BIG DATA AGAINST CHILDHOOD OBESITY

Children and adolescents with obesity have a higher risk of developing various diseases later on, compared to children without obesity. The reasons why some children become obese are complex, and behaviour, the living environment, and public health policies all play a role. BigO collects and analyses anonymous data on children's behavioural patterns and their living environment. With advanced analytics BigO extracts data-driven evidence on which local factors are involved, and how these factors influence childhood obesity in Europe.

With this information BigO will be able to advise clinics and public health authorities on how to develop and plan effective programs and policies in an attempt to reduce childhood obesity.

BigO Newsletter #3

General project information

- BigO collects objective behavioural data from children (9-18y) and their environment using a smartphone and smartwatch application.
- The overall project aim is to show how children's big data - i.e., data on eating behaviour, physical activity and sleep, combined with data on their food and build environment - can help public health authorities take decisions on local policies against childhood obesity (**Figure 1**).
- To this aim a digital platform is build which supports collection of data by children with a citizen science approach (**Figure 2**).
- See **Figure 3** for screenshots of the myBigO application for smartphones and smartwatches.
- Real time data visualisations and predictive models will be created in order to perform real-time monitoring and data-driven effectiveness predictions of public health interventions.
- The BigO project runs from November 2016 – November 2020 and consists of three phases in which the complexity of the BigO platform is increased and simultaneously used to collect data.
- In year three, the focus was to complete the integration of the system, build the analytics for the Public Health Portal, and collect real life data from children through schools and clinics.

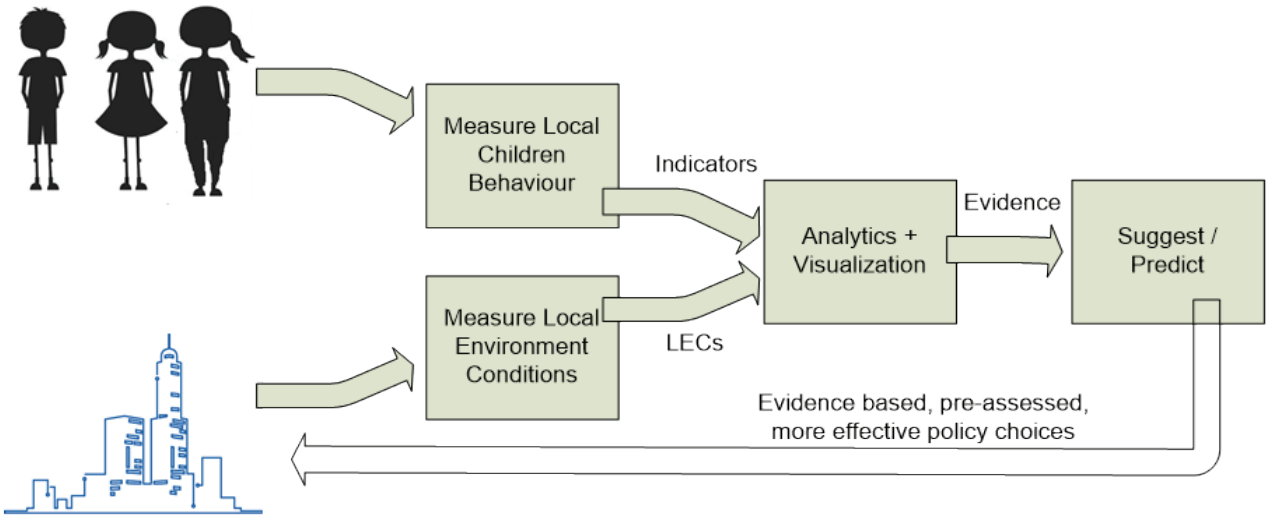

Figure 1. The overall project aim is to show how children's big data on eating behaviours, physical activity and sleep, combined with data on their food and built environment, can help public health authorities take decisions on local policies against childhood obesity.

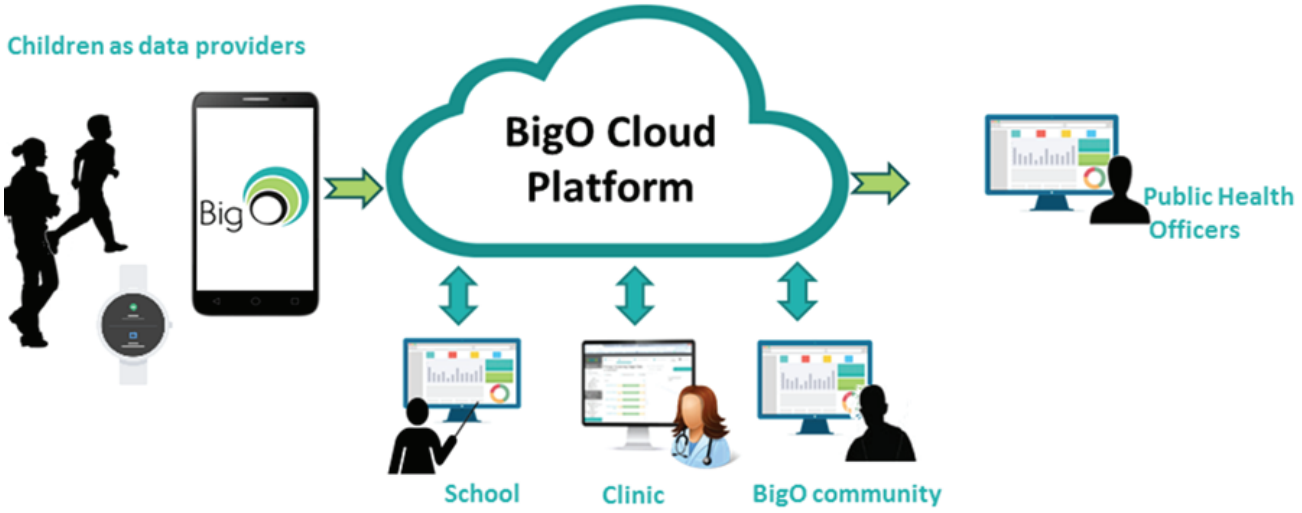

Figure 2. Overview of the digital platform which is built to support collection of data by children (citizen science).

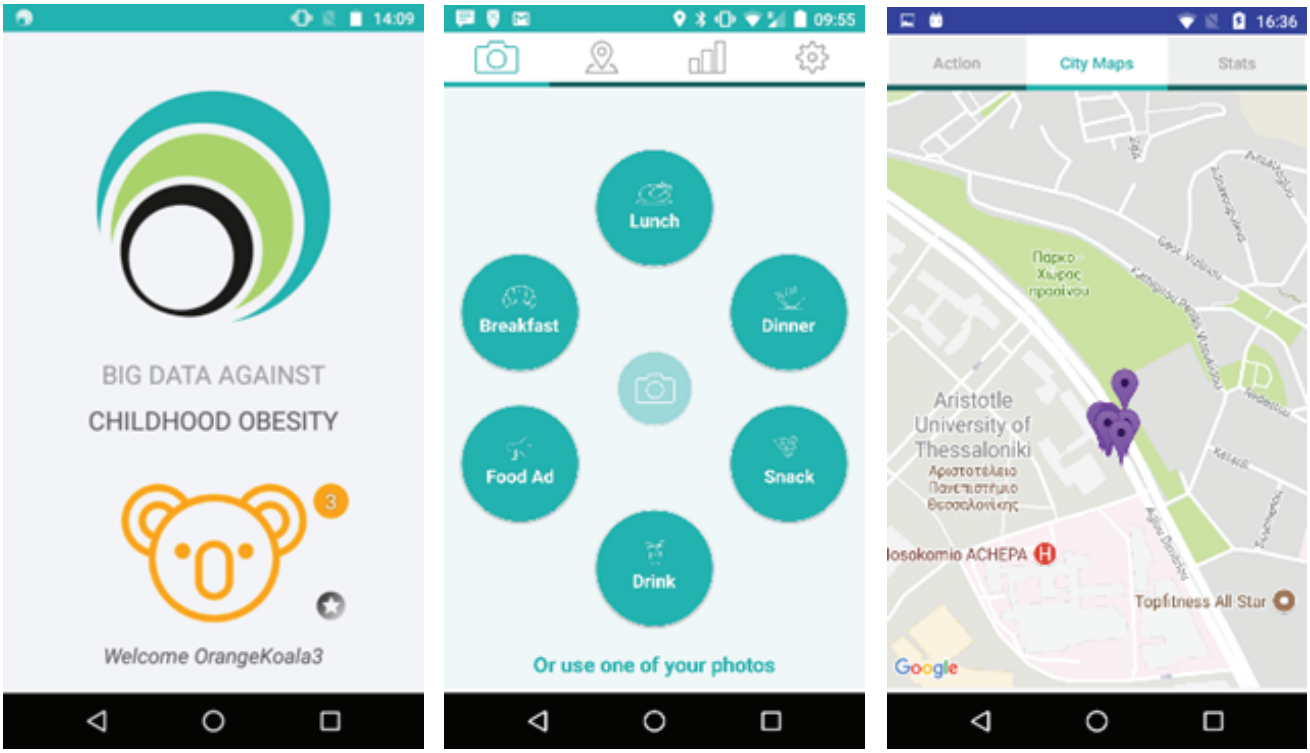

Figure 3. Screenshots of the myBigO application that is used by children to collect data for the BigO project.

Technical development results year 3

- The collected behaviour data by the myBigO app has been integrated with urban environment characteristics as well as with nationally collated statistics.
- Data administration tools have been integrated, to support the data collection of the different types of users, types of data and data collection procedures at schools and clinics (**Figure 4**).
- The BigO Public Health Portal (**Figure 5**) is built; this portal offers a powerful interface with a dashboard and maps, providing insightful visualisations of the data.
- The BigO platform has proved robust operation during the last year with the system being up and running 24-7 in the 12 month duration of the large-scale data collection phase.
- In total project duration the myBigO app and system have been used by 4.324 students, 74 teachers, 18 clinicians and 5 administrators.

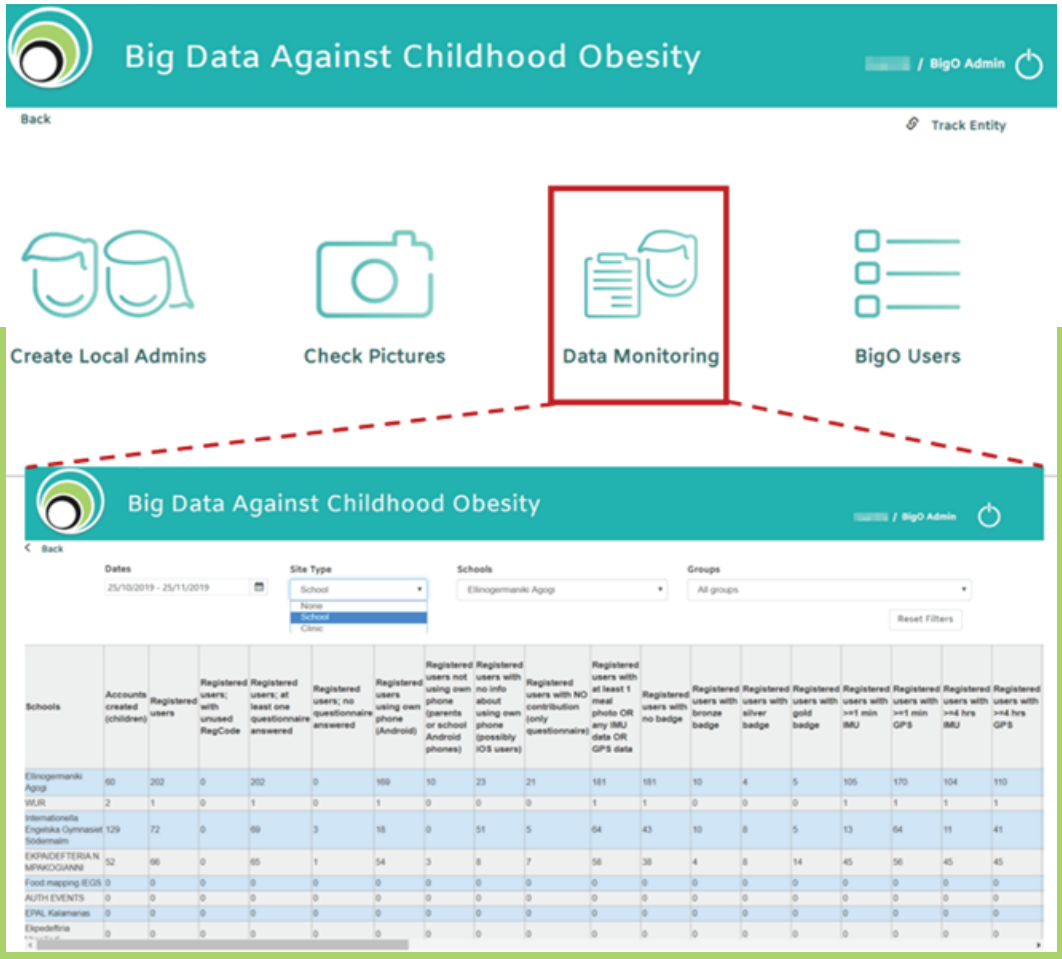

Figure 4. Screenshots of the integrated data administration tools.

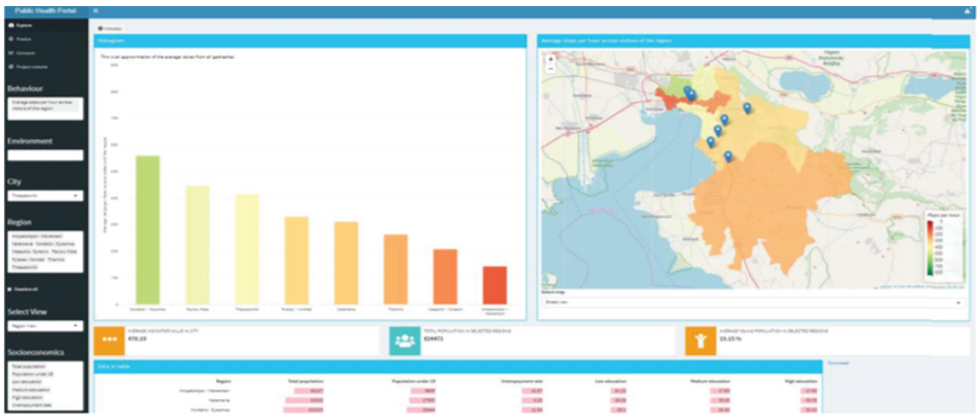

Figure 5. The BigO Public Health Portal; this portal offers a dashboard and maps with the integrated data from different sources, providing insightful visualisations from the data.

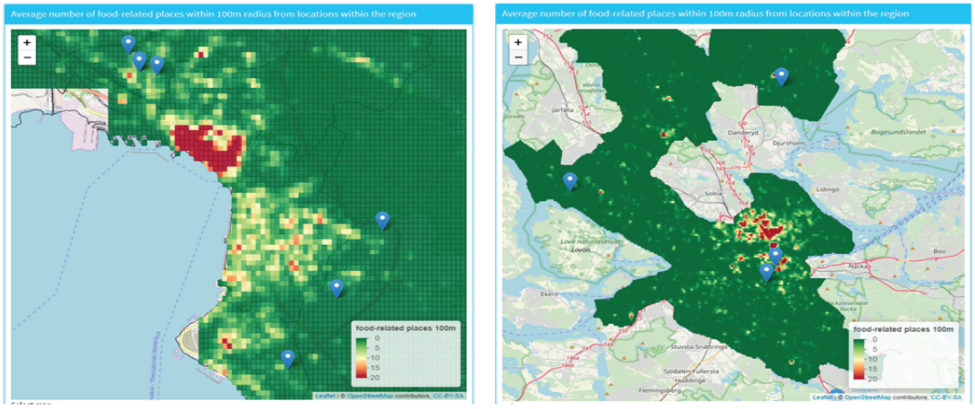

Figure 6. Nationally collated statistics are integrated in the BigO Public Health Portal. Left panel: Thessaloniki, right panel: Stockholm.

Data collection results

Who provided data?

- Between Nov 2018 and Nov 2019, 8.000 students were informed about the project. The aim was to recruit 2.880 children in clinics and schools.
- Data was collected in 4 countries (Greece, Ireland, Netherlands, Sweden).
- Data was collected from 18 schools and 2 clinics. In total 3.053 children collected data, of which:
    - 1.679 children from schools in the consortium (55%).
    - 872 children from clinics in the consortium (29%).
    - 502 children from schools outside of the consortium (16%).

What data were collected?

- 2.611 questionnaires on wellbeing and sleeping habits.
- 41.343 meal pictures.
- 2.079 food advertisement pictures.
- 22.185 days (>60 years) worth of accelerometry data.
- 20.864 days (~57 years) of GPS data.

Figure 7. Depending on the curriculum of the school and the age of the children, different citizen science projects have been undertaken. This is an example of how young children discuss their results on paper.

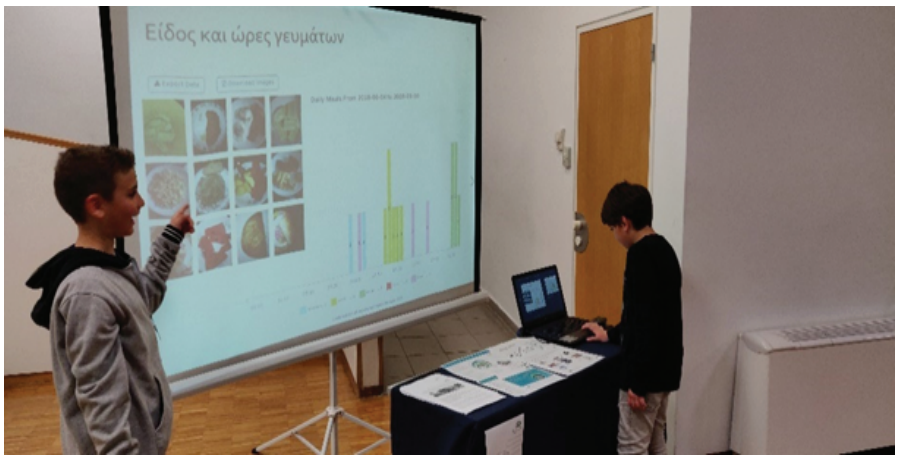

Figure 8. Depending on the curriculum of the school and the age of the children, different citizen science projects have been undertaken. Older children summerize the collected pictures of their peers in class.

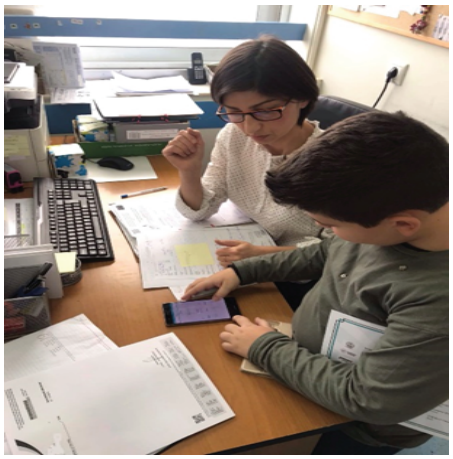

Figure 9. Teachers and clinicians have a central role in the project; they are critical in stimulating the parents and kids to take part in the data collection of the project.

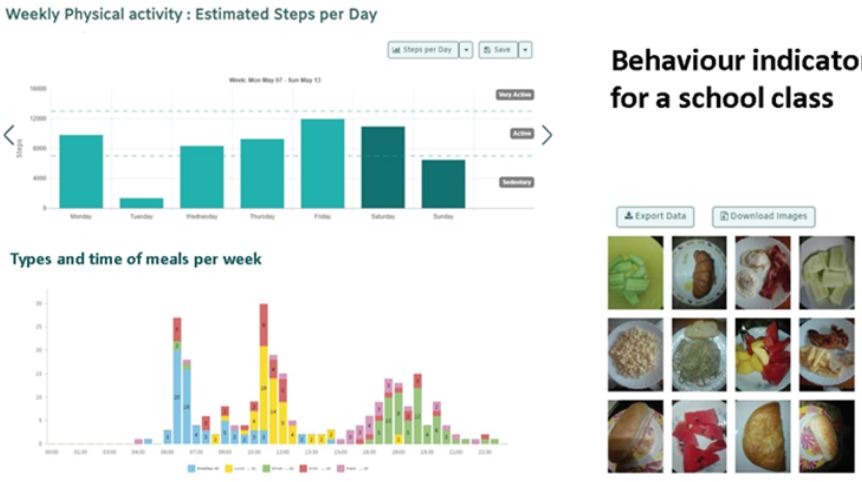

Figure 10. Data collected by a school class. Visualised in the school portal.

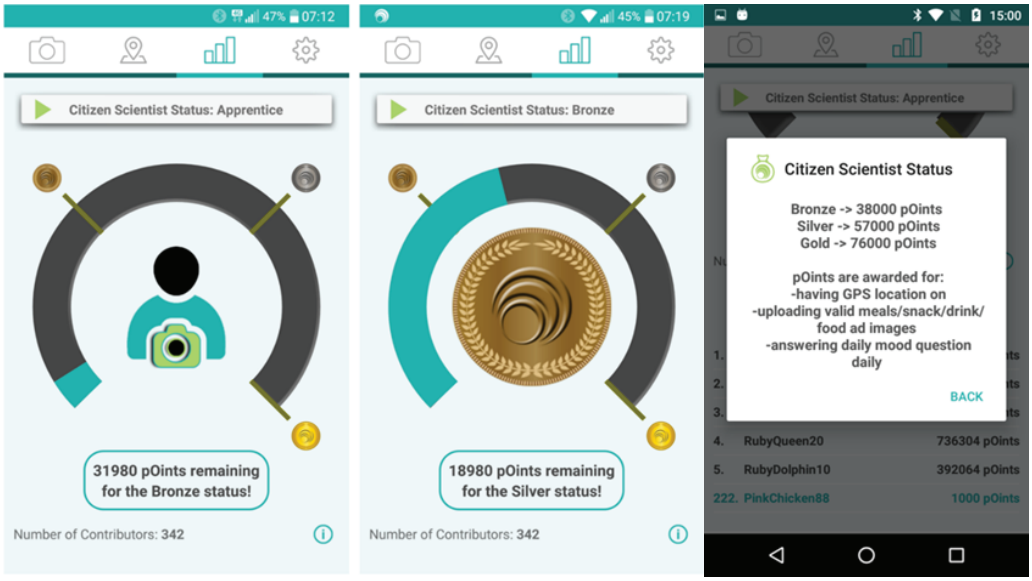

Figure 11. As an incentive children can earn a bronze, silver or gold citizen science status. 21% of students earned a bronze status, while 11% earned a silver and 68% a gold status.

Figure 12. All children participating in the BigO project as citizen scientists can get a certificate of participation.

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Scientific publications BigO:

Inferring the spatial distribution of physical activity in children population from characteristics of the environment. Sarafis, I., Diou, C., Papapanagiotou, V., Alagialoglou, L., & Delopoulos, A. (2020) arXiv: 2005.03957. (pre-print, full paper, accepted as conference proceeding)

BigO: A public health decision support system for measuring obesogenic behaviors of children in relation to their local environment. Diou, C., Sarafis, I., Papapanagiotou, V., Alagialoglou, L., Lekka, I., Filos, D., Stefanoupoulos, L., Kilintzis, V., Maramis, C., Karavidopoulou, Y., Maglaveras, N., Ioakimidis, I., Charmandari, E., Kassari, P., Tragomalou, A., Mars, M., Ngoc Nguyen, T., Kechadi, T., O'Donnel, S., Doyle, G., Browne, S., O'Malley, G., Heimeier, R., Riviou, K., Koukoula, E., Filis, K., Hassapidou, M., Pagkalos, I., Ferri, D., Pérez, I., Delopoulos, A. (2020). arXiv:2005.02928. (pre-print, fullpaper, accepted as conference proceeding)

Ultra-processed food advertisements dominate the food advertising landscape in two Stockholm areas with low vs high socioeconomic status. Is it time for regulatory action? Fagerberg, P., Langlet, B., Oravsky, A., Sandborg, J., Löf, M., & Ioakimidis, I. (2019). BMC Public Health, 19(1), 1-10. (peer reviewed manuscript)

Mobile health (mHealth) applications with children in treatment for obesity: A randomised feasibility study. Browne, S., O'Donell, S., Tully, L., Dow, M., O'Conner, J., Kechadi, T., Doyle, G., O'Malley, G. (2019, October) In FENS 13th European Nutrition Conference. (conference abstract)

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Assessment of In-Meal Eating Behaviour using Fuzzy SVM. Sarafis, I., Diou, C., Ioakimidis, I., & Delopoulos, A. (2019, July). In 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) (pp. 6939-6942). IEEE. (conference proceeding)

BigO: The use of New Technologies for the Management of Childhood Obesity–A Clinical Pilot Study. Tragomalou, A., Kassari, P., Ioakeimidis, I., Filis, K., Theodoropoulou, E., Lymperopoulos, G., … & Lekka, E. (2019, August).In 58th Annual ESPE (Vol. 92). European Society for Paediatric Endocrinology. (conference abtract)

Detecting Meals In the Wild Using the Inertial Data of a Typical Smartwatch. Kyritsis, K., Diou, C., & Delopoulos, A. (2019, July). In 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) (pp. 4229-4232). IEEE. (conference proceeding)

Developing a novel citizen-scientist smartphone app for collecting behavioral and affective data from children population. Maramis, C., Ioakimidis, I., Kilintzis, V., Stefanopoulos, L., Lekka, I., Papapanagiotou, V., Diou, C., Delopoulos, A., Kassari, P., Charmandari, E., Maglaveras, N. MobiHealth 2019 - 8th EAI International Conference on Wireless Mobile Communication and Healthcare, University College Dublin, Ireland (conference abstract)

A methodology for obtaining objective measurements of population obesogenic behaviors in relation to the environment. Diou, C., Sarafis, I., Papapanagiotou, V., Ioakimidis, I., & Delopoulos, A. (2019). Statistical Journal of the IAOS, pp. 677-690, 2019 (peer reviewed manuscript)