

## 学位論文審査の結果の要旨

令和 4年 1月 18日

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願出者	専攻	医学	部門	(平成27年度以前入学者のみ記入)
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論文題目	Temporal Trends in Apparent Food Consumption in Bangladesh: A Joinpoint Regression Analysis of FAO's Food Balance Sheet Data from 1961 to 2013			
学位論文の審査結果	<input checked="" type="radio"/> 合格	・	<input type="radio"/> 不合格	(該当するものを○で囲むこと。)

[ 要 旨 ]

Summary: We analyzed the temporal trends and significant changes in apparent food consumption or availability in Bangladesh from 1961 to 2013. Due to the lack of a long-term national dietary intake dataset, food availability data in Bangladesh were obtained from the FAO's food balance sheets documented in the FAOSTAT database from 1961 to 2013. We used joinpoint regression analysis to identify significant changes in the temporal trends. The annual percent change (APC) was computed for each segment of the trends. Bangladesh has experienced inadequate but significant structural changes in the diet in the late-1970s, early-1990s, and early-2000s. Overall, the apparent intake of starchy roots, eggs, fish, vegetables, milk, and vegetable oils increased significantly in the Bangladeshi diet from 1961 to 2013. Apparent food intake except cereals, though substantially inadequate, significantly increased during the 1960s. Starchy roots, eggs, sugar, fish, vegetable, and fruit apparent consumption increased during that time. Since the late-1970s, vegetable oils; since the late-1980s, fish, eggs, and meat; and since the early-2000s, milk, vegetable and fruit apparent intakes in the Bangladeshi diet started to increase significantly, though the increasing amounts were inadequate compared to the recommended level of intake. Overabundance of cereals and inadequate structural changes in the diet may have caused the increasing prevalence of overweightness and emergence of diet-related, non-communicable diseases in Bangladesh.

**Question 1:** In the food availability equation, do you mean that all the food that is produced within a country is consumed totally, as a large quantity of food is stored and remains unused. What do you think about this aspect?

**Answer 1:** Food balance sheets are built on the basic principle that within a given country in a given year, the sum of all aspects in the supply of a given food product must be equal to the sum of utilizations for that product. Based on this basic principle, not all the food that is produced within a country is used totally as food available for consumption. Components like, storage which is measured from the changes in stock, feed, seed, and waste are included in the utilization or consumption side of the equation. So, the amount of food that is produced within a country is not completely used for human consumption purposes. Production of a food product within a country is adjusted with the trade, stock, and domestic utilization within the country, like feed, seed, and waste. After this adjustment, the amount is referred to as food available for consumption that is used to calculate the per capita food availability within a country for a given food product in the reference time.

**Question 2:** In most of the availability results, especially for cereals, vegetables, fishes, and fruits, you found that there was an unchanged period of availability in Bangladesh about 25-30 years of stagnant phase. What is the reason for these unchanged trends?

**Answer 2:** From the late-1960s, consecutively for three decades food availability trends in Bangladesh had been almost stable. For example in the case of cereals, the growth rate was estimated at only 0.19% per year from 1967 to 1997. During the early-1970s, food production was disrupted due to the Liberation War and following natural disasters such as a cyclone in 1970/71, drought in 1973/74, and floods in 1974/75. The aftermath of the liberation war and natural calamities had disrupted the entire agriculture sector of Bangladesh. Agriculture during this period mainly depended on nature and traditional method was the sole way of cultivation. Bangladesh highly depended on rain-fed rice production to irrigation-based cultivation. Green revolution still did not start during this period which made agriculture failed to produce more food for the growing population. Moreover, a high emphasis was placed on the intensive production of rice because of food sufficiency issues and facing a mono-crop situation, which might have decreased the production and hence the availability of fruits, vegetables, and fish.

**Question 3:** I want to ask you about the food self-sufficiency ratio in Bangladesh. Globally it has affected the availability of food. Please show the self-sufficiency ratio of each food group in Bangladesh.

**Answer 3:** The self-sufficiency ratio expresses the magnitude of production in relation to domestic utilization. In the context of food security, the self-sufficiency ratio is often taken to indicate the extent to which a country relies on its own food production resources. In this study, our prime focus was not to assess the food security situation of Bangladesh so we did not calculate the self-sufficiency ratio of the 101 foods under the 11 food groups considered in this study. But I can provide information about the food self-sufficiency ratio in Bangladesh. The self-sufficiency ratio of rice is 1.09 in Bangladesh which indicates that Bangladesh is self-sufficient in rice but in the case of which the value is only 0.21. Since 2000, the average grain self-sufficiency ratio in Bangladesh declined and it was 0.87 in 2005. In 2019, the rice self-sufficiency ratio in Bangladesh is 1.13. The food self-sufficiency ratio cannot indicate the food security situation, as in the case of Japan. Being a country with low self-sufficiency ratio (0.37), Japan is food secure.

Question 4: In fish availability, there is a very drastic change in fish availability since 1990. Is there any effect of lifestyle-related factors on this drastic change of fish availability in Bangladesh?

Answer 4: The drastic increase in fish availability is mainly due to the increase in intensification of production methods. During this period, inland capture fisheries increased by 2.3-fold, and inland culture fisheries have increased by as much as 10.1-fold, whereas production of marine fisheries has increased by 2.5 times. One of the reasons behind the growth in the fisheries sector is that new farmers are coming out to produce fish, and both traditional rural aquaculture and intensive commercial aquaculture of high-value species of fishes have been widely produced. Lifestyle factors might have acted as the latent factors for this drastic change. An increase in income attracted people to consume more animal-based food and a high supply of fish had made the price low and affordable for people. These factors may be acted as a promising aspect to increase the fish availability trend.

Question 5: Based on this study, what will be the nutrition future of Bangladesh? What future steps need to be taken in this regard?

Answer 5: Based on this study finding, it can be seen that Bangladesh has been experiencing structural changes in its food availability from cereal-centered to more diversified foods. The structural changes have increased the diversity in the diet, but the amount was grossly inadequate to have any positive effect on health. Most of these changes were related to the expansion effect and characterized by higher energy supply from cheaper foodstuffs of plant origins, mostly from cereals. The substitution effect, where shifts from carbohydrate-rich staples to foodstuffs of animal origin at the same overall energy supply, started but the amount was grossly inadequate in the diet, even at national level availability in Bangladesh. From this, about future, I can postulate that overabundance of cereals and grossly inadequate structural changes may act as the main causes of the increasing prevalence of overweight and the emergence of diet-related, non-communicable diseases in Bangladesh. Agriculture diversification may be a good option to overcome this situation. Moreover, the policy of the Government should focus on the availability of more diversified food at affordable prices.

Question 6: Do you have information about the lifestyle-related diseases in Bangladesh?

Answer 6: Lifestyle-related diseases account for 61% of total deaths in Bangladesh. The most common NCDs include cardiovascular diseases, diabetes mellitus, cancer, and chronic respiratory diseases. Here in the background of my study, I have provided the lifestyle-related diseases information in Bangladesh together with the under nutrition-related components like stunting, underweight, and wasting. But, I did not conduct any joinpoint regression analysis on these lifestyle-related diseases databases.

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(備考) 要旨は, 1, 500字以内にまとめてください。