

## The protocol for the study about association between radio frequency wave and children's health: New challenge from Hokkaido study

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### Abstract

It is needed to clarify the association between radio frequency (RF) wave exposure and child health, especially focused on neurodevelopment. We conduct questionnaire survey on mobile phone usage and children's behavior and health status for all children in the existing Hokkaido study cohort (n = 12,000, 7-17 year-old). Additionally, we implement three types of face to face survey for neurodevelopment (cognitive assessment, electroencephalogram recording, and intelligence test), along with personal radio frequency wave exposure measurements by portable devices, on children participating the existing Hokkaido birth cohort study (n = 400, respectively). All together, we examine the association between radio frequency wave exposure and children's health, controlling for potential confounding factors. In the presentation, we introduce the protocol of our project.

### 1 Introduction

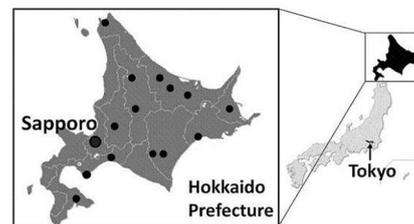
The opportunities for children to be exposed to radio frequency (RF) waves are increasing due to the wide spread of smart phone and wireless LANs in each household. Previous studies investigated association between RF waves and behavioral problem [1, 2, 3, 4] and cognitive ability [1, 3, 5, 6, 7] of school-aged children. However, the results were not consistent probably due to the difficulty in assessment of exposure and lack of data about confounders. Therefore, we try to assess RF exposure by both dosimetry and questionnaires to estimate individual exposure levels. The ongoing birth cohort study enable us to consider about confounders. Additionally, we would compare the environment for RF wave exposure in Japan and Europe or other countries.

### 2 Methods

#### 2.1 Participants

All participants are from a prospective birth cohort study, the Hokkaido Study on Environment and Children's Health (Fig.1), which enrolled pregnant women from 2003 to 2012 in Japan [8]. We have basic information for mothers and children and mother's and children's blood sample both in utero and at birth. After delivery, we have the information about various aspect of life mainly by questionnaires (ex. lifestyle, social and

economic status, neurodevelopment, and allergy, etc.). Our project has two big part and sub-part for each. One of these is questionnaire survey for all children in the ongoing cohort (n=12,000), and the other is three types of face to face survey for small part of the cohort (n=400).



**Fig.1 The region of the Hokkaido study cohort in Japan**

#### 2.2 Questionnaire survey

In the questionnaire (Fig.2), we collect the information about RF wave exposure, outcome, and confounders. Exposure measure include the use of mobile phone and wireless electrical devices (talking, internet, game etc), internet environment in the home, lifestyle and the residential area. For outcome, the diagnosis of developmental disorder, behavioral problem (SDQ; Strength and difficulties questionnaire), and sleep habits (CSHQ-J; The Japanese version of children's sleep habits questionnaire) or quality of life (J-KIDSCREEN-10) is included. Additionally, as confounding factors, question for screen time for electrical devices, favorable internet contents etc. are also included. The questionnaire will implement 2020 as baseline survey and 2022 as follow-up, to clarify the association between RF wave exposure, especially before and after introduction of 5G in Japan.



**Fig.2 Schedule of questionnaire survey**

#### 2.3 Face to face survey

In the face to face investigation (Fig.3), we assess whole body RF wave exposure by using dosimetry. Participants take mobile recording device (Expo-M) to their home, and record radio frequency wave exposure for 3 days each after face to face neuro-functional examination, one of a) easy cognitive task for 9-11 years old, b)

Electroencephalogram & Event related potentials recording for 12-13 years children, c) Intelligence quotient by WISC-IV for 14-15 years old.

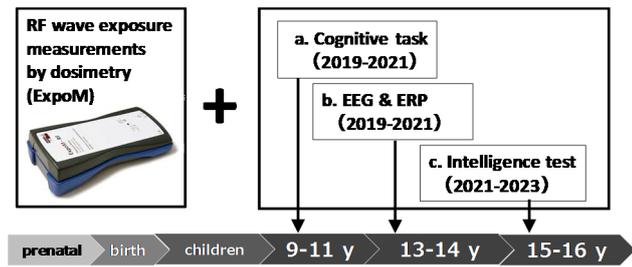


Fig.3 Schedule of face to face survey

## 2.4 Analysis

For the questionnaire survey, we can compare RF wave exposure and outcome before and after 5G introduction in Japan. Face to face survey enable to analyze association between detailed neuro-function and individual exposure levels in each survey. Additionally, we plan to establish computational model to estimate individual exposure by using dosimetry data and questionnaire data, and cumulative cohort data. Finally, we aimed to estimate individual exposure level only from questionnaire data.

## 3 Results & Discussion

From 2020, we start baseline questionnaire survey and a part of face to face survey. In the presentation, we report progress and first results of these survey. Strength of our project is that usage of ongoing birth cohort enables to adjust potential confounders since birth, such as socioeconomic status, smoke exposures, other health status such as allergies, etc. The challenge is to estimate RF wave exposure using questionnaires before and after 5G introduction, and differentiation of radio frequency wave exposure and mobile/smart phone usage.

## 4 Funding

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