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Measurement of food poverty (*Shoku no Hinkon*) as capability deprivation in high-income countries: operationalisation with single Mothers in Japan

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ABSTRACT

Existing food insecurity instruments are focused largely on the financial constraints associated with acquiring sufficient amounts of food. This narrow focus has resulted in underestimating the true prevalence of food poverty, particularly in high-income countries. Food poverty needs to be defined as capability deprivation, extending from the nutritional to the temporal, spatial, qualitative and affective aspects of eating. In this article, the Alkire-Foster counting approach is evaluated and an alternative method for measuring such multidimensional food poverty is proposed. The method is demonstrated by using evidence from interviews with 53 single mothers, the most high-risk social group in Japan. On the basis of an operational definition of food deprivation and poverty cut-offs, 16 mothers (30%) were identified as living in food poverty, followed by a qualitative analysis of their deprivation profiles. The results show that the economically-poor were highly likely to fall into food poverty, but that food poverty also occurred without economic deprivation, notably among the mental or physical illness carriers and long-hour workers. This multidimensional and decomposable measurement tool is effective for identifying food-poor populations not reflected in traditional food insecurity measurement instruments.

Key Words: food poverty, food insecurity, Alkire-Foster method, capability approach, single mothers

INTRODUCTION

Challenges in food insecurity measurement

Food insecurity is a complex phenomenon that currently attracts social and academic attention in both low- and high-income countries.¹ Various measurement tools have been proposed, but they have some methodological challenges.

The first limitation concerns the multidimensionality of eating lives.^{2,3} Most instruments are focused on the ability to acquire enough food (with differing degrees of attention to its quality), neglecting the importance of other socio-cultural aspects of eating. In other words, the main concern of these instruments is currently material poverty, not social deprivation.⁴ This is problematic in addressing food insecurity, particularly in high-income countries, where material poverty is largely overcome and food insecurity manifests itself differently from that in low-income countries.²

The second limitation is that most instruments measure mainly the economic dimension of material food insecurity.^{2,3} However, food insecurity and nutritional deprivation can be caused

by multiple factors, such as time constraints, health problems, knowledge and cooking skills, not merely financial constraints.

To illustrate these points, we take two examples: the US Household Food Security (HFS) and the FAO Food Insecurity Experience Scale (FIES). The HFS is one of the most widely used instruments in high-income countries (such as the US, UK and France). The index is composed of 10 questions, such as, ‘*In the last 12 months, were you ever hungry, but didn’t eat because there wasn’t enough money for food?*’⁵ Although one question concerns the quality aspect (nutritious meals), most of the questions are framed in relation to the economic and material aspect of food insecurity. Similarly, the FIES is composed of eight questions focused on the experience of not having enough food due to a lack of money, although the emphasis on ‘lack of other resources’ and the integration of some quality-related questions (nutrition and diversity) slightly relativise the economic and material paradigm of food insecurity.⁶

These instruments are certainly effective for capturing severe food insecurity and enabling international comparisons. However, with their narrow focus, which ignores the total dimensions and multiple underlying factors of eating well, these instruments can ‘underestimate the true prevalence of food insecurity’.³

Food poverty in Japan

Interestingly, Japanese academics have been somewhat detached from the international debate on food insecurity. One reason for this isolation is that the current assessment tools fail to capture the true prevalence of food insecurity in Japan. For example, according to the latest FIES, only 3.8% of the Japanese population suffers from moderate or severe food insecurity.⁷ These data are not convincing, given that the country’s poverty rate is 15.7%, the highest among the high-income countries.⁸

Consequently, Japanese society seems to prefer the concept ‘food poverty’ (*shoku no hinkon*) or ‘inequality’ (*kakusa*) of dietary standards. These concepts relate to various food-related problems, extending from malnutrition to skipping meals, access to quality food, lack of opportunities to eat at home or dine out, and eating together with others, thus covering the multidimensionality of eating lives.^{9–15} However, most studies target low-income households (or those that have low socioeconomic status [SES]) and do not explicitly overcome the idea that food poverty can be approximated with economic poverty (i.e., low dietary standards).

Admittedly, these studies are valuable in highlighting the eating habits of the previously-neglected population. Nevertheless, food poverty without economic deprivation also exists,

such as among career-oriented individuals who do not have adequate time or social relations to achieve eating well.² The current conceptual framework does not effectively capture such food poverty.

Multidimensional poverty measurement and its application to food

In light of the above, we need alternative or complementary approaches to measuring food poverty in high-income countries, with full attention being paid to the multidimensional aspects of eating and to the multiple underlying factors affecting dietary standards. In such an endeavour, we apply Alkire-Foster's multidimensional poverty measurement method¹⁶ and demonstrate its potential in the analysis of eating standards in high-income countries. The Alkire-Foster method is one of the most widely used instruments in general poverty studies and it has had significant political implications, notably in the UNDP Human Development Index and Bhutan's Gross National Happiness Index.

The Alkire-Foster method is an intuitive counting approach to poverty and is intended to (see details in Method section): (i) determine evaluative dimensions that express the multidimensionality of poverty (e.g., life expectancy, years of schooling, income); (ii) set a deprivation threshold for each dimension, below which the person is considered to be deprived of the capability to achieve adequate functioning (i.e., valuable beings and doings) in the given dimension; (iii) determine the poverty threshold, that is, how many deprivations are needed to identify the person as 'poor', and calculate H, the poverty headcount ratio; and (iv) calculate A, the average deprivation share of the identified poor. This process ultimately generates HA, the multidimensional poverty index which is sensitive to both the probability and the severity of poverty.

The use of the Alkire-Foster method can facilitate the formulation of an operational concept of food poverty which is absent from current instruments.² It will be 'operational' because it depends on deprivation and poverty cut-offs, the choice of which is constrained by data availability and policy resources. The conceptualisation of food poverty and the visualisation of inequalities among social groups might be useful tools for policy development and further social discussion regarding what the 'minimum dietary standard' should be in a given society.

In this article, we thus aim to apply the Alkire-Foster method by using empirical data on single mothers in Japan to demonstrate its usefulness in the analysis of eating lives in high-income countries. To our knowledge, this application is the first attempt at food insecurity/poverty studies in high-income countries. Therefore, for familiarisation purposes,

we perform a qualitative analysis of the identified food-poor single mothers, rather than merely treating the results quantitatively, with a view to assessing the methodological validity of the application. We then conclude, based on the results of the calculation, that food poverty cannot be equated with economic poverty and should be reframed as capability deprivation.

MATERIALS AND METHODS

Data and participant profile

The empirical data were obtained from the Eating Life of Single Mothers (ELSM) survey. The ELSM involved in-depth interviews (2–2.5 hours each) with 53 single mothers living together with at least one child under the age of 15 in urban areas of Japan (Tokyo, Osaka, Kobe and Nagoya). The survey protocol details were reported elsewhere,^{17–19} so we describe here only the essential information for our demonstration.

The participants were recruited by partnered non-profit organisations in the social aid sector and agreed to participate in the survey by filling out a letter of informed consent. The survey protocol was in line with the Declaration of Helsinki and approved by the Ethical Committee of the Anonymous University (blinded for peer-review).

Single mothers are the most high-risk social group in Japan, with a poverty rate of 51.4%,²⁰ which, as noted above, is the highest level in high-income countries.²¹ Despite their experiencing desperate inequality, only one qualitative dietary survey, involving eight single mothers, has been conducted.¹⁴ Given this lack of knowledge, all the applicants who satisfied the above-mentioned eligibility criteria were selected regardless of their socio-demographic status. The ELSM is, consequently, the qualitative dietary survey with the largest sample size currently available in Japan.

The participant profile is summarised in Table 1. Although our demonstration does not strictly require a national representative sample, a couple of characteristics deserve attention. Mainly due to the eligibility criteria, the mothers were younger (in their 30s and with pre-schoolers) and had a higher socioeconomic status (SES: education, income and profession) than the national average. Economic poverty was defined on the basis of equivalent disposable personal income and each prefectural criterion on minimum living expenses;²² ultimately, nine (17.0%) of the total of 53 mothers were identified as ‘poor’.

It is important to note that this sample deviates from the national average of 51.4% living in economic poverty and thus concerns single mothers whose economic status is above the national average (although their income levels are lower than those in two-parent households). We shall keep these sample characteristics in mind when setting deprivation thresholds.

Evaluative dimensions

Semi-structured interviews were developed based on eating model theories within the French sociology of food. To understand the contemporary evolution of eating models, this group of sociologists has identified the following major dimensions for empirical investigation:^{24–29} meal frequency, place of eating, timing of meals, meal duration, persons to eat with, place of procurement, quality of food, pleasure of eating and meal content, which were also applied in the ELSM survey. Each dimension was evaluated in terms of its desired/valued level of achievement (e.g., ‘*How many times per day would you like to eat?*’), its current achievement (e.g., ‘*How many times did you eat yesterday?*’) and the underlying factors that caused such norm-practice gaps (for concrete questions, see original citations).^{17,19}

After the interviews, the participants were asked to fill out the brief-type self-administered diet history questionnaire (BDHQ), one of the most widely used tools in Japan, to assess their nutritional state.³⁰ Within our framework, this nutritional assessment can be positioned as relevant to the meal content dimension.

Food deprivation thresholds

The Alkire-Foster method has a dual cut-off approach, requiring deprivation and poverty thresholds for poverty measurement. The deprivation thresholds used for our measurement are summarised in Table 2. Among the various outputs from the ELSM survey, we used primarily the practice data as the basis of cut-offs for simplicity, while the respondents’ norms (i.e., subjective evaluation) and the underlying reasons for such norm-practice gaps were partially integrated. The totalled results were reported previously,¹⁷ so the objective here is not to describe the dietary situations of single mothers but to determine the cut-offs based on the empirical insights gained.

In setting the cut-offs, we also referred to relevant policy documents (e.g., Health Japan 21), national statistics (e.g., National Health and Nutrition Survey) and our previous survey. The last survey, conducted among the nationally-representative population, aged 20–69 in Japan (n = 973), is informative for our demonstration because it reported the national average of norms and practices across the above-mentioned nice dimensions of eating.²⁹ Hereafter, justification is provided for the cut-offs of each evaluative dimension:

(1) Meal frequency: ‘Less than three meals per day’ was set as the cut-off. Consequently, 28.3% of the single mothers were identified as being deprived. The cut-off can be justified because the majority of the Japanese population desired to have three meals per day²⁹ and reducing the ‘breakfast skipping’ ratio is one of the health policy objectives.³¹ Interestingly,

15% of the single mothers first reported 'less than three meals' as their ideal. However, further analysis of the underlying reasons revealed that this ideal was the result of adaptation,^{32,33} which refers to lowering their expectations when facing difficult circumstances (such as irregular working hours and care of child[ren] with handicaps) and that these mothers had originally wished to have three meals.^{17,19}

(2) Place of eating: Following the previous survey, we limited our consideration to dinner and set two cut-offs, depending on whether the individuals idealised outsourcing meals (i.e., taking-in and eating out, together called Eat-Out) occasionally or not having family meals all the time (called Eat-In).¹⁹ Among the single mothers, the Eat-Out group was 81.1%, whereas the Eat-In group was 18.9%. For the former, 'no opportunity for Eat-Out' was set as the cut-off and 28.3% was identified as being deprived. For the latter, 'less than four times a week for Eat-In' was set as the cut-off and 1.9% was identified as being deprived. The latter cut-off represented situations in which the mothers outsourced too often, leaving few opportunities for cooking family meals. Also note that even the Eat-Out group in the national population regarded outsourcing dinner 'more than three times a week' (i.e., less than four times for Eat-In) as too often, thus failing to achieve this functioning.²⁹

(3) Timing of meals: Consideration was again limited to dinner, for which the majority of the national population felt that 'earlier dinner is better'.²⁹ Since the post-war economic development in Japan, the timing of dinner has been delayed and even polarised to an earlier or later dinner. For the latter, '9 pm or after' has been used as a threshold.³⁴ We followed this policy discourse and set it as the cut-off, resulting in 7.5% being identified as deprived.

(4) Meal duration: Regardless of their personal behaviours, in-depth interviews revealed that all the single mothers regarded 'eating more slowly as better' for breakfast, lunch and dinner;¹⁷ thus, consideration was given to all three meals. In terms of the norms (median), there was no significant difference between the single mothers (breakfast: 20 min, lunch: 30 min, dinner: 35 min) and the national population (20 min, 30 min, 30 min, respectively).²⁹ As is the case with the OECD's income-based poverty threshold, almost half the median for each meal (10 mins, 15 mins, 15 mins respectively) was regarded as the cut-off reference. To express the strongest possible urgency, situations in which the mothers could not spend a longer time eating than the reference duration for all three meals were identified as being deprived (7.5%). Note that meal skipping was regarded as 0 min.

(5) Persons to eat with: Consideration was limited to dinner again, for which the majority of the population regarded 'eating together' as ideal.²⁹ Although 8% of the single mothers initially reported 'eating alone' as ideal, in-depth interviews revealed that this was also the

result of adaptation (mostly due to the high pressure of solo parenting) and that they originally wished to eat together (including with friends and colleagues). Given their norms, it is reasonable to set 'eating alone' as the cut-off, identifying 13.2% mothers as deprived.

(6) Place of procurement: There was no consensus about 'good' places for procuring daily foodstuffs, but the in-depth interviews with the single mothers revealed a consensus about 'not good' places, notably discount supermarkets, convenience stores, and drugstores (the last of which also sell fresh and processed products in Japan). Only 6% of the single mothers idealised discount supermarkets, but they were forced to use them due to financial constraints and originally wished to use other procurement methods (i.e., the case for adaptation). Thus, the mothers who used only these 'not good' procurement places daily were considered to be deprived (7.5%).

(7) Quality of food: An open-ended question about the quality of food revealed eight valued criteria (excluding price), namely, freshness, seasonality, production area, locality, face-to-face rapport with producers, organic/reduced pesticides, no additives and taste.¹⁷ As the strictest possible cut-off, no achievement for any of these criteria during the recent week was considered deprivation (7.5%).

(8) Pleasure of eating: The principle for setting deprivation cut-offs is essentially the same as that for the quality dimension. An open-ended question about the pleasure of eating revealed seven valued beings and doings, namely, shopping, cooking, conviviality, eating out, feeling a sense of season, new food experiences and tasting delicious dishes.¹⁷ As the strictest possible cut-off, no achievement of any of these criteria during the recent week was considered deprivation (49.1%).

(9) Meal content: Following our previous survey, the quality of meal content was evaluated based on dish combinations.^{19,34,35} The national survey revealed that the majority regarded 'staple and one dish' as a culturally-minimal standard of meals²⁹ and the high frequency of 'staple only' meals was problematised in terms of their low nutritional value.³⁵ Among the single mothers, the frequency of having less than this minimal standard ('staple and one dish') was three times a day for 0%, twice for 27% and once for 38%. Given the importance of dinner for single mothers, the mothers who could not achieve this minimal standard twice a day (including dinner) were identified as being deprived (ultimately, 11.3%). Note that this cut-off is stricter than the current health policy, whose aim is to promote 'having a proper meal (such as staple and at least two dishes) at least once a day'.³¹

(10) Nutritional status: Given its central importance, the nutritional dimension was added as a sub-dimension of meal content and measured using the BDHQ. The participants reported

their food intake frequency during the most recent one-month period by completing the questionnaire, which made it possible to quantitatively measure their nutritional status. Among various outputs from the BDHQ, the number of nutrients (a total of 14 items, such as calcium, iron and vitamin C) that greatly deviate from national standard amounts and are thus considered 'necessary for dietary intervention' were used as an indicator of nutritional status.³⁰ The distribution of the number of deviations among the single mothers was as follows: 0–2 deviations for 30%, 3–4 deviations for 32%, five deviations for 21% and 6–8 deviations for 17%. To have a reasonable classifying power, 'more than five deviations' (17.0%) was considered the deprivation cut-off.

Food poverty thresholds

Having set the food deprivation cut-offs, the next task was to determine the food poverty cut-off. Figure 1 shows how different cut-offs generate different identification results. If we choose to determine that individuals with three deprivations or more ($k = 3$) deserve social interventions, the identified food-poor population will be 30% (16 out of 53 mothers). Similarly, the choice of $k = 4$ or $k = 5$ identifies 15% or 4% food-poor population respectively.

As mentioned in the introduction, the choice of food poverty cut-offs depends largely on policy objectives and ultimately requires social consensus about the minimum dietary standard. What is important at this initial methodological stage is not to settle this debate but rather to better understand how different choices cause different results. For this purpose, we chose $k = 3$ in our demonstration to enable further qualitative analysis of the single mothers with the best possible diverse profile.

RESULTS

Profile of the food-poor single mothers

The deprivation profile of 16 identified food-poor single mothers is summarised in Table 3. Qualitative analysis identified some common profile patterns (although overlapping): the economically poor (#1–7), the mental/physical illness carriers (#8–11) and the long-hour workers (#12–14), as well as others (#15–16).

(1) The economically poor: Six (#1–6) of the nine mothers under economic poverty were also identified as being food-poor. Although not identified as income-based poverty, more than half of mother #7's household income was from a care insurance benefit for her disabled father; thus, she can also be regarded as essentially living in economic poverty. The eating

realities of these economically-poor single mothers were previously reported,¹⁹ so here we note only a couple of examples to illustrate their deprivations.

Mother #1 habitually skipped breakfast or lunch due to work-related time constraints and had no opportunity to dine out, mainly due to financial constraints. Coupled with her son's picky eating, she managed to prepare only rice and miso soup (i.e., 'staple and one dish') for dinner, which prevented her from enjoying daily meals and having adequate nutrition (six nutrients with deviation). Mother #2 suffered from a triple burden of financial limitations, the care of two children with autism and long working hours (including the night shift), thus being deprived of a wide range of capabilities to eat well. Although she was able to prepare a proper dinner (e.g., rice, miso soup, grilled salmon and salad), Mother #5, who suffered from financial constraints and depression, was still forced to lead a low-standard eating life, including the use of discount supermarkets (with low quality), no opportunity for dining out and eating 'for survival' with no pleasure.

(2) The mental/physical illness carriers: Mother #8 managed to prepare a close-to-ideal dinner for her child. However, as she said, *'It's too good for me...just wasteful (mottainai), so I'm okay with leftovers.'* Thus, she was deprived of various capabilities (e.g., dinner only with rice and seasonings, eating alone and very busily) due to a self-sacrificing psychology inflicted by her complex form of post-traumatic stress disorder (PTSD) and financial constraints.

Two mothers (#9–10) had relatively high incomes but suffered from depression due to overwork, which resulted in low-standard eating lives. As mother #9 helplessly said, *'I already abandoned a family meal and decided to leave everything to school lunch.'* The extremely picky eating of her child, who has a development disorder, negatively affected her quality of food, meal diversity and nutritional state. As an interesting case, mother #10 took medical advice from her psychiatrist to improve her care of herself, but doing so eventually adapted her expectations unnecessarily upwards (e.g., eating out, food delivery, organic food) and enlarged the norm–practice gaps, leading to various deprivations in a relative sense. Aside from mental illness, mother #11, who had been recently diagnosed with obesity, followed strict diet restrictions and was thus deprived of various capabilities to eat well.

(3) The long-hour workers: Mother #12 was a fully employed accountant in an ordinary company and was economically stable. However, her long working hours (10 hours plus two hours of commuting per day) prevented her from shopping for fresh food and eating her dinner slowly before 9 pm. Furthermore, the extremely picky eating habits of her child inhibited her from preparing dinners that were richer than ready-made noodles (i.e., 'staple

only'). Similarly, mother #13 had long working hours (10–12 hours plus two hours of commuting per day) and was left with inadequate time for cooking and shopping, eventually leading to quality and nutritional deprivations. Mother #14 did not work long hours but was a night-shift worker. She was thus unable to find time to go shopping or eat proper dinners (normally only salad and tofu [no staple food]) slowly with her children.

Two mothers (#15–16) did not have the above-mentioned characteristic profiles, but their eating standards were low for multiple reasons, such as financial instability, mental instability, their children's picky eating and high dietary ideals (only mother #16: such as organic food procured directly from farmers).

Food poverty index, group- and dimension-specific deprivations

Table 4 translates these qualitative insights into quantitative form. Again, the food poverty index HA concerns both the prevalence of food poverty, H, and the severity experienced by the food poor, A. For example, 30% of the single mothers were identified as food-poor and as experiencing an average of 3.63 deprivations.

Table 4 also shows group food poverty levels, notably for the economically poor and the non-poor. It is important to note that the food poverty index $HA = 0.244$ for the former is three times higher than the index $HA = 0.082$ for the latter, implying that the economically poor are likely to fall into food poverty.

The rows in Table 4 break these food poverty levels down by dimension, where H_j is the share of the mothers who were both food-poor and deprived in dimension j . The overall HA is simply the average of H_1 through H_{10} (see the formula, see the original methodological article¹⁶). The second row expresses the same data in percentage terms and shows the percentage contribution of the given dimension to each group level of HA.

Interestingly, for the economically poor, the contribution of meal content and nutritional dimensions was relatively low. Rather than such material deprivations, the spatial (18.2%), temporal, quality and affective deprivations were more characteristic (13–18% contributions) of the economically-poor. The non-economically-poor had a slightly different deprivation profile, with higher contributions in the quality, meal content and nutrition dimensions than those for the economically-poor. We shall come back to this point in the discussion section, but these examples show how the food poverty index can be readily broken down by subgroup and dimension to help explain its aggregate levels.

DISCUSSION

Key features of food poverty measurement

In this article, we demonstrated how the Alkire-Foster method can be applied to food poverty measurement. In this discussion, we first summarise the key properties of our proposed approach (for its graphical abstract, see Figure 2).

First, this method concerns the multidimensionality of dietary lives and thus marks a sharp contrast from other food insecurity measurement instruments, which are focused primarily on material food poverty.^{2,3} This does not deny the importance of the existing instruments and their usefulness in identifying severe material poverty. However, a new approach should also be integrated to account for the multidimensionality of food poverty, the non-material aspects of which become problematic, particularly in high-income countries. It would be desirable to combine this proposed approach with the existing ones to effectively capture the totality of eating.

Second, our dual cut-off approach facilitates the conceptualisation of food poverty. Although there is no official definition of food poverty in high-income countries,² an operational definition is still needed for the development of food policy. In this article, we defined food poverty operationally as a situation with three or more deprivations of food capabilities across the 10 dimensions ($k = 3$), and qualitative analysis confirmed that each mother had reasonably low dietary standards for such identification. In addition to the current headcount ratio of severe material food poverty of 3.8% in Japan,⁷ the headcount ratio of multiple food poverty of 30%, for which measurement is absent but urgently needed in this country, can also be used as a reference for food policy targeting.

The conceptualisation of food poverty also helps to develop its integrated indicator, HA. This would be effective both for longitudinal monitoring and for identifying inequalities in food capabilities across groups. The latter feature is called 'decomposability'.¹⁶ We revisit the inequality between the economically-poor group and the non-poor one below.

Food poverty and economic poverty

The idea that food poverty can be equated with economic poverty has not been explicitly challenged in previous studies, partly due to the researchers' strategic focus on low-income households.⁹⁻¹⁵ Our measurement results call this idea into question and suggest that food poverty should be reformulated as capability deprivation. The term 'capability' refers to the freedom to achieve a person's well-being that is composed of various functionings (not just

having enough food) and influenced by multiple factors (not merely income). This formula also applies to food capabilities.^{37,38}

This conceptual framework does not deny the importance of income. Indeed, our results imply that economically poor single mothers are more likely to fall into food poverty than the non-economically poor ones. However, our measurement also identified food poverty without economic deprivation, namely, among mental/physical illness carriers and long-hour workers. The identification of long-hour workers with middle or high income makes a good case for the capability approach, which is particularly suggestive of Japan, the country with the longest working hours among high-income countries.^{39,40}

It is also important to note that the economically poor, illness carriers and long-hour workers are ideal categories to show the diversity of food poverty. In reality, there are many factors that can influence their food capabilities, including financial constraints, time constraints, maternal health, children's handicaps, taste (picky eating), cooking abilities, local food environments and food aid.¹⁸ In other words, single mothers are likely to fall into food poverty if several of these inhibiting factors are simultaneously applicable.

Furthermore, our measurement illuminates wide-ranging deprivation among food-poor single mothers that extends not merely to meal content and nutrition, but also to the spatial, temporal, quality and affective aspects of eating. Some studies on single mothers in Japan have recently explored their disadvantages in such non-material aspects.^{13,14} Our results support their exploratory insights and highlight the necessity for a wide-ranging food policy (not just food aid) to address multidimensional food poverty.

Limitation and perspectives

The first limitation concerns data availability. Due to the population being difficult to access, low-income single mothers were underrepresented in our survey, possibly affecting the headcount ratio of the food-poor and the integrated index. Nevertheless, the ELSM is the only survey currently available in Japan that enables the in-depth qualitative analysis of single mothers' dietary lives across multidimensional dimensions. Further political/institutional commitment is needed to obtain a nationally-representative sample of single mothers.

Another issue is scalability. Luckily, Japan has a relatively long tradition of dietary surveys, some of which already cover a wide range of food functionings, such as meal frequency, place of meals and conviviality (e.g., the National Health Nutritional Survey, the National Survey on Food Education). The sociologically-informed nine (or 10) functionings

were operationally set as evaluative dimensions in our measurement, but some flexibility of choice can be accommodated for future policy integration.

In selecting the functionings, the weighting issue should also be addressed. In our demonstration, each functioning is weighted equally, and such a choice would be defended by an intuitive appeal, unless the importance of these dimensions is ‘grossly different’.³⁷ Some might stress the central importance of nutritional deprivation over other deprivations. By dividing the meal content dimension into two sub-dimensions (‘meal pattern’ and ‘nutritional status’), our approach ultimately allocated more weight to nutritional deprivation, but we did not address the debate about exactly how much the dimension should be weighted. The same issue also applies to the task of setting valid food deprivation and poverty cut-offs.

Solving this ambiguity ultimately requires social consensus about food poverty in a given society. The dual cut-offs used for our measurement do not determine the sole definition of food poverty but rather help to promote an informed social discussion about the minimum dietary standard that society has to ensure.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare no conflict of interest.

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Table 1. Profile of single mothers in the ELSM survey (n = 53)[†]

| | | | | |
|--------------------------|------------------------|------------------------------------|------------------------------------|-----------------------------|
| Age (mother) | 20s | 30s | 40s | 50s |
| Sample | 1.9 | 47.2 | 45.3 | 5.7 |
| Average | 7.8 | 30.2 | 48.0 | 11.5 |
| Age (youngest child) | Preschool | Elementary 1–3 rd grade | Elementary 4–6 th grade | Junior high school or older |
| Sample | 45.3 | 22.6 | 15.1 | 15.1 |
| Average | 16.1 | 14.5 | 16.0 | 41.5 |
| Education | High school | Technical college | Junior college | University or higher |
| Sample | 30.2 | 3.8 | 18.9 | 47.2 |
| Average | 44.8 | 4.9 | 14.2 | 11.5 |
| Profession | Professional/technical | Clerical | Service | Others |
| Sample | 26.4 | 41.5 | 17.0 | 15.1 |
| Average | 20.4 | 23.5 | 22.3 | 11.4 |
| Employment | Regular | Irregular | Self-employed | Others |
| Sample | 49.1 | 41.5 | 7.5 | 1.9 |
| Average | 44.2 | 48.4 | 3.4 | 4.0 |
| Equ. income [‡] | Below 1 million yen | 1–1.99 million yen | 2–2.99 million yen | 3 million yen or above |
| Sample | 5.7 | 32.1 | 54.7 | 13.2 |
| Average | 30.9 | 48.0 | 14.9 | 6.4 |

[†]Each national average was calculated from the national survey on single mothers.²³

[‡]Equ. income: equivalent annual disposable personal income (1 million yen = 7365 USD in May 2023)..

Table 2. Food deprivation cut-offs

| Dimension | Deprivation cut-offs | % |
|--------------------------|---|------|
| Meal frequency | Less than 3 meals per day | 28.3 |
| Place of eating | Eat-Out: 0 day per week or Eat-In: ≤ 3 days per week | 30.2 |
| Timing of meals | Starting dinner 9 pm or after | 7.5 |
| Meal duration | Breakfast: ≤ 5 mins, Lunch: ≤ 15 mins and Dinner: ≤ 15 mins | 7.5 |
| Persons to eat with | Eating alone for dinner | 13.2 |
| Place of procurement | Use of 'discount supermarkets', 'convenience stores' and 'drugstores' exclusively | 7.5 |
| Quality of food | Achieved 0 criterion (e.g., seasonal, social good) | 7.5 |
| Pleasure of eating | Achieved 0 criterion (e.g., shopping, cooking, conviviality) | 49.3 |
| Meal content (dish) | Less than a 'staple + 1 dish' meal for dinner and other 1–2 meal(s) per day | 11.3 |
| Meal content (nutrition) | More than 5 nutrients 'necessary for dietary intervention' (BDHQ) | 17.0 |

Table 3. Deprivation profile of the food-poor single mothers (n = 16)

| # | Notes | Equi. income [†] | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 | Sum |
|----|--------------------------------|---------------------------|----|----|----|----|----|----|----|----|----|-----|-----|
| 1 | Economic poverty, picky eating | 71 | ○ | ○ | — | ○ | — | — | — | ○ | — | ○ | 5 |
| 2 | Economic poverty, picky eating | 161 | ○ | — | ○ | ○ | ○ | — | — | — | — | — | 4 |
| 3 | Economic poverty, depression | 96 | ○ | ○ | — | — | — | — | — | ○ | — | — | 3 |
| 4 | Economic poverty, picky eating | 152 | — | — | — | — | ○ | — | ○ | ○ | — | — | 3 |
| 5 | Economic poverty, depression | 155 | — | ○ | — | — | — | ○ | — | ○ | — | — | 3 |
| 6 | Economic poverty | 153 | — | ○ | — | ○ | — | — | ○ | ○ | — | — | 4 |
| 7 | Care of father with disability | 243 | — | — | — | — | — | ○ | ○ | ○ | — | — | 3 |
| 8 | PTSD | 204 | — | — | — | ○ | ○ | — | — | ○ | — | — | 3 |
| 9 | Depression, picky eating | 277 | — | — | — | — | — | — | ○ | — | ○ | ○ | 4 |
| 10 | Depression, picky eating | 288 | — | ○ | — | — | ○ | — | ○ | ○ | — | ○ | 5 |
| 11 | Obesity | 161 | — | ○ | — | — | ○ | — | — | ○ | — | — | 3 |
| 12 | Long-hour work, picky eating | 395 | — | — | ○ | — | — | — | ○ | ○ | ○ | — | 4 |
| 13 | Long-hour work | 196 | ○ | — | — | — | — | — | ○ | — | — | ○ | 3 |
| 14 | Night-shift work | 255 | — | — | ○ | — | ○ | — | ○ | — | ○ | — | 4 |
| 15 | Picky eating | 208 | ○ | ○ | — | — | — | — | — | ○ | — | — | 3 |
| 16 | None | 289 | ○ | — | — | — | — | — | ○ | ○ | — | — | 3 |

D1: meal frequency; D2: place of eating; D3: timing of meals; D4: meal duration; D5: persons to eat with; D6: place of procurement; D7: quality of food; D8: pleasure of eating; D9: meal content; and D10: nutritional status.

[†]For equivalent annual disposable personal income, see Table 1

Table 4. Food poverty index and contribution of each dimensional deprivation

| | <i>H_A</i> | <i>H</i> | <i>A</i> | <i>H₁</i> | <i>H₂</i> | <i>H₃</i> | <i>H₄</i> |
|--------------------|----------------------|----------|----------|----------------------|----------------------|----------------------|----------------------|
| Total | 0.109 | 0.302 | 0.363 | 0.13 | 0.13 | 0.06 | 0.08 |
| percent. contri. % | | | 100 | 12.1 | 12.1 | 5.2 | 6.9 |
| Eco. Poor | 0.244 | 0.667 | 0.367 | 0.33 | 0.44 | 0.11 | 0.33 |
| percent. contri. % | | | 100 | 13.6 | 18.2 | 4.5 | 13.6 |
| Non-poor | 0.082 | 0.227 | 0.356 | 0.09 | 0.07 | 0.05 | 0.02 |
| percent. contri. % | | | 100 | 11.1 | 8.3 | 5.6 | 2.8 |

| | <i>H₆</i> | <i>H₇</i> | <i>H₈</i> | <i>H₉</i> | <i>H₁₀</i> |
|--------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|
| Total | 0.04 | 0.19 | 0.21 | 0.08 | 0.08 |
| percent. contri. % | 3.4 | 17.2 | 19.0 | 6.9 | 6.9 |
| Eco. Poor | 0.11 | 0.33 | 0.44 | 0 | 0.11 |
| percent. contri. % | 4.5 | 13.6 | 18.2 | 0 | 4.5 |
| Non-poor | 0.02 | 0.16 | 0.16 | 0.09 | 0.07 |
| percent. contri. % | 2.8 | 19.4 | 19.4 | 11.1 | 8.3 |

H_A: food poverty index; *H*: headcount ratio; *A*: average deprivation share of the poor; *H_j*: share of the individuals who are both food-poor and deprived in dimension *j* (*j*=1 ~ 10: each number corresponds to the number in Table 3)

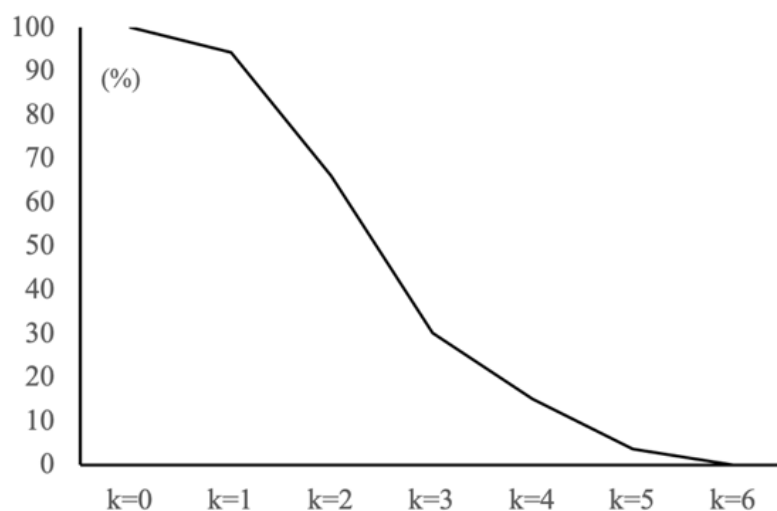


Figure 1. Food poverty cut-offs k and the identified population. The identified population has k number of deprived dimensions.

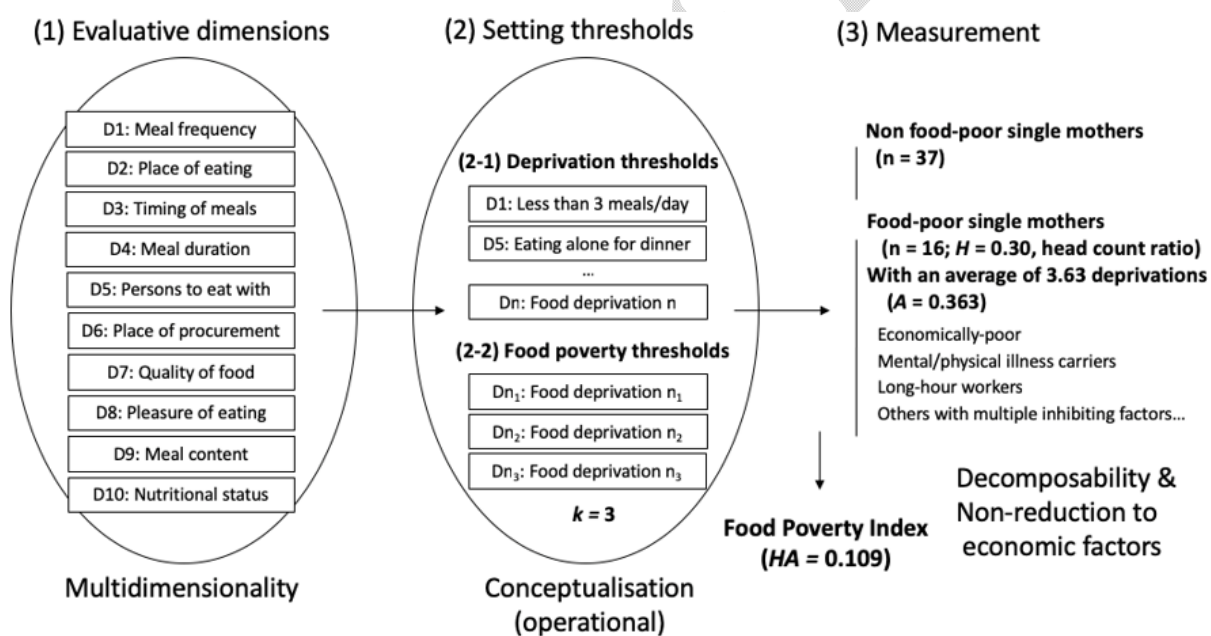


Figure 2. Graphical abstract. This chart represents how the food poverty measurement can be employed by taking the empirical example of single mothers (n = 53) in Japan surveyed in this study