



From Nutritional Capability to Food Capability: Measurement of Multidimensional Food Poverty in Japan

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Abstract

Amartya Sen's work has contributed to shifting our focus from food availability to food access and utilisation, together called 'nutritional capability'. Existing food insecurity instruments have been informed partially by the capability approach, but remain focused on material deprivation and its economic sub-dimensions. This narrow focus has become problematic, particularly in high-income countries, where material deprivation is largely overcome and food poverty manifests itself differently from that in low-income countries. Food poverty in high-income countries should thus be approached from a 'food capability' perspective that fully recognises the multidimensionality of eating lives and the multiple factors that affect their dietary standards. To demonstrate the usefulness of this perspective, the Alkire-Foster method for multidimensional food poverty was utilised to analyse food poverty in Japan. The Alkire-Foster measure has a dual cut-off approach and its adapted method can produce a multidimensional food poverty index by setting reasonable food deprivation and poverty thresholds. The national data used for empirical demonstration was obtained from a web-based questionnaire conducted in Japan, to which 973 participants (aged 20–60 years) responded. The measurement identified a 20.6% food-poor population and inequalities in food capabilities among subgroups. Although economic deprivation was tightly linked to food poverty, the results suggested that gender- and age-based inequalities were larger than socioeconomic status-based ones, which reflected much wider societal problems in Japan than growing economic poverty, such as gender inequality and population ageing. The proposed measurement is effective for monitoring food policy impacts and complementing existing food insecurity assessment tools. The results will be useful for promoting social debate about what the minimal dietary standard should be in high-income societies.

Keywords Multidimensional Poverty Measurement · Food Insecurity · Capability Approach · Food Capability

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Introduction

From Food Availability to Nutritional Capability

It is well known that Amartya Sen's series of works have enriched our understanding of food insecurity (e.g., Barret 2010; Peng & Berry 2019). However, almost all the studies on food insecurity that refer to Sen cite only his book *Poverty and Famine* and the entitlement approach, not *Hunger and Public Action*, which was co-authored by Jean Drèze, and their capability approach.

The theoretical implications of this puzzling absence in the food insecurity literature was explored in Burchi and colleagues' seminal article in 2016, 'From food availability to nutritional capabilities.' They note that, in *Poverty and Famine*, Sen (1981) demonstrated that the starvation that occurred in low-income countries throughout the 20th century was the result of a failure to be entitled to enough food, not of national food availability. This contributed to shifting the focus from the 'availability' to the 'access' dimension when addressing food insecurity.

However, in *Hunger and Public Action*, Drèze and Sen (1989) explain why we need to move beyond food entitlement towards 'nutritional capabilities': 'The focus on entitlements, which is concerned with the command of commodities, has to be seen as only instrumentally important, and the concentration has to be, ultimately, on basic human capabilities [...] A person's capability to avoid undernourishment may depend not merely on his or her intake of food but also on the person's access to healthcare, medical facilities, elementary education, drinking water, and sanitary facilities' (p.13). The presence of these non-food inputs that affect one's nutritional capability, more formally called 'conversion factors' (Sen 1985a), highlights the limit of the food entitlement approach and the necessity to include the 'utilisation' dimension in evaluating food insecurity (Burchi et al. 2016, p.15).

Food Capability and Food Poverty

The abovementioned features – availability, access and utilisation – of the capability approach have become integral dimensions of the notion of food insecurity, defined as the absence of 'a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that merits their dietary needs and food preferences for an active and healthy life' (FAO 2009).

However, there still remains a large gap between this overarching ideal and its actual operationalisation. Among the several challenges pointed out in review studies on food insecurity instruments used in high-income countries (Marques et al. 2014; Ashby et al. 2016; Bartelmeß et al. 2022), we highlight two major issues in this article. First, most assessment tools focus largely on financial constraints, dismissing the importance of non-income factors. As cited by Bartelmeß et al. (2022), career-oriented individuals who have high incomes but few time resources or social companions can also be deprived of the capabilities for achieving 'an active and healthy' dietary life.

Second, current food insecurity instruments also fail to address the multidimensionality of eating lives. These tools currently focus on the material aspects of food insecurity, while not catering for its social dimensions. For example, in the assessment method of US Household Food Security (USDA 2022), one of the most widely-used tools in high-

income countries, most of the 10 questions concern the material aspects of eating ('hungry', 'enough food', etc.), although one question concerns the quality aspect ('balanced meals'). Although these tools are effective in identifying severe material food poverty, they might 'underestimate the true prevalence of food insecurity' (Ashby et al. 2016). This feature becomes problematic, particularly in high-income countries, where material food insecurity is largely overcome and where food insecurity manifests itself differently from that in low-income countries (Bartelmeß et al. 2022).

Burchi et al. (2016) did not explicitly discuss this issue, perhaps because of their primary focus on operationalising the capability approach in low-income countries.¹ In fact, Drèze and Sen (1989) had already paid careful attention to 'the valuable and valued aspects of non-nutritional uses of food in social living' (p.43), but did not elaborate on the matter empirically in their book on hunger in low-income countries. In other words, the capability approach itself is not confined to the analysis of basic and nutritional functionings, but can also be tailored to suit 'more complex' functionings. The potential of the capability approach for analysing contemporary food issues in high-income countries has been advanced in recent studies (Hart 2016; Hart and Page 2020; Visser and Haisma 2021; Ueda 2021, 2022a, Ueda 2022b, 2023a) and our study follows this empirical direction.

Going beyond the literature on food insecurity, socio-anthropological studies have demonstrated that our 'eating well' consists of a total range of valued functionings, extending not just from nutritional but also to the temporal, spatial, qualitative and affective dimensions (Herpin 1988; Poulain 2002a, b, 2017; Warde 2016; Ueda and Poulain 2021). A narrow focus on the nutritional aspects of eating has also been criticised for its limitations in facilitating understanding the contemporary evolution of eating models and thus desirable behavioural changes (e.g., Scrinis 2008; Poulain 2017).

We therefore need to enlarge our focus from nutritional capability to 'food capability' in recognition of the totality (multidimensionality) of eating lives. While the nutritional capability perspective, which originated from development studies in low-income countries, is primarily focused on nutritional functionings, the food capability perspective, which derived from contemporary food issues (such as eating alone and meal skipping) in high-income countries, aims to complement the nutritional perspective by integrating a wide-range information (e.g., where, with whom, how long to eat) that directly relate to people's dietary well-being. It is possible to argue that this total perspective already exists in FAO's (2009) definition of food security, namely 'an active and healthy [eating] life', but it has not adequately captured social and academic attention. In the food insecurity literature, the term 'multidimensionality' refers mainly to multiple evaluative bases of food insecurity, namely, availability, access, utilisation and stability. Instead, we here mean the 'multiple food functionings' that constitute people's eating lives. The latter focus is already evident in the international definition of 'health' as a total (physical, mental and social) well-being (WHO 1986), but the food insecurity literature is somewhat disconnected from the health literature.

From the same perspective, 'food poverty' can be defined as the deprivation of this food capability. We prefer the term 'food poverty' to 'food insecurity', given the current gap between the ideal and reality in the notion of food insecurity, the potentially meaningful linkage with the poverty literature and the relative popularity of the term *shoku no hinkon* (food poverty in Japanese) in relation to dietary situations that have been problematised in

¹ Note that this article (Burch et al. 2016) was initially prepared as the background paper for the African Human Development Report 2012.

Japanese society. Note that food poverty should not be confused with the sub-dimension ‘economic poverty’, because we later demonstrate the existence of food poverty without economic deprivation.

The Alkire-Foster Method and its Application to Food

To demonstrate the food capability perspective, we apply Alkire and Foster’s (2011) method for measuring multidimensional food poverty in contemporary Japan. The Alkire-Foster method is one of the most widely-used instruments in general poverty studies and it has had significant political implications. It is used, for example, when developing the UNDP Human Development Index and Bhutan’s Gross National Happiness Index.

As already mentioned in the preceding paragraphs, there exist several relevant methods, notably the US Household Food Security indicator, but, at this moment, they are inadequate to capture the totality of eating lives (Marques et al. 2014; Ashby et al. 2016; Bartelmeß et al. 2022). In advocating the capability approach to food security, Burchi et al. (2016) go on to exemplify important evaluative dimensions (e.g., ‘diet quality’, ‘diet diversity’, ‘taste’, ‘nutritional knowledge’), but not an established measurement method.

Admittedly, the Alkire-Foster method is not the only choice to measure food poverty and this choice also possesses its own limits (to be mentioned soon later). Nevertheless, there are a couple of reasons for making the Alkire-Foster method desirable for our study: First, it shares a common theoretical ground with the capability approach. Second, it has an established approach to identify the (food-)poor and inequalities among the given population. Third, it can generate an ‘integrated’ indicator of food capability and can take a step further from profile-based approaches (i.e., listing multiple evaluative dimensions without aggregation) which are often used in the public health (e.g., Takemi 2001). Fourth, practically speaking, it is also suitable for the structure of data collected for our study.

The Alkire-Foster method is an intuitive counting approach to poverty as capability deprivation and is intended to: (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.

We use the national data on eating models in Japan to demonstrate the Alkire-Foster method and understand food poverty conditions in Japan. To our knowledge, this application is the first attempt to use the method in food insecurity/poverty studies in high-income countries. At this early methodological stage, it would thus be important to note the limitations before moving on to the demonstration.

First, there is currently no social consensus about food poverty in high-income countries (Bartelmeß et al. 2022), so its definition, which refers to food deprivation and poverty cut-offs in our demonstration, has to be operational and is confined by data availability and policy resources. Second, we apply the common definition to the whole population because we use 10 evaluative dimensions and do not adjust the cut-offs for all sub-groups

across all dimensions (e.g., 10 sub-groups by age and gender). Doing so would be ideal but unnecessarily complicate the presentation. This methodological choice can be justified by its simplicity and practicality and it might not be an embarrassment given that most dietary guidelines also provide national (not group-specific) standards (Food and Agricultural Policy Research Centre 1983; MHLW & MAAF 2000).

Third, urgency is another issue for setting reasonable cut-offs. ‘Urgency’ refers to the degree to which the deprivation in a given dimension becomes detrimental to human functionings. In contrast to poverty studies (e.g., life expectancy, income), one might view the urgency of each dimensional deprivation in eating (e.g., solo eating, meal skipping) as being relatively low. Nevertheless, as Townsend (1979) gave legitimate status to these dimensions in defining ‘relative deprivation’ in the UK in the 1970s, they should not be dismissed. In fact, Japanese scholars have already approached these non-nutritional dimensions in their attempt to understand social inequalities in eating (e.g., Hayashi et al. 2015; Abe et al. 2018; Ishida et al. 2017; Matsuda et al. 2020).

The fourth issue is weighting. 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’ (Atkinson et al. 2003). Some might stress the central importance of nutritional deprivation over other deprivations. By setting two dimensions closely related to nutritional status (‘meal pattern’ and ‘nutritional status’), our approach ultimately allocates more weight to nutritional deprivation, but, in this same article, we cannot address the debate about exactly how much the dimension should be weighted (for more details on weighting, see Alkire and Foster 2011a; Alkire and Santos 2014).

In sum, the objective of this article is to demonstrate the Alkire-Foster method for multidimensional food poverty in Japan as a complementary approach to existing food insecurity instruments, which are focused largely on material food deprivation and its economic sub-dimensions. We analyse the unequal distribution of food poverty across different social groups and go on to argue that, in developing food policy, we need to address not only economic inequality, but also gender- and age-based inequalities that particularly characterise Japanese society.

Methods

Data and Evaluative Dimensions

The data was obtained from the Survey of Your Eating Life, a web-questionnaire survey conducted in 2021 to identify the norms and practices of eating well in the Japanese population ($n=973$). The details of this survey were reported in our previous studies (Ueda 2022a, b), so we focus here on describing only the essential information. The respondents were aged 20–69 (excluding students) and their socio-demographic profiles were of national representativeness in Japan. This survey was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Ritsumeikan University (ID: 2020-49).

The questionnaire covered the 10 dimensions of eating well: (1) meal frequency, (2) place of eating, (3) timing of meals, (4) meal duration, (5) persons to eat with, (6) place of procurement, (7) quality of food, (8) pleasure of eating, (9) meal content and (10) nutritional status. These dimensions were derived from sociological theories of eating (Herpin 1988;

Table 1 Food Deprivation Cut-offs

Dimension	Deprivation cut-offs	%
Meal frequency	Less than 3 meals per day	10.2
Place of eating	Eat-Out: 0 day per week or Eat-In: ≤ 3 days per week	22.3
Timing of meals	Starting dinner 9 pm or after	13.1
Meal duration	≤ 10 min for all three meals	7.3
Persons to eat with	Eating alone for all three meals	20.9
Place of procurement	Use of discount supermarkets, convenience stores and drug-stores exclusively	9.2
Quality of food	Achieved ≤ 4 criteria (seasonal, social good, etc.)	14.8
Pleasure of eating	Achieved ≤ 3 criteria (shopping, cooking, conviviality, etc.)	16.4
Meal content (dish)	Less than a 'staple+1 dish' for all three meals	12.1
Meal content (nutrition)	0 dietary variety score	18.4

Poulain 2002a, b, 2017; Warde 2016; Ueda and Poulain 2021). The validity and extensiveness of these dimensions in relation to people's subjective valuations were also tested (Ueda 2022a), which process was important for the capability approach, which values the 'choice' dimension of eating lives (Drèze and Sen 1989, p.43; Sen 1985b, p.212).

Each dimension (excluding nutritional status) was explored in terms of dietary norms and practices (Moscovici 2001; Lahlou 1995; Poulain 2002a, b). Here, 'norms' signify the person's desired or valued level of functioning achievement, whereas 'practices' refer to their actual achievement. These achievement levels can be determined by asking questions such as, 'How many times per day would you like to eat?' (norms) and 'How many times did you eat yesterday?' (practices). Furthermore, the norm–practice gaps can be interpreted as an indicator of one's capability, in which smaller gaps generally signify the situation in which the person is better able to achieve his or her ideals and thus has a higher capability (Goto 2017).

The nutritional dimension was measured by using the dietary variety score (Kumagai et al. 2003). The score (1–10) was calculated from the number of the 10 food groups (meat, seafoods, eggs, milk, beans, vegetables, seaweeds, potatoes, fruits and oils) taken every other day or more.

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 1. Among the various outputs from the Survey of Your Eating Life, we used primarily the practice data as the basis for the cut-offs, while the norms were partially integrated for some difficult-to-standardise dimensions, such as quality and pleasure.²

This choice was made for simplicity, but it is worth mentioning its implications from the capability perspective. Although we primarily used the data on achieved functionings (i.e., what the person actually achieved), the ultimate purpose is to determine food capability (i.e., what the person can do). However, there is no available data to directly measure the capability. It is possible to infer capability based on commodities and conversion factors

² Although it is interesting to incorporate more thoroughly the information regarding norm-practice gap, it requires further data treatment and complicates unnecessarily the methodological demonstration, due to multiple reasons such as the problem of adaptation (for this issue, see Ueda 2022a, b).

(e.g., cooking ability, time constraint), but we chose the achieved functionings as derivative informational bases (for this methodological issue, see Sen 2009, pp.231–238). This choice will also be easily comprehensible to general food scholars who focus on nutritional achievement and food insecurity experiences.

The aggregate results of the Survey of Your Eating Life were reported previously (Ueda 2022b), so the objective here is not to describe the dietary situations of the population but to determine the cut-offs based on these empirical insights and identify food capability inequalities. 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, 10.2% of the population was identified as being deprived. The cut-off can be justified by the fact that the majority desired to have three meals per day (Ueda 2022b) and that reducing the ‘breakfast skipping’ ratio is one of the health policy goals (MHLW 2022).
- (2) Place of eating: We limited our consideration to dinner and set two different 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’). The Eat-Out group was 69.5%, whereas the Eat-In group was 30.5%. For the former, ‘no opportunity for Eat-Out’ was set as the cut-off and 19.3% were identified as being deprived. For the latter, ‘three times or less a week for Eat-In’ was set as the cut-off and 3% were identified as being deprived. The latter cut-off represented the situation in which the individuals outsourced too often, leaving few opportunities for cooking family meals. Note that even the Eat-Out group regarded outsourcing dinner ‘more than three times a week’ (i.e., ‘three times or less for Eat-In’) as too often, and thus failed to achieve this dimensional functioning (Ueda 2022b).
- (3) Timing of meals: Consideration was limited to dinner, for which the majority felt that ‘earlier dinner is better’ (Ueda 2022b). 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 (MHLW 1997). We followed this policy discourse and set it as the cut-off, resulting in 13.1% being identified as deprived.
- (4) Meal duration: The majority considered ‘eating more slowly is better’ for breakfast, lunch and dinner (Ueda 2022b); thus, consideration was given to all three meals. The ideal duration of meals (median) was 20 min for breakfast, 30 min for lunch and 30 min for dinner (Ueda 2022b). As is the case with the OECD’s income-based poverty threshold of the Organisation of Economic Cooperation and Development (OECD), almost half the median for each meal (10 min per meal) was regarded as the cut-off reference.³ To express the strongest possible urgency, the situation in which the individuals could not spend a longer time eating than the reference duration for all three meals were identified as being deprived (7.3%). Note that meal skipping was regarded as 0 min.
- (5) Persons to eat with: We generally treated ‘eating together’ to be the ideal because the current health policy is also to reduce the ratio of those who eat alone (MHLW 2022). Although ‘eating alone’ was idealised by 27.8% for breakfast, 30.9% for lunch and 12.0% for dinner (Ueda 2022b), we assumed that this was the result of adaptation (Qizilbash 2006; Clark 2009), which refers to a lowering of expectations when facing difficult

³ Meal duration was determined in 10-minute units, so the cut-offs were adjusted downwards from 15 min to 10 min.

- circumstances (long working hours, one-person household, etc.). This assumption was validated specifically in the case of single mothers (Ueda 2023a). Some individuals, such as one-person households, might have difficulty eating with others for breakfast and dinner, but might be in a position to ensure conviviality during lunch hours. Thus, to express the strongest possible urgency, the situation in which the individuals could eat alone for all three meals was identified as being deprived (20.9%).
- (6) Place of procurement: There was no consensus about ‘good’ places for procuring daily foodstuffs, but consensus was obtained during the in-depth interviews, conducted as a preparatory stage, with the single mothers regarding ‘not good’ places, notably discount supermarkets and convenience stores (Ueda 2023a), which insight we applied to the national population. Again, we assumed here that the quality of food sold at discount supermarkets was generally inferior to that found at normal supermarkets and professional retailers. Moreover, there is increasing evidence that the exclusive use of convenience stores can be seen as one barometer of the ‘food desert’ (Yakushiji 2015). Therefore, the individuals whose main procurement method was either of these ‘not good’ ones were considered deprived (9.2%).
 - (7) Quality of food: The respondents were asked closed questions about 12 quality criteria, namely ‘easy to cook’, ‘rich ingredients (nutrients, etc.)’, ‘traditional, regional’, ‘producers are visible’, ‘famous’, ‘socially good (environment, etc.)’, ‘certified by trustable institutions (safety, etc.)’, ‘producers’ passion’, ‘original’, ‘fresh’, ‘pure’, ‘seasonal’ and ‘delicious’ (for concrete questions, see Ueda 2022b). Daily use (‘every other day or more’) indicated achievement of the given criteria. The cut-off was set at half the median (eight) of the achieved criteria, i.e., ‘achieving four criteria or less’, resulting in 14.8% being identified as deprived.
 - (8) Pleasure of eating: The principle is essentially the same as that for the quality dimension. The respondents were asked closed questions about eight quality criteria, namely, ‘shopping’, ‘cooking’, ‘having meals’, ‘feeling full’, ‘appreciating delicious tastes’, ‘having conviviality’ and ‘feeling seasonality and connection with nature’ and ‘cleaning and stocking’ (for concrete questions, see Ueda 2022b). Experience in a week indicated achievement of the given criteria. The cut-off was set at half the median (six) of the achieved criteria; that is, ‘achieving three criteria or less’, and 16.4% were identified as being deprived.
 - (9) Meal content: The quality of meal content was evaluated based on dish combinations (Adachi 1984; Kudo et al. 2017). The majority regarded a ‘staple and one dish’ as a culturally-minimal standard for meals (Ueda 2022b) and the high frequency of a ‘staple only’ meal was problematised due to of its low nutritional value (Kudo et al. 2017). To express the strongest possible urgency, the non-achievement of this minimal standard for all three meals (i.e., less than a ‘staple and one dish’ for all three meals) was set as the cut-off, and 17.6% were identified as being deprived. Note that this cut-off is stricter than the current health policy, the aim of which is to promote ‘having a proper meal (such as a ‘staple and at least two dishes’) at least once a day’ (MHLW 2022).
 - (10) Nutritional status: To express the strongest possible urgency, a 0 dietary variety score, which represents the situation in which none of the 10 food groups were taken every other day or more and was thus considered a low nutritional level, was set as the cut-off, and 18.4% were identified as being deprived.

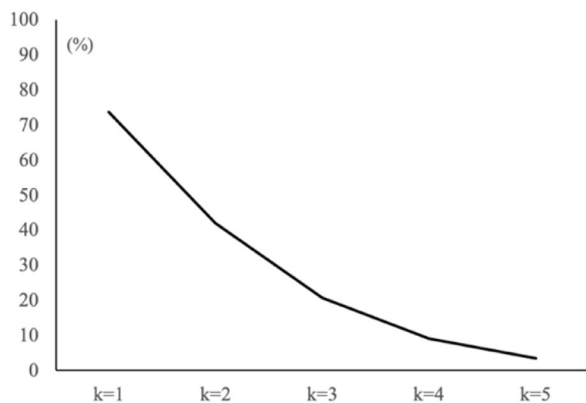
Food Poverty Cut-off

Having set the food deprivation cut-off, the next task was to determine the food poverty cut-off. Figure 1 shows how different cut-offs, k , generate different identification results. If we choose to determine that individuals with three deprivations or more ($k=3$) deserve social intervention, the identified food-poor population will be 20.6%. Similarly, the choice of $k=2$, $k=4$ or $k=5$ identifies a 41.9%, 9.1% or 3.6% food-poor population respectively.

Since there is no agreed definition of food poverty in high-income countries (Bartelmeß et al. 2022), any definition has to remain operational, and the choice of any food poverty cut-off largely depends on policy objectives and data availability. The conceptualisation of food poverty and the visualisation of inequalities among social groups are potentially useful for policy development and further social discussion needs to take place regarding what the minimum dietary standard should be in a given society.

We chose $k=3$ as the food poverty cut-off for our demonstration and this choice can be justified by a couple of practical considerations. First, the process of elimination was taken into account. The identified food-poor population derived from $k=2$ becomes too large and not particularly effective for policy targeting, whereas the result derived from $k=4$ might be viewed too small, given Japan's relative poverty rate of 15.7% (OECD 2022a) and its material severe food insecurity rate of 3.8% (FAO 2022). This line of reasoning does not relate to the direct relationship between economic poverty and food poverty, but this number zone might be compelling for the development of anti-food poverty policy. Secondly, prior to in-depth investigation, we performed a ranking test of food poverty indexes, HA , for 10 sub-groups divided by gender and age, and confirmed a relatively stable ranking structure.⁴

Fig. 1 Food Poverty Cut-offs k and Identified Population



⁴ The ranking structure with $k=2$ and $k=3$ was, in the descending order of HA , 30s, 40s, 20s, 50 and 60 s for men and 20s, 40s, 30s, 50s, 60s for women. The ranking with $k=4$ and $k=5$ was almost the same, with reversed rankings between the 30 and 40 s for men and between the 30 and 50 s for women.

Results

Food Poverty Index and Inequalities by Sub-group

Following the founding paper with the primary purpose of demonstrating a novel method (Alkire & Foster 2011), our results are also described by indexing, which is, the use of the given measure as a reference to illustrate the comparative characteristics in food capabilities among different sub-groups.

Table 2 contains a summary of the measurement results by subgroup. 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, 32.2% of men in their 20s, who experienced an average of 3.66 food deprivations, were identified as food-poor.

We can observe large gender- and age-based inequalities. Men (excluding those in their 60s) were generally more deprived than women. Even men in their 50s ($HA=0.094$), the second-least deprived among men, were more deprived than the women in their 20s ($HA=0.075$), the most deprived among the women. For both men and women, the middle-aged (30–40s) and the young (20s) were more deprived than the older (50–60s) groups. For example, only 6.9% of women in their 60s were identified as living in food poverty.

In terms of income, a non-negligible inequality was observed between the low-income group (I) and other income groups (II–V), although rankings among the latter groups were not perfectly consistent. Regarding social class, interestingly, we can observe reversed effects: the new middle class ($HA=0.092$) and capitalist class ($HA=0.088$) were more likely to fall into food poverty than the lower social class groups. Nevertheless, it is important to note that the inequalities based on socioeconomic status (SES) were not larger than the gender- and age-based inequalities.

Dimension-specific Deprivation

The rows in Table 3 break these food poverty levels down by dimension, where H_j is the share of the individuals who were both food-poor and deprived in dimension j (described in

Table 2 Food Poverty Index by Sub-Group

	HA	H	A		HA	H	A
Men 20s	0.118	0.322	0.366	Income I (low)	0.082	0.220	0.371
Men 30s	0.154	0.440	0.350	Income II	0.075	0.213	0.353
Men 40s	0.130	0.330	0.393	Income III	0.078	0.219	0.356
Men 50s	0.094	0.237	0.396	Income IV	0.069	0.178	0.388
Men 60s	0.043	0.131	0.331	Income V (high)	0.072	0.191	0.376
Women 20s	0.075	0.198	0.380	Underclass	0.076	0.208	0.365
Women 30s	0.046	0.137	0.336	Working class	0.079	0.206	0.383
Women 40s	0.055	0.141	0.386	Old middle class	0.053	0.158	0.333
Women 50s	0.037	0.099	0.370	New middle class	0.092	0.246	0.373
Women 60s	0.024	0.069	0.343	Capitalist class	0.088	0.229	0.383
Total	0.076	0.026	0.368				

¹ HA : food poverty index; H : headcount ratio ($k=3$); A : average deprivation share of the food-poor

² Income quintile (I~V) was calculated based on the National Census of Japan

³ Social class was categorised based on Hashimoto (2018)

Table 3 Dimensional Contribution to Food Poverty Index

	H _A	Contri. (%)	H ₁	H ₂	H ₃	H ₄	H ₅	H ₆	H ₇	H ₈	H ₉	H ₁₀
Total	0.076	100	8.6	9.2	9.6	5.7	12.5	5.6	12.6	14.3	9.0	12.9
Men 20s	0.118	100	8.5	8.5	10.4	5.7	12.3	4.7	11.3	13.2	6.6	18.9
Men 40s	0.130	100	6.8	5.9	12.7	7.6	11.0	5.9	13.6	16.1	8.5	11.9
Men 60s	0.043	100	2.3	7.0	0.0	4.7	16.3	4.7	9.3	16.3	23.3	16.3
Women 20s	0.075	100	7.9	6.6	7.9	6.6	13.2	7.9	18.4	10.5	9.2	11.8
Women 40s	0.055	100	14.8	16.7	11.1	5.6	9.3	1.9	13.0	13.0	9.3	5.6
Women 60s	0.024	100	12.5	8.3	4.2	4.2	16.7	4.2	12.5	8.3	16.7	12.5
Income I	0.082	100	6.4	8.3	4.9	7.4	13.2	7.8	16.7	14.7	8.8	11.8
Income V	0.072	100	10.9	11.7	13.3	5.5	12.5	5.5	6.3	14.1	9.4	10.9
Old middle class	0.053	100	7.5	10.0	5.0	0.0	10.0	7.5	7.5	20.0	10.0	22.5
New middle class	0.092	100	5.7	11.9	12.4	6.7	13.4	5.2	9.3	14.4	9.8	11.3

¹*H_j*: share of individuals who are both food-poor and deprived in dimension *j* (described in percentage terms)

²*j* = 1: meal frequency, 2: place of eating, 3: timing of meals, 4: meal duration, 5: persons to eat with,

6: place of procurement, 7: quality of food, 8: pleasure of eating, 9: meal content, 10: nutritional status

³ Only selected sub-group populations with high or low food poverty index are described here

percentage terms) and it simply represents the given dimension's contribution to each group level of *HA* (see the formula, Alkire and Foster 2011a). For simplicity, only the sub-groups whose food poverty index was large or small are presented in Table 3.

For the low-income group (I), deprivations in the meal content (8.8%) and nutritional dimensions (11.8%) certainly contributed to the food poverty index; however, deprivations in other dimensions made higher contributions, such as quality (16.7%), pleasure (14.7%) and conviviality (13.2%). This result expresses the diversity of their deprivations, which can hardly be captured by existing instruments that are focused on material food deprivation.

On the other hand, the high-income group (V) was characterised more by deprivations in the frequency, place and timing dimensions and less by procurement and quality dimensions than the low-income group. This demonstrates how food poverty can occur without economic deprivation.

A similar contrast can be observed between the old middle class and the new middle class. Material deprivation was notable for the former (nutritional: 22.5%), whereas temporal (timing: 12.4%, duration: 6.7%) and convivial (13.4%) deprivations were more characteristic of the latter than the former.

It is also worth mentioning some notable deprivation profiles of sub-groups by age and gender. The contribution of nutritional deprivation was relatively high for men (20s: 18.9%, 40s: 11.9%, 60s: 16.3%), the last of which also had a high rate of meal content deprivation (23.3%). This pattern of material deprivation was in common with that of the elderly women.

Deprivations of shopping-related capabilities (procurement: 7.9%, quality: 18.4%) were characteristic of the young women, meaning that this population was more likely to be forced to purchase low quality daily food at discount supermarkets or convenience stores than the other sub-groups. There were no particular characteristics (which means wide-ranging deprivations) for the middle-aged group, aside from the middle-aged women's relative tendency to skip meals (14.8%) and outsource meals too often (16.7%).

Discussion

Key Properties of Multidimensional Food Poverty Measurement Method

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.

First, this method concerns the multidimensionality of dietary lives and thus marks a sharp contrast to other food insecurity measurement instruments, which are focused primarily on material food poverty (Ashby et al. 2016; Bartelmeß et al. 2022). This is not to deny the importance of existing instruments and their usefulness in identifying severe material food 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.

Second, our dual cut-off approach facilitates the conceptualisation of food poverty. There is no official definition of food poverty in high-income countries (Bartelmeß et al. 2022); but, 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 ($k=3$), which resulted in identifying a 20.6% food-poor population with an average of 3.68 deprivations. This headcount ratio of multidimensional food poverty of 20.6% might be more compelling for policy development than the current headcount ratio of severe material food poverty, which is 3.8% (FAO 2022) and which might be an underestimation of the true prevalence of food poverty in Japan.

Third, 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’ (Alkire and Foster 2011a) and we revisit inequalities in food capabilities in contemporary Japan to solicit the policy implications below.

Inequalities of Food Capabilities in Contemporary Japan

There is a shared international understanding of the SES inequalities in health and nutritional levels as a ‘solid fact’ (WHO 2003; Kondo 2005; Kawakami 2006). However, in Japan, it was not until the 2000s that food scholars started investigating the effects of SES on eating lives. These scholars have elucidated inequalities in nutritional levels (Fukuda and Hiyoshi 2012; Nishi et al. 2017) and, more recently, in various functionings such as meal frequency, eating out, access and attention to the quality of food in low-income households (e.g., Hayashi et al. 2015; Abe et al. 2018; Tani and Kusakari 2017; Ishida et al. 2017; Yasui 2021). Our measurement results, which demonstrated inequalities in food capabilities between low-income and other income groups, were consistent with these previous studies and thus confirmed that the economically poor are likely to fall into food poverty, and that their deprivations are multidimensional.

However, this does not mean that food poverty can be equated with SES deprivation. Our results reported an interesting phenomenon, namely that the higher social class was more deprived than the lower social class. Further analysis of their deprivation profiles revealed that the former group was characterised more by non-material deprivations, such as in the temporal and convivial dimensions, than the latter group. This finding seems to suggest the critical role of time constraints in the various conversion factors (van der Heijden et al. 2021; Zorbas et al. 2018; Ueda 2023a), particularly in Japan, which is notoriously characterised as having the longest working hours of the high-income countries (OECD 2022b; Takami 2019). Although the time factor was not integrated into the survey, higher SES is correlated with longer working hours and thus greater time constraints (Hashimoto 2018), which might have caused non-material deprivations and undermined a consistent expression of the SES effects on food capability in our study.

Moreover, one needs to pay more attention to gender and age disparities when discussing capability inequalities in Japan. Our findings showed that men, the young and the middle-aged groups were more likely to fall into food poverty than women and the elderly, whose inequalities were larger than those due to the SES differences. Such gender- and age-based inequalities have been undermined in current food insecurity (and food poverty) discourse in Japan, in which there is an exclusive focus on SES inequalities.

In fact, these findings resonate with long-debated social problems in Japan. Due to the economic growth in Japan leading up to the early 1990s, the socio-political restructuring of the post-war family regime was greatly delayed in the country (Ochiai 2019), which has

resulted in the current situation, marked by the greatest gender inequalities among the high-income countries (World Economic Forum 2021). Within this gendered social structure, women (whether housewives or regular workers) have served as the primary family meal providers. This is one of the reasons for which middle-aged women (40s) had fewer deprivations in some dimensions, such as conviviality, but more shopping-related deprivations than men. However, from the opposite viewpoint, this gendered system has distanced men from the kitchen sphere (Cabinet Office 2003) and prevented them from cultivating their food capability.

Age-dependent inequality also characterises the dietary situation in Japan. The results revealed that the elderly had the highest food capability. One explanation for the advantage of the elderly might be a purely demographic factor. The elderly (60s) targeted in our survey were born between the early 1950s and the early 1960s, the exact period when the post-war regime of family – and ‘family meals’ – was established across the nation. Therefore, it is highly likely that the elderly acquired the capability to eat well (in the sense that is defined in Table 1) through family, public and social education, and can utilise their capability without challenging such social norms.

Conclusion and Policy Implications

In this article, we applied the Alkire-Foster method for multidimensional poverty measurement to food poverty in Japan. We conclude this article by extracting policy implications from the findings for both Japan and other high-income countries.

First, the perspective of ‘food capability’ needs to be incorporated into food policies. This perspective concerns the totality of eating lives and goes beyond existing material and nutrition-focused food insecurity approaches. This approach also makes it possible to deal with different types of inequalities, not exclusively SES inequalities. For clarification, the capability approach is more about social justice than the ‘life-stage approach’ in current food policies in Japan (e.g., Health Japan 21, food education policy), which optimises dietary interventions according to life stages, but offers little insight into inequalities in allocating policy resources.

Second, our measurement results suggest that, in Japan, male workers, young adults and the middle aged deserve priority for resource allocation to remove their capability-based disadvantages. Since previous food policies uncritically targeted women and reproduced gendered dietary norms (Kimura 2011, 2016), gender consciousness at all food policy levels is a prerequisite for developing men’s capabilities.

Reinforcing food education at the early stages to ensure minimal ‘food literacy’ (Vidgen and Gallegos 2014; Feuer 2022) is necessary if young adults are to address their nutritional deprivations. A comprehensive policy package, such as food education, the improvement of local food shops and community canteens, and house-keeping services (that include cooking) is also necessary to address the multidimensional deprivations of the middle aged, particularly for mothers who have difficulty achieving a work and eating-life balance (Ueda 2023a). There has been increasing reflection on population ageing in Japan and the ‘debatable’ current prioritisation of the elderly in general social policies (pension, healthcare, etc.). This social debate should be extended to food policy to address the generational inequality of food capabilities.

Second, we argue that multidimensional food poverty measurement can serve as a tool for monitoring policy impacts and complementing existing food insecurity instruments. This proposition is not entirely new to researchers and policymakers in Japan, given the presence of various food-related indicators already included in current food policies (e.g., meal skipping, eating together with others, having a ‘staple and at least two dishes’), albeit not in an integrated way.

Lastly, the case of Japan has been under-represented in the international literature (compared to the Western countries), but this country is criticised in food insecurity research in other high-income countries for having the largest economic gap, the greatest gender gap, the longest working hours and the fastest ageing (i.e., intergenerational gap in social resources) of the high-income countries. We demonstrated how food poverty in Japan, although having mostly overcome material deprivation, still exists and manifests itself differently from that of low-income countries, and how such food poverty is tightly linked with the country’s much wider societal problems.

Our measurement method is not without methodological challenges. As already noted prior to demonstration, the fundamental challenge is the absence of social consensus about food poverty, which led to operational issues in setting effective thresholds and weights. These challenges are in common with the studies of multidimensional poverty measurement, for which several solutions have been proposed, such as robustness test to the set parameters (Alkire and Foster 2011b; Alkire and Santos 2014; Alkire et al. 2015). Admittedly, further statistical adjustments are required for our study.⁵ Nevertheless, according to Sen (1997), the need to set effective thresholds and weights in multidimensional measures is as a strength, not an embarrassment, that can spark public discussions about well-being and poverty. This understanding is true to food poverty studies. In this sense, our way of visualising food poverty and capability inequalities would be helpful for further social discussions about what should be a ‘minimum dietary standard’ to be ensured in a given society.

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Declarations

Conflict of Interest The author declares no conflict of interest.

Ethical Statement This research is in line with the Declaration of Helsinki and the protocol was approved by the Ethical Committee of Ritsumeikan University (ID: 2020-49).

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⁵ Robustness test is the process to assess how sensitive identification results are to the selection of a set of parameters. One of the useful ways is by computing a rank correlation between the original ranking (e.g., *HA*) and the alternative rankings (Alkire et al. 2015). The alternative specification may be a different food poverty cut-off (*k*), a different set of deprivation cut-offs (for 10 dimensions), a different set of weights, or a combination of three. In this paper, we have confirmed the robustness of ranks with the different food poverty cut-offs (see Fig. 1 and footnote 4). Further robustness tests involve too many alternative sets and cannot be performed in the same article.

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