Food Balance Lunchbox: Enabling Healthy Eating by Knowledge

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As the rate of obesity arose among South Koreans, the Korean Ministry of Health and Welfare published a visual food-based dietary guideline, *Food Balance Wheel* in 2005. It is supposed to impart personalized nutritional knowledge for healthy eating, i.e., what and how much to eat/drink from five food groups to stay healthy with balanced and nutritious meals. The current Food Balance Wheel design, however, is problematic in that (1) the concepts of moderation and personalized dietary patterns are not represented, (2) the proportionality between five food groups are inaccurately illustrated, and (3) food serving sizes are not visually exemplified. Daily water recommendation is missing. An alternative model, *Food Balance Lunchbox*, is designed in the constant column width (CCW) treemap format for the audience's reduced cognitive burden. A CCW treemap consists of rectangles with equal widths; it is visually simpler than a pie chart, and it allows for fast and easy one-dimensional height comparison of proportionality between five food groups. The concepts of moderation and personalized calorie recommendations are visualized by varying CCW treemap sizes. Food items' serving sizes are exemplified in photographic images to impart more accurate information in volume, weight, and calories. Information on total daily water recommendation that includes water from food and beverages, and the proportionality between three macronutrients (carbohydrates, protein, and fat) information are also provided. With the Food Balance Lunchbox model, we expect consumers to perceive healthy eating actionable daily goals to achieve, not as an abstract concept.

Keywords: food-based dietary guidelines; frequency graph comprehension; proportionality visualization; nutrition knowledge; treemaps

1 Introduction

According to 2018 Korean Ministry of Health and Welfare statistics, the percentage of overweight cases (BMI ≥ 25) have risen from 31.3% in 2005 to 34.8% in 2016, and extreme obese cases (BMI ≥ 30) amount to 5.5% (Lim, 2018). As obesity is linked to an increased risk of lifestyle diseases (diabetes, e.g.), the Korean government published the Dietary Reference Intakes for Koreans (hereafter KDRIs) as a preventive measure. The KDRIs booklet—first published in 2005 and revised twice in 2010 and 2015—is now distributed online, as part of nationwide nutrition education programs at educational/medical institutions, to encourage Koreans to have balanced, nutritious meals in moderation.

The KDRIs booklet (Jung, 2015) consists of chapters on energy and macronutrients, vitamins, minerals, as well as recommended dietary patterns for various life cycle stages and anthropometric characteristics (Figure 1, Jung, 2015, pp.958-959). For an easier understanding and application of the dietary patterns, KDRIs also provides the *Food Balance Wheel*—식품구성자전거 in Korean—as a visual food-based dietary guideline (hereafter FBDG) where items in five food groups are presented in a drawing of a person riding a bicycle (Figure 2, Jung, 2015, p.919).

A Type						
Kcal	Grain	Meat, fish, eggs, beans	vegetables	Fruits	Milk, Dairy products	Oil, sugar
1,000	1	1.5	4	1	2	3
1,100	1.5	1.5	4	1	2	3
~	-	-	-	-	-	-
2,600	3.5	5.5	8	4	2	8
2,700	4	5.5	8	4	2	8
2,800	4	6	8	4	2	8

* Pattern A: 1,000 ~ 2,700 / Pattern B: 1,000 ~ 2,700 (Milk·Dairy products 1 times recommended)

Figure 1. An example of KDRIs dietary patterns table. The pattern A applies to infant and youth population who need two servings of dairy products, while the pattern B is for adults.

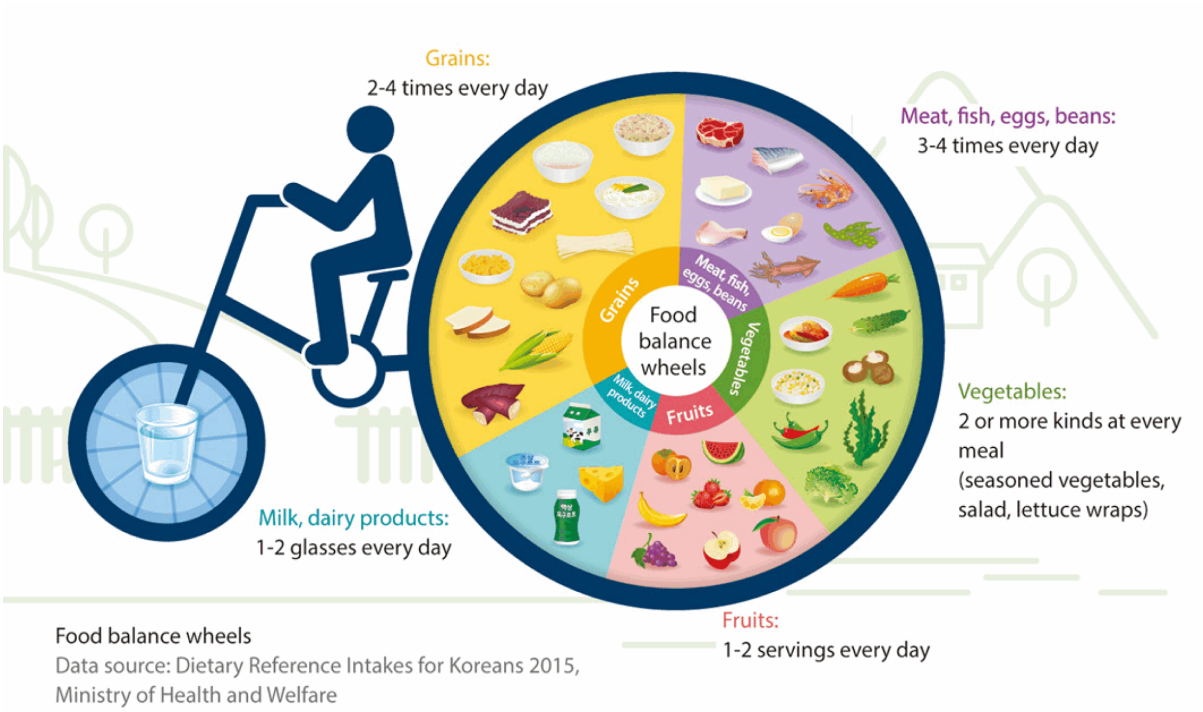

Figure 2. The Food Balance Wheel in the KDRIs booklet.

Ideally, food-based dietary guidelines are supposed to visualize concepts of **moderation, diversity, proportionality, and hydration** (Figure 3) for a healthy and balanced diet. Also, the information should be personalized according to each person's age, height, weight, and physical activity level for moderation. For this reason, the KDRIs booklet list up 37 calorie cases as recommended dietary patterns (Figure 1, Jung, 2015, pp. 958-959): 19 for children and adolescents (Pattern A), and 18 adults (Pattern B). For each case, recommended servings from five food groups differ.

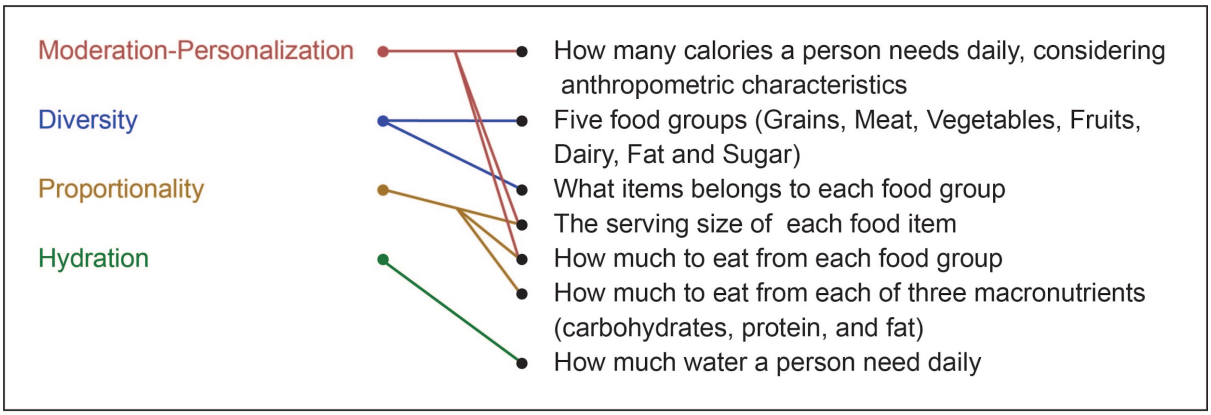

Figure 3. Information requirements for visual food-based dietary guidelines.

The KDRIs booklet, however, is a 55-page long scientific document, and it is neither practical to expect most Korean adults to carefully read and remember what it says, nor Korean children to fully grasp its complicated scientific terms. For the reason, visualized FBDGs—the Food Balance Wheel (Figure 2)—is called for as an executive summary version of the booklet, to inform what both children and adults practically need to know for healthy eating. The bicycle metaphor emphasizes the concept of balance: a balanced diet, and a balance between nutrition and physical activities. The bicycle rider image is easy to grasp and memorable, even for children. The proportionality between five food groups is visualized in a pie chart, a popular frequency comparison chart most Koreans are familiar with.

Our qualitative study with 37 college students, however, revealed many communication problems of the bicycle model.

- The concept of **moderation** and **personalized** dietary patterns are not presented there, because the model is distributed as a sheet of printable image. To encompass all 37 calorie cases, servings in each food group are written in range values ("Eat from the Grains group 2-4 times daily"), which can be rather ambiguous to everyone.
- **Diversity** is exemplified with illustrated food icons, but the icons are presented without labels, so some are not identifiable. Food icons are also presented as the whole (a bunch of grapes, e.g.) to make it recognizable with ease, while a serving of fruit is usually smaller than that (a third of the whole grape bunch, e.g.). As **serving size information** is missing on the model, you do not know how large a serving is, and cannot follow the guidelines in the dining context.

- **Proportionality** information is distorted: Meat group slice look almost as large as Vegetables group slice while the recommended Vegetables intake is always higher in servings and heavier in weight.
- The concept of **hydration** is illustrated with a cup of water on the front wheel, but information on exactly how much water you should drink is missing.

In a word, the Food Balance Wheel has problems of ambiguous and misleading information. Such findings led us to develop alternative models that are improved on the design (format, colour, and icon style) and the content (text information and icon label) for more personalized and accurate food knowledge.

One of the basic assumptions in this study is imparting apprehensible nutrition knowledge will lead to the consumer's improved food behaviour. In fact, many scientific investigations are conducted on the correlation between knowledge and behaviour change, and the results are still inconsistent. For instance, Puttapitakpong et al. (2014) investigated 430 women's knowledge on osteoporosis prevention; they found that 85.2% of the participants had adequate knowledge about osteoporosis, and 53.3% of them had good attitudes towards osteoporosis prevention, but preventive behaviour is only correlated with attitude, not with the knowledge level. The knowledge level, however, is linked to positive attitudes toward osteoporosis prevention that lead to prevention behaviours. On the contrary, other studies find positive linkage between knowledge and healthy behaviours. Ghannadi et al. (2016)'s study with 117 Type 2 diabetes patients finds significant correlation between patients' knowledge and practicing self-care activities. Jang's study with 300 Korean college students (2010) concludes that subjects with higher nutritional knowledge spend longer time for eating; they eat fruits and vegetables more frequently and avoid animal fat and fried food, compared to other subjects; they also prefer fish, egg, beans and other soy-based foods, milk, spinach, cucumber, while low nutrition knowledge group subjects prefer instant and fast foods. Park (2016) also reports that college students with higher nutrition knowledge consider nutrition information on cafeteria menus trustworthy and understandable, so they are more inclined to read nutrition information and choose healthier options in dining context.

Based on previous studies, this study also hypothesizes that providing concrete and straightforward knowledge on nutrition will lead to improved eating behaviours. While *healthy eating* is abstract and ambiguous concept for most consumers, translating it into easy and plain terms ("eat three Grains servings daily, and examples are two slices of bread, a rice bowl, and a noodle bowl", e.g.) will affect the consumer's *perceived behaviour control*, i.e., "people's perception of the ease or difficulty of performing the behaviour of interest" (Ajzen, 1991, p. 183). People tend to carry out a behaviour more frequently when they think it is easy to do. If they regard *healthy eating* as sufficiently fathomable and doable, they are more likely to follow recommended FBDGs.

Another hypothesis is that providing actionable goals to meet will lead to healthier eating behaviours. Specific examples of eating healthy in the KDRIs booklet and the Food Balance Wheel are a clear *reference value* as suggested in Control Theory (Carver & Scheier, 1982). If people are given sufficiently personalized food-based dietary guidelines, they can simply compare their current diets to the reference value and try to adjust, without struggling too much to find out what, how and how much to eat to stay healthy.

In summary, hypothesizing that educating adult consumers with concrete and actionable nutrition knowledge is conducive to healthier eating behaviours, this study (1) discusses inaccurate and insufficient information in the current *Food Balance Wheel* and (2) proposes an alternative dietary guideline model for improved communication. Before designing new models, the research team reviewed various FBDG models from all over the world for inspirations, as summarized in the following section.

2 Food-based Dietary Guidelines

Each country's FBDGs is designed considering the agricultural production system, culinary tradition, and lifestyle-induced health issues specific to the country. Visual styles (format, colour, and icon style, if there is any) of the guidelines differ, and in some countries, scientific studies were conducted during the development process to find out which style options are preferred by consumers or effective in communication; such findings are particularly insightful in the design of an alternative Korean FBDGs.

2.1 Formats: Pyramid, Pie, and Others

Visualization allows for an intuitive and progressive understanding of complex data, as diagrams shed lights on the conceptual structures of information (Oxman & Planning, 1997), and knowledge captured in a dynamic diagram can facilitate a group's decision-making process based on a shared understanding of given information (Eppler & Kernbach, 2016). FBDGs from various countries visualize current ideas of what constitutes a healthy diet in each country, and they elicit discussions through which the ideas evolve and develop.

Montagnese et al. (2015) reviewed FBDGs in 34 European countries and found that 67% of them are designed in the pyramid format. While the format is popular and considered familiar to many, in the U.S., it stirred a controversy of whether the food items in the top section is superior to others in nutrition as they are the highest in the vertical position, or you need to eat them in moderation because they occupy the smallest area (Perelman, 2011). Thanks to the lessons, recently developed pyramid-shaped FBDGs come with design elements to clarify it. For instance, Germans built a 3D Food Pyramid (Oberritter et al., 2013): a doughnut chart of six food groups is presented at the bottom and items in each group are listed on the four triangular sides. Less healthy items are placed higher and occupy smaller space than healthier options. A narrow, red–green spectrum printed on the side indicates which one is recommended to eat more. Japanese cleverly dodged this issue by turning a pyramid upside down to make it inversely conical (like a spinning top), so the smallest space goes to the bottom ("Japanese Food Guide Spinning Top", n.d.).

Other than the pyramid, pie charts (with the metaphor of a plate) are the second popular choice. One of them is the UK model, the Eatwell Guide, most recently revised in March 2016. In its development process, Hunt et al. (1995) tested 10 different designs of the model, made in combinations of three formats (pyramid, flat pie chart, or tiled pie chart), 2 colour schemes (multicolour or single colour), and two food item presentation styles (colour photos or line illustrations). With the participating public and nutrition educators, which design is preferred, more memorable, or communicates better are investigated. The study concludes that consumers prefer *the single-color tilted pie chart with food photos* design the most, and *the multi-colour pyramid with illustration* designs second most, but *the single-color tilted pie chart with food photo* design is also among the three least favoured designs, so the findings

are debatable. The findings—circular format is preferred to pyramid, and photos are preferred to illustrations—are, in fact, congruent with what Talati et al.'s qualitative study (2017) with Australian consumers concluded. Hunt et al. (1995) found, however, that the design of FBDGs is not significantly correlated to their communicating performance of food groups and proportionality, as much as the study subjects' gender, age, or their socio-economic groups do.

More format variants exist. The Hungarian model is drawn after a house of 5 sections. Larger rectangular areas are assigned to vegetable and grain groups, the smallest area of the chimney shows moderate intake of sugar and fat. The triangular roof is not entirely symmetrical – Meat area on the left is larger than Milk area on the right (Montagnese et al, 2015, p.210). The French model is a column chart metaphorically described as stairs. Each column is intuitively drawn in proportion to the amount of food intake from each group. People climbing up the stairs conveys two-fold messages: (1) importance of exercise and (2) reaching the goal of living healthy by eating more vegetables and keep hydrated on the last, highest column.

2.2 Korean Food Balance Wheel Model

In comparison to the American and European models, the Korean Food Balance Wheel model (Figure 2) is unique in format: a stick-figure person riding a bicycle. Functionally the model consists of two pie charts, the front wheel for water, and the rear wheel assigned to five food groups. It emphasizes regular physical activity as a critical part of a healthy lifestyle. While the key messages of balanced diet (diversity) and exercise were sufficiently communicated, the Food Balance Wheel performed poor in communicating how to eat healthy in Hong (2013)'s study with elementary school students, and the authors' own unpublished qualitative study with 35 adults. The model failed to accurately clarify the following information.

(a) personalization-moderation: the personalized recommendation of daily calorie intake. Being a static image, the Food Balance Wheel fails to individuate 37 cases (from 1000 to 2700 kcal) of personalized dietary patterns, i.e., recommended servings in 5 food groups. On the model, servings in each food group are written in range values (Figure 2, "2-4 times a day from the Grains group", e.g.), so it is open for arbitrary interpretation. As a result, the majority of Hong (2013)'s study participants answered they should eat three Grains servings per day as they habitually eat three meals daily, but female students' recommended Grains servings are 2 or 2.5.

(b) proportionality: the recommended ratio of food intake from each food group. In the Food Balance Wheel, slices are ordered from wide to narrow (Grains, Meat, Vegetables, Fruits, and Dairy) with exceptions of Meat and Vegetables. Such design of pie chart is misleading in two aspects:

- It is not clear what slice widths are proportionate to—the number of servings, weight of food, volume of food, or calories—though the slices appear to indicate how much to eat from each group.
- Current arranging order and slice size (Figure 4, Meat comes before Vegetables, and the Vegetable slice is only slightly larger than the Meat) can be misleading. In Hong (2013)'s study, some male students think they should eat more meat than vegetables, while both the recommended servings and weight are higher in the

Vegetables group (Figure 1). In authors' own unpublished study, most subjects also failed to read that they should eat more vegetables than meat from the Food Balance Wheel. Two possible causes are (1) the misleading design of Food Balance Wheel, and (2) the subjects' groundless belief that protein should take up about 30% of the daily calorie intake, while experts' recommendation is between 7-20% (Jung, 2015, p. 927).

In summary, the rear wheel in the bicycle model fails to communicate personalized dietary patterns, and its slice widths are misleading the audience.

(c) hydration: recommended daily water intake. On the Food Balance Wheel, how much water you should drink and if it includes water from food is not clarified. Hong (2013)'s study participants said drinking 500-1000ml of water was enough per day, while recommendations are 1900ml for girls and 2100ml for boys, including water from food (Jung, 2015, p.213). Here are interesting insights we gathered on how the two wheels are interpreted in the authors' own qualitative study:

Front wheel slices (12) are the cups of water you need to drink.

Rear wheel slices (6) are the cups of water you need to drink, one per each food group.

The ratio between front and rear wheel diameters is the water to food ratio.

The ratio between front and rear wheel areas is about 1:10, so....

Subjects who could not find any hints from the bicycle model simply answered "I cannot tell from the Food Balance Wheel, but I hear I need 2000 ml of water", as they heard from various news media. On hydration, the Food Balance Wheel is not informative but just confusing.

3 Food Balance Lunchbox: Alternative Models Development

In response to the weak performance of current Food Balance Wheel as a pie chart, the authors chose to develop an alternative model in constant-column width (hereafter CCW) treemap format. The new model is titled *Food Balance Lunchbox*, because of its two-dimensional structure of a square divided into five sections looks similar to the top view of typical lunchboxes sold in Korean convenient stores. Following design variables are considered.

(1) Proportionality visualization: Though widely used for visualizing frequency data, Cleveland and McGill (1984, as cited in Huestegge & Pötzsch, 2018) pointed out that a pie chart is complex as a shape thanks to its curved and straight lines, and the different orientations of pie slices (if the slices are not adjacent) add more cognitive difficulties of mentally rotating them prior to comparison (Figure 4). In contrast, previous studies report superiority of the bar chart and CCW treemap to the pie chart in quantity comparison (Huestegge & Pötzsch, 2018, p. 213). Column charts and CCW treemaps (Figure 5)—de facto column charts, you need to compare slice heights only—are:

- Simpler in shape
- They allow for one-dimensional comparison of length

- Higher space efficiency: labels can be placed within the chart.
- CCW treemaps also provide “additional visual anchors for proportion judgments” such as a quarter, a half as is in a pie chart

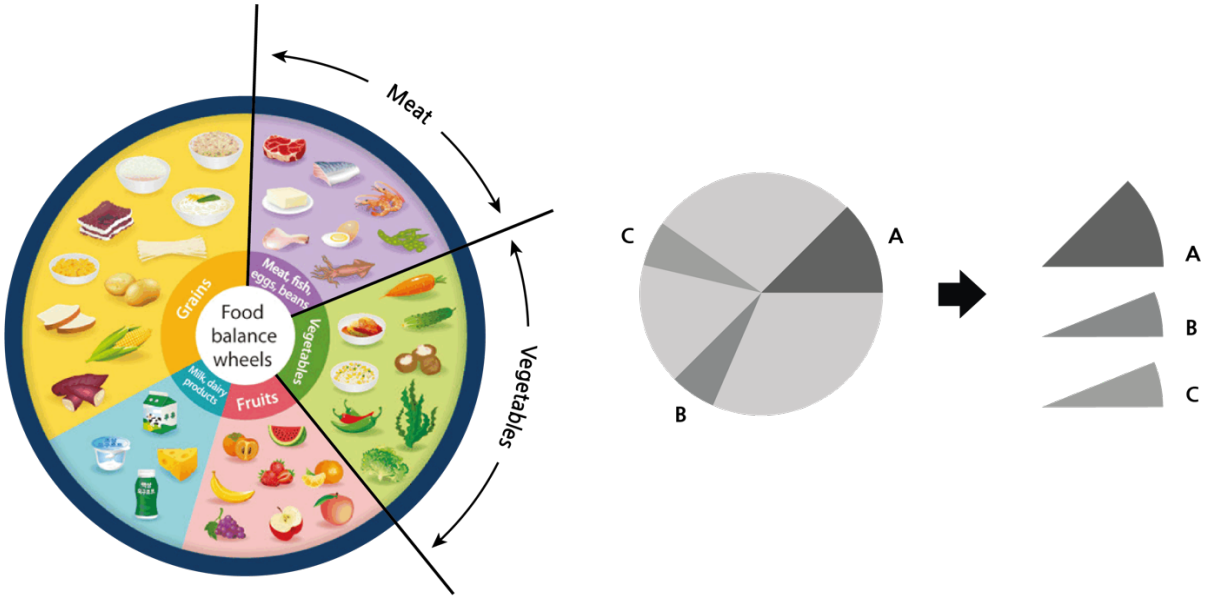

Figure 4. The current Food Balance Wheel and its cognitive issues. Current arranging order and slice size of five food groups are misleading (left). In the pie chart, slices require mentally rotating them prior to comparison (right).

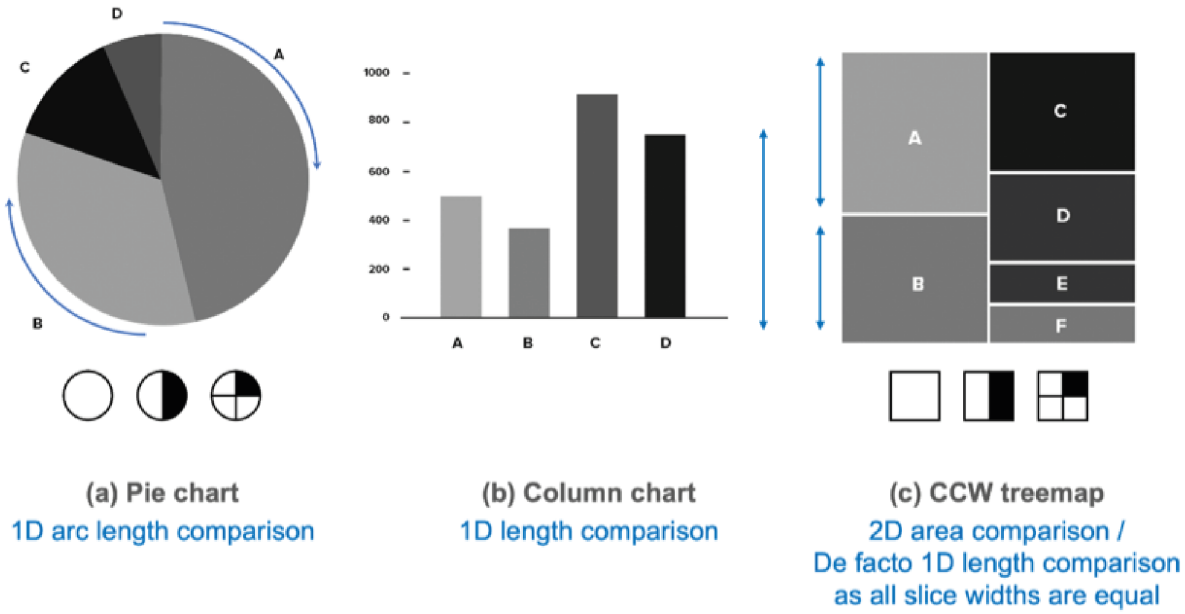

Figure 5. A comparison of pie chart, column chart, and CCW treemap formats. Pie chart and CCW treemap formats provide additional visual hints such as a half or a quarter. In the column chart and CCW treemap, labels look more organized.

Such findings inspired us to design the first alternative model in CCW treemap formats (Figure 6). For the print version, treemap areas are drawn in proportion to weight(gram) of a representative item in each food group—for example, a rice bowl (210g) in the Grains group—for the following reasons.

- Recommended dietary patterns are written in servings. A serving in five food groups are different in calories, which is unknown to most people: A Grains serving is 300kcal, a Meat serving is 100kcal, while a Vegetables serving is 15kcal. A serving in five food groups are also different in weight, depend on specific food items. Visualizing proportionality based solely on the number of servings can inaccurately illustrate the proportionality between food groups.
- Proportionality between food groups is best calculated in calories, but for consumers, estimating-calculating food calories in the dining context is difficult.
- When people eat, weight and volume are tangible and easy cues to guess serving sizes.

In the Food Balance Lunchbox, food group slice sizes are calculated in weight of the representative food of the group. Recommended daily servings are also written in each food group slice.

(2) Scalability for moderation-personalization visualization: The Food Balance Lunchbox in CCW treemap formats are also easier to be scaled up or down, for visualizing quantitative differences of 37 calorie cases. For example, three calorie cases of B1200kcal, B1700kcal, and B2500 kcal CCW treemaps will be drawn in different sizes (Figure 7, left).

(3) Photographic food icons for diversity and serving size representation: In place of current food illustrations, Food Balance Lunchbox shows colour photos of food items that accurately portray diverse food items to the last step of classification (rice, brown rice, or multigrain steamed rice, e.g.), instead of just saying “rice” for improved information granularity. We intentionally included items people might be mistaken about. For example, walnuts are rich in fat, but in KDRIs they are included to the Meat group as they also contain protein. The photos and labels (“Tomato, 100g”) also exemplify the recommended weight and volume of a serving (Figure 7, right).

(4) Information on hydration: In response to the confusion caused by the Food Balance Wheel (a water cup in the front wheel), a text description of recommended daily water intake in litre and a cup image is added on the right side (Figure 6), to clarify how much water you need, and whether that includes water from food and beverages (soup, juice, etc.).

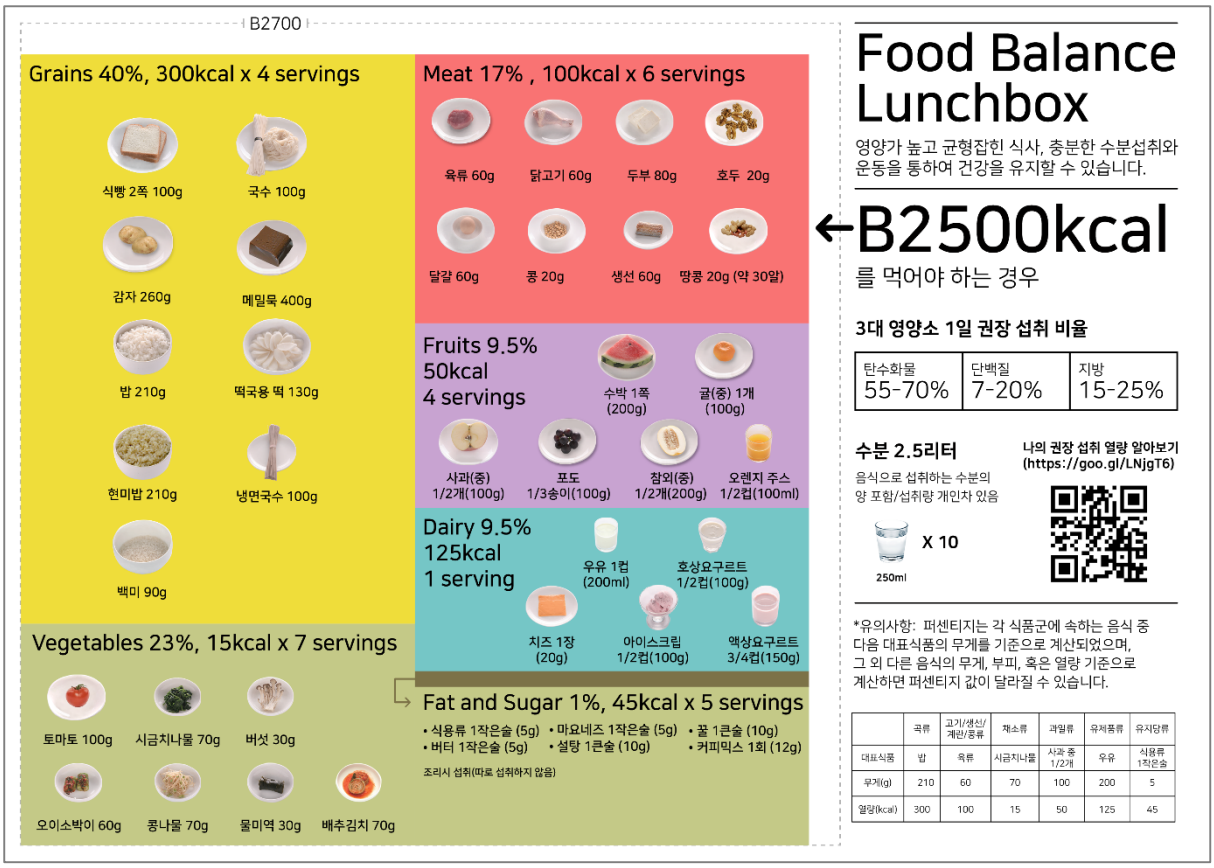

Figure 6. Food Balance Lunchbox: an alternative Korean FBDGs designed in the CCW treemap format. The text is partially translated from Korean into English for this paper.

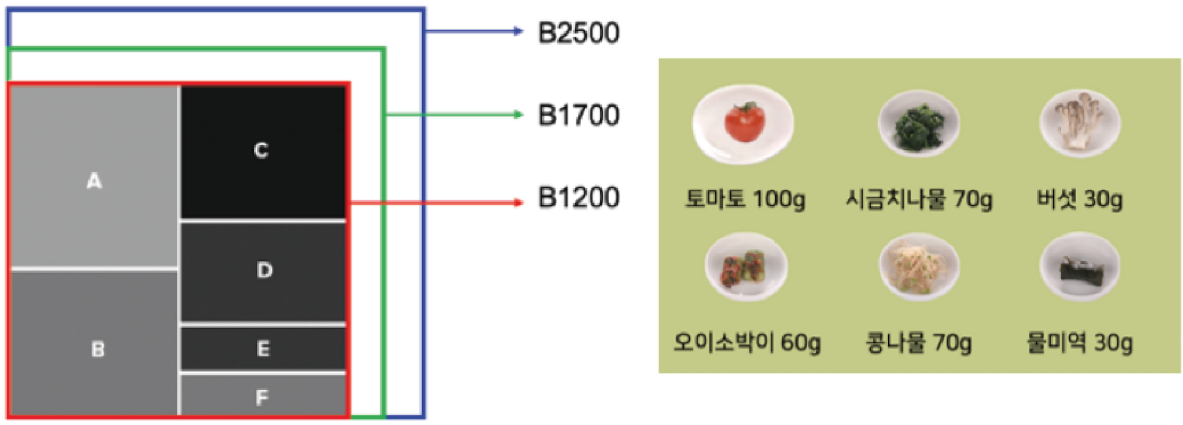

Figure 7. In the Food Balance Lunchbox, different calorie cases will be drawn in different sizes (left), and labelled food photos exemplifying serving sizes in volume and weight are provided.

4 Discussions: Improvements in the Alternative Design

4.1 Format

The biggest problem of current Food Balance Wheel lies in the pie chart format where proportion judgments (i.e., estimating the size of one element relative to the whole) and comparison judgments (i.e., comparing the size of two elements to judge which one is larger) are difficult, compared to other chart types (Huestegge & Pötzsch, 2018). These two tasks matter in that they are part of the audience's cognitive process of reading proportionality (i.e., how much you should eat from each food group per day). For Food Balance Lunchbox, we considered column chart and constant-column width treemap formats that are proven performing better than pie charts in length/area comparison, label alignment, space efficiency, and scalability.

The column chart (Figure 5, center) allows for quick one-dimensional comparison of length and easy label alignment. The white space created on the upper space can be utilized to accommodate more text information. In comparison, the treemap consists of rectangles of different areas, so two-dimensional area comparison is required, but still treemaps are proven to perform better at both proportion and comparison judgment tasks than the pie chart, as well as providing a natural label reading pattern than the circular array of labels around a pie chart (Huestegge & Pötzsch, 2018). As treemaps are rectangular in shape, their space efficiency is high and more information (food photos and labels, e.g.) can be inserted in the slices.

The CCW treemap (Figure 5, right) is a square-shape chart that comes with the benefits of column, pie and treemap charts altogether: (1) it allows for the ease of one-dimensional length comparison of a column chart, (2) it hints on "additional visual anchors for proportion judgments" such as a quarter, a half as is in a pie chart (Huestegge & Pötzsch, 2018, p.213), and (3) the high space efficiency of a treemap that allows for easy labelling and food photo display.

4.2 Concepts

In the Food Balance Lunchbox, **diversity, proportionality, moderation- personalization, and hydration** are better presented, compared to current Food Balance Wheel.

Diversity is illustrated in detail with various items in each food group. Food photos exemplifying serving sizes make the message concrete and actionable. As Montagnese et al. (2015, pp. 909-910) reported, in the world's FBDGs, the diversity concept is depicted on different abstraction levels. American, Italian and Hungarian FBDGs only present food group labels ("cereals", "milk", e.g.), so no efforts are made to exemplify food groups. The Finnish circle shows a typical public lunch catering meal of potatoes, fish, and vegetables served on a plate to contextualize the information better. German and UK models show specific food items in each food group.

In the Food Balance Lunchbox, the authors went a step further and visually exemplify a serving of each food item for improved **information granularity**, e.g., to distinguish *steamed white rice* from *steamed brown rice* (the latter contains more fibre and micronutrients and recommended as a better choice), and such a decision is grounded on the findings from an Australian qualitative study with 85 participants (Talati et al., 2017) that subjects in various

age groups preferred realistic photo images of food to cartoon-style drawings, because “you can actually tell what they are” (p. 173).

Also, the photos clarify how much steamed white rice is a serving of 300kcal, for **moderation-personalization**. Robinson et al. (2016) report that repeated exposure to large portion (not serving) sizes actually affect what consumers think a normal-sized food portion, and Marchiori, Papies, and Klein (2014) conclude that, due to anchoring effect, participants whose expected serving sizes are larger consume significantly more food than others, but Spanos, Kenda, and Vartanian (2015) conclude that informing consumers on how many servings are in the food portion reduce their food consumption. The authors hypothesize that repeated exposure to correct serving sizes of food can affect how much people eat, by enabling visual estimation of whether they are eating more than or less than recommended serving sizes. The concept of **moderation** is also expressed in the model’s (1) customized dimension (e.g., B1200, B1700 and B2500 models are different in areas (Figure 7, left), (2) exclusion of junk food from food examples, and (3) the **personalized recommendation** of daily calorie intake measured in servings (“7 Vegetable servings a day”).

The **proportionality** of six food groups is calculated based on the weight (grams) of a representative food items, instead of their calories, to assist people to estimate better in dining context. Volume is a good visual cue for consumers to know how much they are eating, but accurate volume measurement, comparison, and calculation is difficult for irregular forms of solid food, such as ribs or salad. Visual estimation of food weight in grams is not an easy task either, but the research team hypothesizes that it will be easier than accurately guessing the calories of what they eat. Zhou, Bell, Nusrat, Hingle, and Surdeanu (2018)’s study with 2028 subjects report poor performance on food calorie estimation; “average accuracy was 5 out of 20 correct guesses, where ‘correct’ was defined as a number within 20% of the ground truth”. In conclusion, the print version of the CCW treemap slices are calculated in weight, but the authors are now developing an online version of the model where people can switch units of percentage calculation between weight and calories.

Drinking water is an important part of healthy eating. Drinking water when you feel hungry can let you tell thirst and hunger, so it may contribute to a healthy weight-loss plan. Experts recommend drinking water on a schedule (“Hydration: Why It’s So Important.”, 2017). For **hydration** information, the problematic and misleading water cup in the Food Balance Wheel is replaced with more detailed text description on the right side. Comments on personal differences are added because each person needs different amounts of water to stay hydrated, and the difference between drinking plain water and indirect drinking from food is mentioned to call attention to the extra calories from sugary drinks and fruits.

5 Conclusions and Future Studies

In this study, the authors developed an alternative model of Korean FBDGs, Food Balance Lunchbox in the CCW treemap format, for improved communication of healthy eating for consumers. With the new FBDGs, we expect consumers living on currently unhealthy diet to accurately perceive (1) the concept of personalized dietary patterns, proportionality between five food groups and three macronutrients, food serving sizes, and hydration, and (2) eating healthy as something fathomable and doable daily activities.

Work done in this study is limited, however, because the Food Balance Lunchbox should be tested in a large-scale quantitative study to be proven helpful. In the future studies, first, another alternative model in the column chart format will be developed. Two designs will be tested in comparison with the Food Balance Wheel in a printed image format, in terms of clarity, memorability, and applicability of information.

Also, to improve on the limitation of a static image, interactive versions of the Food Balance Lunchbox are being developed, where consumers can (1) switch formats between column chart and CCW treemap according to their preferences, (2) switch units of proportionality calculation between grams and calories, to see the resulting changes in slice length and understand how the models work, and (3) customize food items in five food groups to make the list more practical in the grocery shopping and dining contexts.

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