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FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

The effect of the way seafood is consumed on fishery management awareness: Evidence from Japan

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Abstract: To deal with declining seafood consumption in Japan, the Japanese government has promoted a campaign termed "Fast Fish," which offers convenient and unique processed fishery products for consumption. Although the campaign is expected to restore seafood consumption and contribute to health enhancements, it could pressure fishery resources without providing sufficient resource management. Furthermore, promoting processed fishery products might make consumers forget that the materials are originally from living fish and regard that they are mere inorganic items. If that is the case, Fast Fish campaign could have negative impacts on consumers' consideration for wild fish in the ocean. This study examined the effects of the way seafood is consumed on consumers' fishery management awareness, focusing on the difference between eating processed seafood products, eating raw fish, and cooking fish to eat. Survey data were analyzed by structural equation modeling. The results found that cooking fish to eat significantly improved

ABOUT THE AUTHORS

Our group has been examining the determinant factors of consumers' fisheries management awareness under the context of increasing fish consumption and/or resource protection by eco labeling of fish products.

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PUBLIC INTEREST STATEMENT

A campaign termed "Fast Fish", promoted by the Japanese government to combat declining seafood consumption, offers convenient and unique processed fishery products for consumption. Despite restoring seafood consumption and contributing to health enhancements, Fast Fish could pressure fishery resources without providing sufficient resource management. Furthermore, promoting processed fishery foods might distance consumers from the idea of fishery resources as living fish and could thus have negative impacts on consumer consideration for wild fish in the ocean. This study examined the effects of the way in which seafood is consumed on consumer awareness of fishery management, focusing on the difference between eating processed seafood products, eating raw fish, and cooking fish to eat. Survey data were analyzed by structural equation modeling. We found significant differences in awareness between consumers who cooked fish and those that consumed processed seafood products or raw fish. Our results imply that it is desirable to leave certain room for cooking or to provide information about fishery management while promoting Fast Fish.

consumers' awareness of fishery management, but consuming processed seafood products or raw fish did not. These results imply that it is desirable to leave certain room for cooking or to provide the information about fishery management at the same time when promoting "Fast Fish."

Subjects: Fisheries Science; Environmental Psychology; Health Psychology

Keywords: cooking fish; Fast Fish campaign; fish consumption; fishery management awareness; structural equation modeling

JEL classifications: Renewable Resources and Conservation: Fishery; Aquaculture Q22

1. Introduction

Japan is a country of islands, and its vast fishing industry has been a major factor in its development. In addition, Japan is a major consumer of marine products in the world because the Japanese food culture is intimately related to many products from the sea. However, the Japanese fishing industry has stagnated and it is at a major turning point because of fish meal decline. According to Japan's Ministry of Agriculture, Forestry & Fisheries (MAFF), the per capita consumption of fish steadily decreased about 20% between 2000 and 2010, whereas meat (beef, pork and chicken) consumption increased about 5% (Ministry of Agriculture, Forestry, & Fisheries, 2012). A comparison of Japan's trends and current situation to that of global regions regarding seafood consumption is shown in Figure 1. Figure 1 illustrates that seafood consumption per capita in Japan has been declining since 2000, whereas consumption in much of the rest of the world has grown.

To reverse the situation, Japan launched what it terms the "Fast Fish" campaign in 2012, aiming to encourage Japanese consumers to eat more fish products. Japan's Fishery Agency developed the campaign as part of the *Sakana no Kunino Shiawase* (Happiness of the Ichthyic Country Project), initiated in August of 2012. The campaign specifically targets new products, focusing on the attributes of affordability, ease of cooking, and the potential to generate demand. The government certifies these fish products, and owners are permitted to use official logos that confirm certification to appeal to consumers (Fishery Agency, 2013). As of 2013, more than 500 companies' products have been certified as Fast Fish products, and the campaign apparently is expanding and growing in popularity in Japan.

The Fast Fish campaign is expected to generate numerous financial benefits for government, researchers, consumers, producers, and other stakeholders (Baba, 2013). First, the Japanese government expects Fast Fish to improve national self-sufficiency. Japan is an island nation with a moderate amount of natural resources besides fishery products. Even so, Japan recently has transitioned from being an exporter of fishery products to being a big importer of those products, which has reduced its national self-sufficiency. A main reason for this change is that, although the Japanese people have traditionally eaten fish as a major source of protein, the recent Westernization of the Japanese

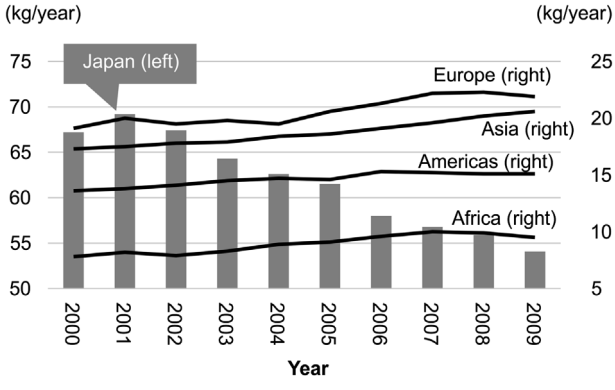

Figure 1. Seafood consumption per capita.

Sources: Ministry of Agriculture, Forestry & Fisheries, Japan: "Food balance sheet" for Japan. Food and Agriculture Organization of the United Nations "Food balance sheets" for regions.

food culture has promoted meat over fish. Therefore, an important governmental task is to reduce dependence on imported seafood, and the Fast Fish campaign could contribute to that end.

The second expected benefit of Fast Fish is that fishery producers will be positively influenced through the profits they reap from Fast Fish. Fishery producers may expand the market of marine products with the addition of Fast Fish products because most of these products are intended to be easy to transport, preserve, and cook, thereby overcoming the problems of traditional fish products, which are challenging with respect to preserving, cooking, and handling waste. In Japan, the ratio of *nakashoku* (take-out and prepared foods) to home-cooked foods has recently been increasing, and it is believed that consumption of *nakashoku* will continue to increase (Fujii et al., 2001). Fast Fish is in the *nakashoku* category and it fits into the current Japanese lifestyle.

Therefore, the benefits of Fast Fish are well founded. However, there is concern that, in the absence of appropriate management, the campaign could deplete the fishery resources, which is another important problem emerging in Japan. In the past, it was not important to consider marine resource management because Japan was benefitting from the surrounding seas. However, the fact now is that the available quantity of some fish species, such as the Bluefin tuna and the Japanese eel, are declining, which has alerted the Japanese people to assess their marine resource management. Even so, only fisheries and others concerned with the fishing industry are considering marine resource management. There is a need for consumers to be conscious of resource reservation as well to sustain marine resource reservations and utilization. Fast Fish products seem to successfully activate fisheries and related industries, but they tend to be semi-cooked when they are in markets, which could suggest to people that fishery products are similar to a type of industrial product, and that perception could lead to a lack of awareness of wild fish conservation.

The purpose of this study is to investigate the effect of seafood consumption on consumers' awareness of fishery management, focusing on the distinction between (1) processed seafood products, which do not have no trace of its original form by minced or pasted, (2) raw fish such as *sushi* and *sashimi*, which keeps the shape of original fish meat but does not require consumers to touch it directly, and (3) cooking fish at home, which requires consumers to touch fish and strongly remind that the materials are fish resources. If all three types of consumption could equally improve consumers' levels of awareness of marine resource conservation, then Fast Fish products should be welcomed; however, if cooking fish at home but not eating processed seafood products matters, the Fast Fish campaign needs further development and careful and appropriate management. The results of our study support the latter outcome.

In the past, many studies on attitudes and fish consumption have been conducted in numerous countries. From the perspective of seafood marketing, consumers' preferences regarding fish products' characteristics were analyzed in a conjoint analysis in Oman (Boughanmi, Al-Musalami, Al-Oufi, & Zaibet, 2007) and the characteristics of people who tend to prefer specific types of seafood were identified using ordered probit analysis in Norway (Myrland, Trondsen, Johnston, & Lund, 2000). Considering consumption, evaluations and intentions regarding seafood were compared between home and restaurant consumption in Spain (Heide, Ottar Olsen, & Calvo Dopico, 2010) and between purchasers and non-purchasers in the UK using factor analysis (Leek, Maddock, & Foxall, 2000).

Many other studies have analyzed the determinants of fish consumption using structural equation modeling (SEM). For example, the role of norms in explaining seafood consumption was revealed in Belgium (Verbeke & Vackier, 2005) and Vietnam (Tuu, Olsen, Thao, & Anh, 2008; Thong & Olsen, 2012). The role of health involvement, among other factors, was found in Norway (Olsen, 2003) and Brazil (Mitterer-Daltoé, Carrillo, Queiroz, Fiszman, & Varela, 2013). Recently, some studies analyzed determinants of seafood consumption for international comparisons using cross-country data (Olsen, Heide, Dopico, & Toften, 2008; Olsen, Scholderer, Brunsø, & Verbeke, 2007; Pieniak, Verbeke, & Scholderer, 2010).

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However, the above-described studies did not assess the influences of seafood consumption on fishery management awareness, although their results contribute to our understanding of the major factors related to decreased seafood consumption. The present study contributes to this body of research by investigating that gap. The remainder of this paper is organized as follows. Section 2 describes the materials and methods used in the analysis, Section 3 presents the results, and Section 4 provides discussion. Conclusions are offered in Section 5.

2. Materials and methods

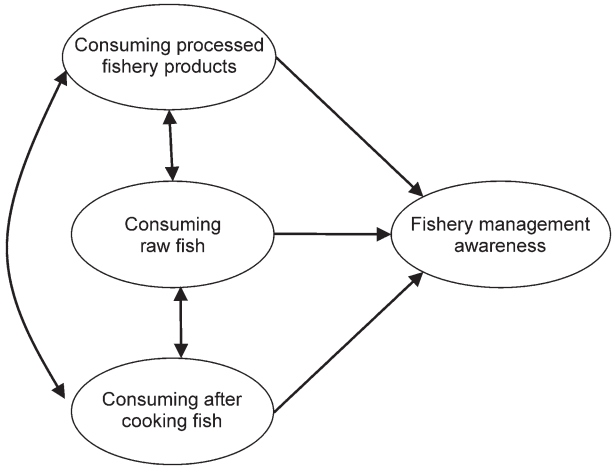
2.1. Hypothesis

We used SEM for our analytical method. SEM is a particularly effective method for analyzing complex relationships of behaviors and awareness and it was frequently used in related studies (Mitterer-Daltoé et al., 2013; Olsen, 2003; Olsen et al., 2007, 2008; Pieniak et al., 2010; Tuu et al., 2008; Thong & Olsen, 2012; Verbeke & Vackier, 2005). However, although these studies identified important predictors of seafood consumption that could encourage fish consumption, they did not address the effects that could occur *after* seafood consumption. The present study addresses this problem.

Figure 2 illustrates the conceptual framework analyzed by SEM in this study. Figure 2 locates fishery management awareness as the dependent variable and seafood consumption (the predictor) as categorized into three types to distinguish between raw, processed, and self-cooked fish consumption. We reasoned that effortful consumption such as self-cooked fish consumption has a positive relationship and larger effect than effortless consumption such as raw and processed fish consumption on fishery management awareness. That is because cooking fish can make people more "mindful" with the strong conscious of "creature" consisting of bones and other organs which consumers need to see and touch when cooking it. On the other hand, it is expected that consuming only processed seafood including sliced raw fish makes people "mindless" since such processed seafood can be regarded as only "product" but not "creature." Also, there is a possibility that some people have learned the importance of marine finite resources from their parents by talking about it when the parents taught them how to cook fish.

We expect the three explanatory variables (i.e. consuming processed seafood products, raw fish, and cooking fish to eat) to be positively intercorrelated because people who generally eat fish tend to consume it in all three forms. Based on the previous studies and this reasoning, the hypotheses are as follows:

Figure 2. Our hypotheses.



H1: Consuming processed seafood products, raw fish, or cooking fish to eat significantly relate to fishery management awareness.

H2: The relationship of cooking fish to eat to fishery management awareness is stronger than the relationships of consuming processed seafood products or consuming raw fish to fishery management awareness.

H3: Consuming processed seafood products, raw fish, and cooking fish to eat are positively intercorrelated.

2.2. Data

We acquired the data from online questionnaire survey. The use of online surveys is increasing, primarily in response to growing personal information protection awareness and logistical issues related to traditional paper and pencil questionnaires. One advantage is that it is easier to reach a wide sample across a region because Internet accessibility is almost universal. Online surveys also are time-efficient and economical devices. Studies about online populations have supported the increase in online survey research (Andrews, Nonnecke, & Preece, 2003).

Although the history of online survey research is young and evolving, some fields have used computerized questionnaires (e.g. Oishi, Tatefuku, & Suzuki, 2014; Yatsuzuka, Inoue, & Mae, 2012). Yatsuzuka et al. (2012) used a web questionnaire to study the use of the domestic wet area's facility and use of hot water. Oishi et al. (2014) used a web questionnaire to conduct Japanese national research on general consumers to identify the latent needs for processed marine products produced in Miyagi prefecture. According to Wright (2005), online survey research has at least two advantages over traditional survey methods: (1) cost and (2) time. Moreover, Internet-based surveys enable researchers to obtain data from people across a broad geographical space. Thus, an Internet-based survey is suited to this research, which aims for a national-level analysis of Japanese residents.

The sample comprised 420 consumers in Japan who provided data via their online questionnaire responses. An intermediary research firm collected the data. A stratified sampling methodology by five-year age groups was established according to the *2013 Statistical Handbook of Japan* (Statistics Bureau, Ministry of Internal Affairs & Communications, 2013), all of the respondents were aged 20 through 69, and gender and age were sampled proportional to the general population. The questionnaire was distributed between 30 November and 2 December of 2013 to 2737 qualifying individuals of the 1,089,340 registered with that firm. Valid data were collected on 420 respondents for a response rate of 15.3%. Table 1 shows the demographic characteristics of the sample.

The questionnaire asked about awareness of fishing topics and the frequencies of seafood consumption and cooking fish on five-point scales. Thirteen questions were based on a comprehensive review of previous studies, which shrank to 11 questions during the analysis. Table 2 provides the standardized factor loadings and Cronbach's alpha statistics of all of the variables.

Fishery management awareness was a construct measured by responses to three items: (1) "I think we need to address fisheries management more actively," (2) "I am willing to pay money or put in some effort to advance fisheries management," and (3) "I intend to purchase eco-friendly fishery products even if the price is 5% more expensive." Response options were on five-point scales ranging from "strongly agree" to "very much disagree."

Consuming fishery processing products was a construct also measured by three items: (1) "I eat canned fish," (2) "I eat fish paste," and (3) "I eat fish sausage." Responses were on five-point scales ranging from "more than once a week" to "few or none."

Consuming raw fish was a construct measured by two items: (1) "I eat *sashimi*" and (2) "I eat *sushi*" Answers were on five-point scales ranging from "more than once a week" to "few or none."

Table 1. Demographic characteristics of the sample (% of respondents, *n* = 420)

Variable	Percentages
Gender	
Male	50.0
Female	50.0
Age (in years)	
20–29	16.4
30–39	21.4
40–49	20.7
50–59	19.3
60+	22.1
Region in Japan	
East	64.3
West	35.7
Marital status	
Married	61.4
Unmarried	38.6
Children in the household	
Yes	40.2
No	59.8
Household income per year in JPY millions	
<4	29.0
4–8	34.3
8+	17.1
Unknown	10.0
No answer	9.5

Note: JPY—Japanese Yen.

Consuming after cooking fish was the final construct, measured by three items: (1) "I cook whole fish at home" and (2) "I cook fillet of fish at home," which were answered on five-point scales ranging from "more than once a week" to "few or none," and (3) "I enjoy cooking fish," with response options on a five-point scale ranging from "very much agree" to "very much disagree."

2.3. Statistical analysis

The data analysis was performed in two steps. First, a confirmatory factor analysis (maximum likelihood procedure) was performed on responses to 11 items to identify latent factors of consumers' awareness of marine resource conservation and hidden influencing factors related to eating raw fish or processed seafood products and cooking fish to eat. Factor analysis is a statistical approach that identifies the underlying structure of interrelationships among a large number of variables as factors that represent the underlying constructs of the original set of observed variables (Wakita et al., 2014).

The second stage employed the results of factor analysis to determine the latent variables and SEM was applied to quantitatively clarify the causal relationships between each latent construct and the outcome variable. Goodness-of-fit for the projected SEM was computed. SEM is a multivariate technique for testing and estimating causal relationships among multiple concepts or constructs. It can be used after the initial identification of latent variables via factor analysis, as was the case in Honkanen, Verplanken, and Olsen (2006) and Oishi, Oishi, and Ominami (2012).

To perform the analysis, IBM SPSS AMOS Version 22 was used for the confirmatory factor analysis and the SEM.

3. Results

3.1. Results of confirmatory factor analysis

Table 2 above presents the standardized factor loadings and reliability estimates resulting from the final confirmatory factor analysis. Initial confirmatory factor analysis using responses to 13 items indicated insufficient goodness-of-fit (AGFI < 0.90; CFI < 0.90). Two items, regarding health attention and frequency of consuming delicatessen-style seafood, were removed. The analysis was performed again on the remaining 11 items. The values of standardized factor loadings were all statistically significant at $p < 0.001$, with values ranging between 0.54 and 0.94. Cronbach's alpha (α) was used to assess the internal consistency of all of the constructs, and all of them exceeded the threshold value of 0.60 (Hooper & Zhou, 2007, p. 279). The adjusted-goodness-of-fit index (AGFI) and comparative-fit index (CFI) were larger than the cut-off fit level of 0.90. The root mean square error of approximation (RMSEA) index was slightly larger than the threshold value of 0.05, but it could be smaller than 0.05 when several passes were added between error terms based on a modification index. Hence, all of the items in Table 2 were deemed suitable to measure the constructs proposed in the conceptual framework (Figure 2).

3.2. Results of the structural equation model

Figure 3 illustrates the results of the SEM. Ellipses, one-directional arrows, and two-directional arrows indicate latent variables, causal relationships, and correlations, respectively. The standardized path coefficients next to the arrows' indicate the strengths of the effects. The goodness-of-fit index (GFI), AGFI, and CFI are 0.950, 0.913, and 0.918, which are equal to or higher than the cut-off values for goodness of fit (GFI = 0.950; AGFI and CFI = 0.900).

Table 2. Results of standardized confirmatory factor analysis with reliability coefficients (Cronbach's *alpha*); *n* = 420

Constructs and items	Standardized factor loadings[a]	*Alpha*
Fishery management awareness		0.69
I think we need to address fisheries' management more actively	0.55	
I am willing to pay money or put in some effort to advance fisheries' management	0.72	
I intend to purchase eco-friendly fishery products even if the price is five per cent more expensive	0.69	
Consuming processed fishery products		0.70
I eat canned fish	0.63	
I eat fish paste	0.73	
I eat fish sausage	0.60	
Consuming raw fish		0.70
I eat *sashimi*	0.94	
I eat *sushi*	0.58	
Consuming after cooking fish at home		0.61
I cook whole fish at home	0.54	
I cook fillet of fish at home	0.67	
I enjoy cooking fish	0.54	

Notes: Degrees of freedom = 38; Goodness-of-fit index = 0.950; Adjusted-goodness-of-fit index = 0.913; Comparative-fit index = 0.918; Root mean square error of approximation = 0.074.

[a]Factor loadings are statistically significant at $p < 0.10$ for all questions.

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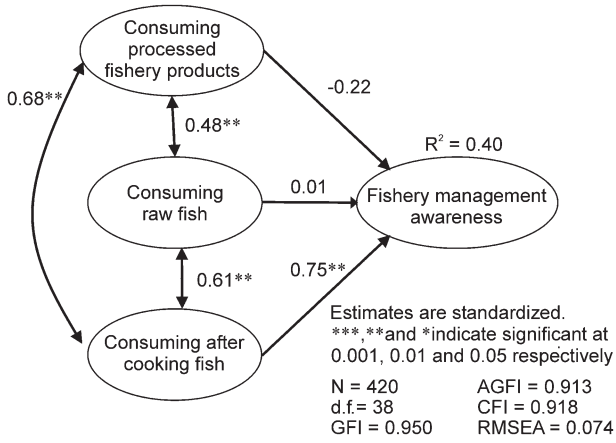

Figure 3. Structural parameter estimates of the proposed model.

The estimated coefficient (= −0.22) of the relationship of *Consuming processed fishery products* to *Fishery management awareness* is negative, indicating that the more often this type of fishery products is consumed, the less is the awareness of fishery management, although the coefficient is not significant at $p < 0.05$. This result suggests that the Fast Fish campaign might not be helpful to people's awareness of fishery management. The estimated coefficient (= 0.01) of the relationship between *Consuming raw fish* and *Fishery management awareness* also was not statistically significant at $p < 0.05$.

The latent construct, *Consuming after cooking fish,* was positively related to *Fishery management awareness* (= 0.75, $p < 0.01$). The result suggests that cooking fish to eat is the most relevant factor for increasing fishery management awareness among the three latent constructs. Figure 3 also indicates that eating processed seafood products, eating raw fish, and cooking fish to eat are positively intercorrelated. Thus, hypothesis H1 (Consuming processed seafood products, raw fish, or cooking fish to eat significantly relate to fishery management awareness) was not supported, whereas H2 (The relationship of cooking fish to eat to fishery management awareness is stronger than the relationships of consuming processed seafood products or consuming raw fish to fishery management awareness) and H3 (Consuming processed seafood products, raw fish, and cooking fish to eat are positively intercorrelated) were supported, in these data.

4. Discussion

Consuming after cooking fish could be an important factor for improving or increasing fishery management awareness because cooking fish might help consumers to notice that fish is one of "creature" before being "product," and provide opportunities to take an interest in fish. Moreover, the consumers who buy uncooked fish to cook at home have more chances to notice the importance of having a symbiotic relationship with fish as "creature" through being taught how to cook by parents, or maybe fishmongers. Of course, in the further studies, it is needed to clarify how strong the influence from each latent factor mentioned above is toward fishery management awareness, but it is at least appreciated in this study that consuming after cooking fish can increase people's awareness on fishery management, and that point is the academic contribution of this study.

This important result suggests that a policy approach that promotes cooking fish that has not been prepared in any way, either in whole or in part (such as fillets), could be effective for fishery management.

Therefore, promoting cooking fish for eating is the first and best approach to attain high seafood consumption under fishery management. A few recent efforts in Japan have emerged to help consumers become more familiar with traditional, local, and/or unique fish culinary activities. For example, in Oita prefecture, the open morning market is a mechanism that helps consumers to easily

recognize and purchase local marine products (Yukihira, Yamamoto, & Hara, 2015). These efforts are expected to contribute as opportunities for consumers to become interested in local and/or unique fish and fish foods.

However, these efforts might not quickly solve the problems. The Fast Fish campaign has been successfully operative because recent Japanese consumers tend not only to decrease their seafood consumption; they also avoid the complex and time-consuming fish cooking process. It can be challenging to achieve a quick change to desired habits.

Considering the short-term fishery policies in Japan, the Fast Fish campaign should not only be a way to solve fishing industry problems; it should be taken as an opportunity to improve consumers' fishery management consciousness. For example, affixing labels to Fast Fish products with information about the origin, quality, transportation history, and with clear cooking instructions is a promising approach. Providing accurate information about fish products is necessary to promote consumers' continuous purchasing behavior regarding marine products by supporting reasoned selections and decisions. Moreover, cooking classes focusing on local fish at schools and local events for children and homemakers could be offered by the Fast Fish campaign, which would educate the public. By promoting these efforts, sustained traditional fish-catching, fish-cooking, and fish-eating in Japan will be realized.

5. Conclusion

In this study, we examined the effects of seafood consumption on consumers' fishery management awareness, focusing on the difference between (1) processed seafood products, (2) raw fish and (3) cooking fish at home, using an SEM analytical approach. The results found that cooking fish to eat is a significant factor for improving fishery management awareness, whereas eating processed seafood products or raw fish was not significant. Promoting effortful seafood cooking and the Fast Fish campaign with opportunities to increase consumers' fishery management consciousness are required to increase fish consumption and improve consumers' fishery management consciousness. One issue going forward will be to clarify why and how much the experience of consuming fish after cooking can improve or increase fishery management awareness.

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Competing Interest

The authors declare no competing interests.

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