最終試験の結果の要旨

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　　主査および副査の５名は、平成 ６年３月15日、学位申請者 Saekhol Bakri 君に面接し、学位申請論文の内容について説明を求めると共に、関連事項について試問を行った。具体的には、以下のような質疑応答がなされ、いずれについても満足すべき回答を得ることができた。

質問１) The mercury level in pregnant women is low, even if they eat a lot of fish. It means it will be safe for pregnant women to eat fish in Indonesia. What is your opinion?
(回答) I think it is too early to say that Indonesian seafood is safe, especially for pregnant women. Since this is the first study conducted in Indonesia and the fish's mercury content has not been measured, yet, we need conduct further research to obtain a more solid conclusion.

質問２) Why is the prevalence of caesarean sections high in your study?
(回答) This study's prevalence of cesarean sections (43.2%) was greater than the WHO-recommended range of 10-15%. Medical conditions such as dystocia, severe pre-eclampsia, and cardiovascular difficulties were the primary indications in these patients. The study area is in the capital city and has an adequate system for referring patients to the right medical institutions, which is also the reason why the individuals' relative frequency of cesarean sections is high.

質問３) In general, what is the correlation between mercury level and birth weight?
(回答) According to a systematic review by Kyle Dack et al., many studies show no strong evidence, but particularly studies of populations with the highest mean mercury concentrations reported an inverse association between mercury exposure and birth weight. In our study, we found that there was no correlation between mercury level and birth weight and I think this is because of a relatively low exposure level in Indonesia.

質問４) What is the pattern of mercury exposure to birth effect? Is it a linear effect or any other pattern?
(回答) The effect of mercury on birth outcomes is linear. This means that increasing mercury will decrease birth outcomes, especially at very high mercury levels. But there isn't enough data to draw a conclusion on a relationship between mercury levels and birth effects, especially at low levels.

質問５) What is the source of methyl mercury rather than fish?
(回答) Because microorganisms in the soil also methylate inorganic mercury to methylmercury, we can obtain methyl mercury from a variety of sources, including rice, vegetables, and seafood. Since there are no large factories or gold mining areas in the research region, and only a small percentage of respondents are farmers, fish eating may be a potential source.

質問６) How did you collect the data? Did you collect the data only once or several times?
(回答) We collected data from participants who were in their 2nd trimester of pregnancy and were enrolled in several public health facilities. As a result, the respondent's data were collected at various times, not simultaneously. We obtained the data and hair sample from each participant only once.

質問７) Is the mercury levels in the hair stable when the hair is checked over different time periods?
(回答) There is an international consensus that a hair sample is a reliable and appropriate biomarker for long-term mercury exposure. Since hair grows on average 1 cm per month, measuring mercury in 1 cm of hair from the root can determine the amount of mercury exposure in the past month. If a long hair sample is obtained, it is also possible to estimate the amount of exposure over the past several months.

質問８) What was the correlation between serum ferritin and mercury?
(回答) This study found no relationship between serum ferritin and mercury levels (spearman correlation's p-value was 0.728) and there was no difference in mercury level between low and high serum ferritin groups.

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質問 9) Are there any effects by various cooking methods on mercury level in the fish?
(回答) Mercury is very stable even in very high temperatures. In our experiments method, we use strong solution and very high temperatures (200°C) but we still can get the mercury in the hair. However, there is only one study examining the effects of different cooking methods on mercury levels in fish. It suggests that the amount of mercury in the fish itself that is ingested may be reduced by its presence in the steam or in boiling broth during cooking.

質問 10) According to the scatter plot between mercury level and fish consumption, several women with high mercury levels showed low fish consumption. What is the reason behind this finding?
(回答) I did not know the exact reason behind this condition. But a possible reason was they used hair treatment that can affect the mercury level in their hair. Or those with high mercury might have eaten fish with high mercury levels, though the consumption amount was small.

質問 11) What about the mercury level in hair treatment? Is there any correlation between hair mercury and the use of hair treatment?
(回答) The median (range) value of mercury in women with hair treatment was 0.400 (0.150 - 8.105) ppm, and we found no association between hair mercury and hair treatment use. Additionally, we were unable to identify the kind of hair treatment in this study. As a result of contaminated soap and hair shampoo, hair samples from Pakistan in our earlier study had extremely high levels of mercury (Anwar 2007).

質問 12) The validity of the questionnaire survey is very important; what is your opinion to your study ?
(回答) In this study fish consumption was estimated using the answers to the questionnaire. We adapt the questioner from previous study. Participants were asked about the type, frequency and amount of fish consumed during pregnancy. In particular, the type and quantity of fish were identified using photos and a food sample of about 50 grams. In addition, they were asked about other fish and shellfish as well.

質問 13) What type of mercury is contained in hair treatments?
(回答) That is inorganic mercury.

質問 14) How did you treat the sample and avoid contamination?
(回答) Washing hair with acetone for 30 minutes can reduce the amount of pollutants on the hair. We followed the "mercury analysis manual" published in 2004 by the Japanese Ministry of the Environment.

質問 15) Do you check mercury inside the hair or external mercury?
(回答) In this study, the total mercury in the hair, both organic and inorganic mercury, was measured. Although measurement of methylmercury is the most effective way to determine mercury exposure from fish, it was not performed in the present subjects because their mercury level was not so high.

質問 16) What is the mechanism by which inorganic mercury is converted to methylmercury?
(回答) The inorganic mercury will be changed to methylmercury by certain bacteria with methylation process in the soil or water.

質問 17) What is the difference between highland and low land areas in the Semarang?
(回答) Mountainous areas make up high land, whereas coastal regions close to the sea constitute low land. Mountainous regions often consume more freshwater fish than marine fish, while low-lying places tend to have greater mercury levels and higher fish-eating rates.

質問 18) Did you obtain the written consent from the participants?
(回答) We obtained written informed consent from each respondent before they were enrolled in this cohort study. I will add this information to my thesis.

質問 19) How do you convert mercury levels in blood to mercury levels in hair?
(回答) We calculated the blood mercury level to the hair mercury level using the 1:250 (blood: hair) comparison between hair and blood based on the report by JECFA and WHO.

質問 20) Is there any correlation in the mercury levels between hair and blood?
(回答) Yes. A strong correlation between mercury levels in blood and hair was reported in earlier research by Lukina et al., 2021

質問 21) Please make sure the calculation between babies' gender and birth outcome. Is the p value correct?
(回答) Thank you for pointing out the result. Upon confirmation, the p value was found to be incorrect. It should be 0.180 (in the power point and the thesis report was 0.937).

以上の結果から、5名の審査委員は申請者が大学院博士課程修了者としての学力・識見を有しているものと認め、博士（医学）の学位を与えるに足る資格を有するものと認定した。