on 3D photos, and then with craniofacial indices and pediatric sleep questionnaires (PSQ-22).

A focus group was conducted with four clinicians in December 2017 to perform an interim analysis of the classification (n=152). From this, the following was observed: (1) OSA classification by clinicians did not agree with the apnea-hypopnea index (AHI), (2) the agreement of the clinicians was low, with range of Kappa statistics (0.001, 0.485), (3) the clinicians had higher agreement when they assessed subjects based on all information (3D photo, PSQ-22, and craniofacial index) than when only considering 3D photos. The clinicians' classification was combined into two groups - control (*not likely and minimal*) and case (*moderate and severe*) and cross validated with the classification based on controls (AHI $\leq$5.0) and Cases (AHI >5.0). Overall, specificity is higher than sensitivity.

A focus group with five clinicians will classify 196 subjects by August 2018. Re-classification of subjects will serve to measuring clinician intra-reliability. In addition, we have interviewed 3 sleep physicians for a parallel study. Currently, we are analyzing data and preparing two manuscripts, one for an orthodontics journal and the other for a statistics and machine journal.

Response to the following questions:

1. **Were the original, specific aims of the proposal realized?**

   All of original aims of the study are realized except two. We had anticipated that all the participating eleven clinicians would categorize the OSA severity of subjects twice to measure their consistency. However, two unexpected issues arose, ethics approval for utilizing external clinicians was very difficult, and the classification itself was very time consuming. It took much longer to categorize the subjects in terms of severity of OSA than anticipated. Thus, only five clinicians from University of Alberta will participate in the second focus group planned for August 2018. The purpose of the reevaluation was to see whether the participating clinicians were consistent within themselves. The other aim that is not realized is that the number of sleep physicians we hoped to interview is significantly less than expected. We sent out interview invitation letters to 20 sleep physicians, but only three agreed to participate in the study. We do not anticipate any publication from the interview results that we had planned as a parallel study.

2. **Were the results published?**

   a. Article published: Betancourt C, Chalifour M, Neville R, Pietrosanu M, Tsuruga M, Darcy I, Heo G. *Pseudo-multidimensional persistence and its applications*, to appear Research in Computational Topology, Springer-Verlag, 2018.

   b. Was AAOF support acknowledged? Yes

   c. Manuscript preparation: One manuscript is review process. Two manuscripts are currently being prepared for publication: one for an orthodontics journal and the other for a statistical or machine learning journal. We expect to submit the first manuscript by December 2018, the second manuscript by September 2019.

3. **Have the results of this proposal been presented?** Yes

   a. If so, list titles, author or co-authors of these presentation/s, year and locations
   Title: *Pseudo-multidimensional Persistence and Its Applications*.
   Co-authors: Betancourt C, Chalifour M, Neville R, Pietrosanu M, Tsuruga M, Darcy I
   Year and location: Workshop on Statistics and Applied Algebraic Topology at the SIAM Conference on Applied Algebraic Geometry 2017 (SIAM AG'17), Atlanta, Georgia, USA.

   b. Was AAOF support acknowledged? Yes

   c. Future presentation: a conference in Multiparameter Persistent Homology
   August 5-10, 2018, Casa Matematica Oaxaca, Mexico.

4. **To what extent have you used, or how do you intend to use, AAOF funding to further your career?**

The data collected for the current research include 36 time series from polysomnography, 3D photos, craniofacial index, demographics, and questionnaires. This kind of data is an example of multi-source data, which has become more common. The types of data in multi-source data are different and thus require different analytical techniques. Instead of analyzing each data set independently, it is more desirable to analyze all the data simultaneously. The classical methods in statistics and machine learning may not be effective for analyzing multi-source data simultaneously and thus require statisticians and scientists to create new methodologies. Our data set is not only an excellent example of multi-source data, but also it will be very useful in demonstrating new analytics methods. We have presented initial findings for analyzing multi-source data and have been well received by referees. With several collaborators and graduate students, I continue to work on developing new techniques for multi-source data that incorporate three major scientific areas; statistics, computing science, and applied computational topology.

Prepared by Giseon Heo, June 16, 2018.

Please return to AAOF via email attachment to
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