

Analysis of Unhealthy Shopping Patterns at ASDA Morley: Consumer Profiling Based on Basket Types and Geographical Distribution

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Abstract

This study investigates consumer shopping behaviors at the ASDA Morley store, focusing on the healthiness of purchased products and the implications for public health policies and retail strategies. Utilizing transaction data from January to May 2023, the research categorizes customer shopping patterns and assesses the nutritional quality of purchases using the Nutrient Profiling Model (NPM). The analysis reveals that healthier options are often more expensive, aligning with broader UK trends, and identifies distinct shopping patterns that vary significantly by customer type and geographic location. The findings suggest that current policy interventions, such as nutritional labeling and tax reductions, have limited effectiveness, particularly among shoppers in economically deprived areas. The study highlights the need for more targeted and behavior-specific strategies to promote healthier food choices across diverse consumer segments.

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1. Introduction

Unhealthy diets are a significant problem in the UK, closely linked to the types of food purchased in supermarkets. The choices customers make are influenced by a complex array of factors. This study utilises transactional data from ASDA to capture authentic customer shopping behaviours, aiming to understand the drivers behind purchases of healthy and unhealthy foods. By categorising these behaviours, we can gain insights into long-term consumer trends and preferences.

The following research questions will guide the study:

- How do shopping patterns differ between the purchase of healthy and unhealthy foods?
- Are customers' shopping patterns consistently healthy, or do they vary over time?
- How does geographical location influence the likelihood of purchasing unhealthy food, and what is its relationship to overall shopping behaviour?

By understanding these behaviours in depth, we can formulate targeted policies to address the issues associated with unhealthy dietary choices.

2. Background and Context

2.1 The issue of healthy food in the UK

Unhealthy diets have become a significant public health concern in the UK. According to the 2021 report from the National Food Strategy, poor diets are responsible for approximately 64,000 deaths annually in England alone and impose an economic burden of around £74 billion. The UK Government (2022) outlines Latest data shows that around 64% of adults and 40% of children in England are overweight or living with obesity. A major factor contributing to unhealthy diets is the high cost of purchasing healthy food. The Food Foundation highlights that "healthy, nutritious food is nearly three times more expensive than obesogenic unhealthy products" when comparing calories.

This issue has been further exacerbated by the ongoing inflation crisis in Britain since 2022. An article by Reuters titled "Insight: In Britain's Inflation Crisis, Healthy Diets Are a Casualty" highlights that British households are increasingly burdened by rising energy costs and rents, which consume a substantial portion of their disposable income. Additionally, the prices of healthy foods have surged during this inflationary period. For example, fresh vegetables have seen a 14% price increase compared to the previous year, while other healthy foods such as fish and beef have risen by 15% to 22%, and the price of low-fat milk has surged by 42%. These factors collectively make it increasingly difficult for British households to maintain a healthy diet.

2.2 Defining Healthy Food: The Nutrient Profiling Model (NPM)

The Nutrient Profiling Model (NPM) was developed by the UK Food Standards Agency (FSA) in 2004/5 as a systematic tool to categorise foods based on their nutritional content. Initially designed to regulate food advertisements during children's television programming by identifying foods that should not be promoted due to their poor nutritional profiles, the NPM is crucial for distinguishing “less healthy” food and drink options. The model employs a scoring system that evaluates both non-alcoholic beverages and foods based on key nutritional components per 100 grams as sold.

The NPM considers a broad range of nutritional factors, including energy (calories), total sugars, saturated fat, sodium, and beneficial components such as fruits, vegetables, nuts, fiber, and protein. This model is unique in its comprehensive approach: it penalizes foods high in negative nutrients while rewarding those containing beneficial nutrients. Higher scores indicate foods that are less healthy, facilitating a clear distinction in the relative healthiness of food products.

The NPM is now used across various sectors of public health beyond television advertising, including product promotions in both physical stores and online shopping platforms. By defining "healthy food" through the NPM, this research aligns with a standardized and widely recognized model, providing a holistic view of food quality and ensuring that healthiness criteria are uniformly applied and understood within the context of current UK dietary regulations.

2.3 Supermarket and the Availability of Healthy Foods

In the UK, supermarkets are the primary shopping destination for most people, with 79% visiting at least once a week (Food Standards Agency, 2022). This frequent patronage underscores the significant influence supermarkets have on dietary habits. Supermarkets in the UK offer a wide range of choices, and consumer preferences for specific brands are shaped by factors such as pricing, product selection, and shopping experience.

Amidst the inflation crisis, discount supermarkets like Aldi and Lidl have gained popularity due to their economic pricing, experiencing a remarkable sales growth of over 23% in the 12 weeks leading up to May 14, according to Kantar. This growth rate far exceeds that of major supermarkets like Tesco and Sainsbury's, reflecting a consumer shift toward value-based shopping driven by the cost-of-living crisis. While Aldi and Lidl focus on deep discounts, ASDA represents a middle tier, offering competitive but not rock-bottom prices.

A 2023 report by the Food Standards Agency highlights that food prices have become the primary concern for UK consumers in 2022, with public concern in England, Wales, and Northern Ireland increasing from 22% in 2021 to 34% in 2022. Furthermore, to afford a diet that aligns with government health recommendations, 20% of households would need to allocate nearly half of their disposable income, in stark contrast to the wealthiest fifth, who would only need to spend 11%. This significant disparity underscores the urgent need for effective policies to support access to healthy foods.

2.4 Current Food Policies in the UK

The Food Foundation (2022) presents compelling arguments for a shift in the nation's food policies to ensure that everyone in the UK has access to healthy food. In 2019, the government implemented restrictions on the promotion of products high in fat, sugar, and salt (HFSS) in medium and large stores. These restrictions prevent such products from being sold through promotions like "buy one get one free" or "3 for 2" deals and prohibit their prominent display at checkouts or store entrances.

To further encourage healthier choices in supermarkets, the government introduced calorie labelling regulations that require large food retailers and out-of-home food businesses to display calorie information on menus and food packaging (Department for Environment, Food & Rural Affairs, 2022). Borgmeier and Westenhoefer (2009) found that multiple traffic light labels were the most effective at helping consumers identify healthier options, but the overall impact on food choices was still minimal. Turnwald and Crum (2019) suggest that taste-focused labeling may be more effective than health-focused labeling in promoting healthy food choices. Similarly, Grunert and Wills (2007) support the idea that simplified labels are more appealing to consumers, but note that it remains unclear whether label use directly influences purchasing behavior.

Additionally, the government has promoted greater transparency in the food system by encouraging retailers to provide clearer information on the healthiness and sustainability of their products. This includes initiatives like the Food Data Transparency Partnership, which aims to make data on food production practices and nutritional content more accessible to consumers.

Together, these policies aim to create a supermarket environment that encourages healthier food choices and makes it easier for consumers to access nutritious, affordable products. However, there remains room for improvement in these policies to further enhance their effectiveness.

2.5 Customer Behaviour in Healthy Shopping

Customer food choices are influenced by various factors. A pan-European survey of consumer attitudes towards food found that the top five influences on food choice in 15 European member states were: "quality/freshness" (74%), "price" (43%), "taste" (38%), "trying to eat healthy" (32%), and "what my family wants to eat" (29%).

Research indicates that customers with lower incomes and educational backgrounds are more likely to have higher obesity rates. Studies also show that price promotions tend to increase the purchase of unhealthy foods. However, 44% of consumers are willing to pay about 9% more when purchasing health and wellness food products. This willingness to pay is significantly influenced by factors such as education, income, and health consciousness. Additionally, product attributes like quality, taste, packaging, and price play a significant role in influencing this willingness. Changes in retail store formats further affect the willingness to pay for health and wellness food products.

Despite the growing interest in customer behaviour, current research predominantly focuses on profiling customers based on their socio-demographic characteristics rather than examining their actual shopping behaviours. There is also a tendency to use obesity rates or other health indicators as proxies for unhealthy food choices. However, these health outcomes are influenced by a range of factors, and using them alone to assess the healthiness of food choices may not be the most accurate approach.

Furthermore, many studies rely on questionnaires to understand consumer behaviour. While useful, these subjective responses can sometimes diverge from actual behaviours, potentially leading to biased results. For instance, individuals may have different definitions of what constitutes healthy food, affecting the reliability of self-reported data. Moreover, there is limited research examining the relationship between the frequency of supermarket visits and the healthiness of food choices. My research addresses these gaps by focusing on actual transaction data, providing a more accurate reflection of customer behaviour and offering insights that go beyond socio-demographic profiling.

3. Overview of Research

3.1 Study Setting

This study, conducted in collaboration with ASDA, seeks to analyse and understand actual customer shopping behaviour, particularly regarding the purchase of healthy versus unhealthy foods. The ASDA Morley store was chosen as the study site due to its diverse demographic profile and its location within areas identified as high-priority for food security improvement by the Priority Place for Food Index (PPFI), a tool developed by the Consumer Data Research Centre (CDRC) to assess food insecurity in the UK. ASDA's focus on providing affordable products makes it an ideal setting for examining the shopping behaviours of customers with varying budgets.

The study is based on detailed customer transaction data from ASDA, covering the period from January 1st to May 31st, 2023. This dataset provides a unique opportunity to investigate real consumer behaviour, offering insights into shopping patterns, particularly regarding the purchase of healthy versus unhealthy foods.

3.2 Definition of Healthy Food/Drink, Healthy Baskets, and Healthy Customers

The concept of "healthy food" in this study is defined using the Nutrient Profiling Model (NPM). According to this model, foods scoring 4 or more points and drinks scoring 1 or more points are classified as "less healthy". Given the differing thresholds for food and drink, scores are standardised for analysis: a score above 0 indicates an unhealthy product, while a score below 0 indicates a healthy one. The higher the score, the less healthy the product is deemed.

A "basket" refers to the collection of items purchased by a customer during a single shopping session. The healthiness of a basket is determined by summing the standardised NPM scores

of all products within it; a basket with a score above 0 is considered unhealthy. This method allows for an assessment of individual shopping behaviours based on the healthiness of the items purchased.

A customer's overall healthiness is determined by averaging the health scores of all their baskets throughout the study period. This average score provides a comprehensive view of the healthiness of different customer types and helps address the research question of whether shopping patterns are consistently healthy or vary over time.

3.3 Analysis of Basket Types

Baskets are categorised based on several key features, including total spending, discounts, health scores, and the number of products. By identifying distinct purchasing patterns within these baskets, the study explores what drives consumer choices towards healthier or less healthy options. This analysis directly addresses the research question of how shopping patterns influence the purchase of healthy versus unhealthy food.

3.4 Analysis of Customer Types

Customers were categorised using two methods based on their shopping behaviour: basket composition and visiting frequency. The first method examines the types of baskets customers typically use, while the second focuses on how often they visit the store. This dual approach helps determine whether customers consistently maintain unhealthy shopping habits or if their choices vary over time, thereby addressing the second research question.

Visiting frequency is measured using two metrics: the average number of visits per week and the total number of visits over the study period. The average weekly visits metric offers insight into how frequently a customer shops, while the total visits metric identifies whether a customer is an occasional shopper or a frequent visitor. These insights are critical in understanding the consistency of shopping patterns over time.

3.5 Geographical Distribution of Customers

Following the analysis of shopping behaviours and visiting frequency, the study examines the geographical distribution of customers to determine whether those from certain postcode districts are more likely to purchase unhealthy foods and how this relates to their overall shopping behaviour. This analysis is particularly relevant to the third research question regarding the influence of geographical location on purchasing habits.

Due to data limitations—namely, not all customers had registered their postcodes—the geographical analysis focused only on postcode districts with more than 30 customers and over 340 transactions. The seven districts included are BD11, LS10, LS11, LS12, LS27, WF17, and WF3.

The geographical findings were then compared with the Index of Multiple Deprivation (IMD), Priority Places for Food Index (PPFI), and other demographic factors to provide deeper insights into the factors influencing unhealthy shopping behaviours and visiting

frequency. This comparison helps to contextualise the relationship between geographic location and overall shopping behaviour, thereby enriching the understanding of the study's findings in line with existing literature.

4. Discussion of Key Findings

4.1 The Healthiness of Products at ASDA Morley Store

The ASDA Morley store offers a wide selection of 12,630 products, with around 60% classified as unhealthy. Out of the 4,899,712 items sold, customer purchases of healthy and unhealthy products are nearly evenly split, although unhealthy products are still sold more frequently.

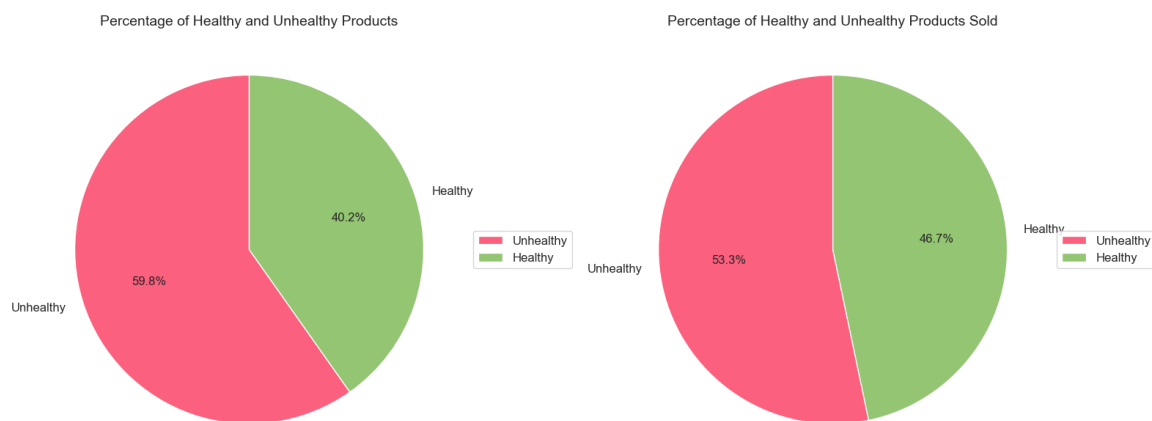


Figure 1: Percentage of Healthy and Unhealthy Products Sold

Figure 2: Percentage of Healthy and Unhealthy Products

Given that customer purchasing behavior is influenced by various factors, especially product price, the relationship between price, discount, product healthiness, and food healthiness across different categories is further explored.

Is Healthy Food More Expensive?

Contrary to the Food Foundation report (2022), which states that nutritious food is nearly three times more expensive than obesogenic unhealthy products, **at ASDA Morley store, healthy food isn't more expensive than unhealthy food; in fact, the average prices are quite similar.** The average price of healthy food is £2.40, compared to £2.70 for unhealthy food. While the averages are close, the price distributions differ statistically, mainly due to higher-priced items within the unhealthy food category. This finding challenges the common assumption that healthy food is more expensive. Overall, both healthy and unhealthy products at ASDA Morley are similarly affordable.

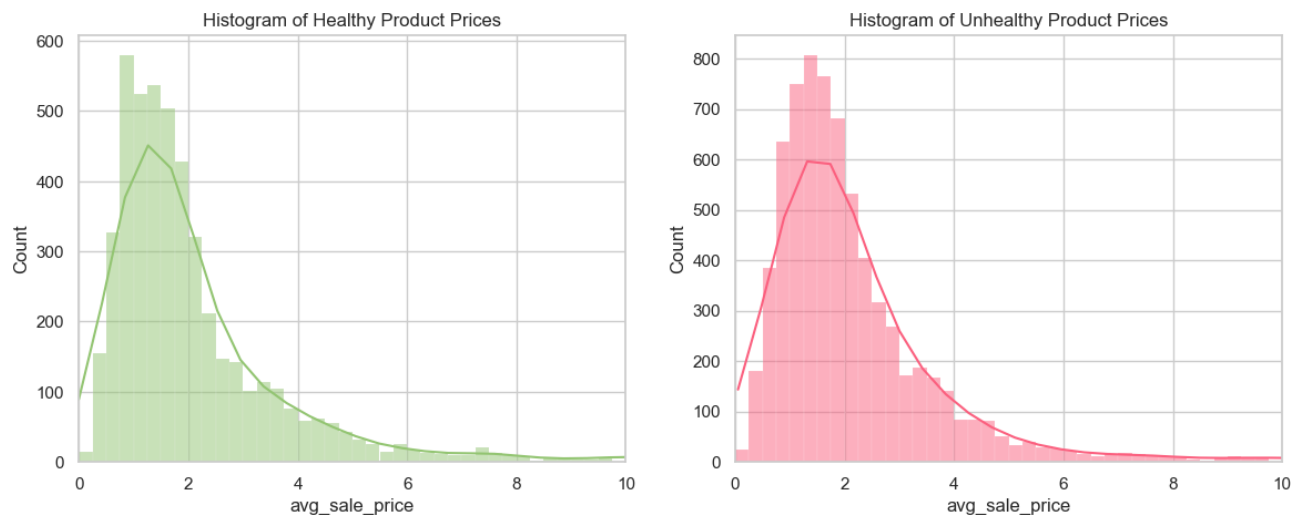


Figure 3: Histogram of Healthy and Unhealthy Product Discounts

Do Unhealthy Foods Receive More Discounts?

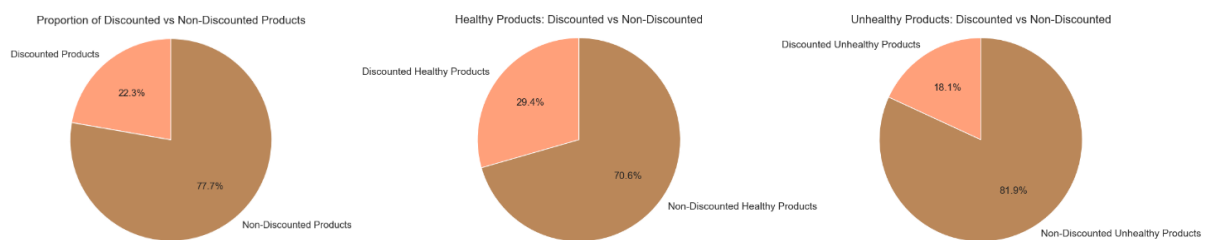


Figure 4: Proportion of Discounted vs. Non-Discounted Products

Figure 5: Healthy Products: Discounted vs. Non-Discounted

Figure 6: Unhealthy Products: Discounted vs. Non-Discounted

Also, contrary to common belief, healthy food at ASDA Morley store tends to receive a higher discount percentage, with a broader range of discounts compared to unhealthy food. Approximately 22% of the products in the store are discounted, with healthy products being more likely to receive discounts (30%) compared to unhealthy products (18%). When discounts are applied, the average discount percentage across all products is 15.67%. Healthy food enjoys a slightly higher average discount (17%) compared to unhealthy food (14%). However, despite similar average discount percentages, the distribution of discounts differs statistically: discounts on healthy food range from low to high, whereas discounts on unhealthy food tend to be on the lower end.

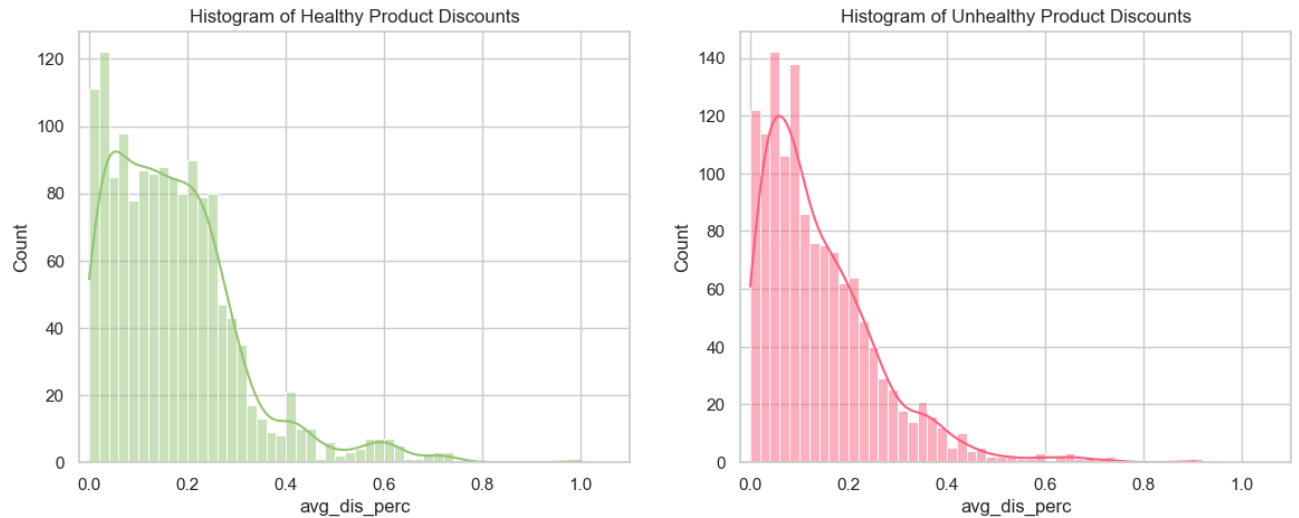


Figure 7: Histogram of Healthy and Unhealthy Product Discounts

4.2 The Uneven Health Score in Different Categories

Looking beyond the overall product range, an analysis of the average NPM scores for food and drink categories reveals that, among the 31 categories considered, only 5 have an average NPM score below 0, indicating they are healthy. The most unhealthy categories are "Pre-Packaged Cheeses," "Chilled Cakes," and "Cookies & Biscuits," while the top three healthiest categories are "Fresh Salads," "Fresh Potatoes," and "Chips, Potatoes & Vegetables." The difference between the most healthy and the most unhealthy categories is a substantial 25 NPM score.

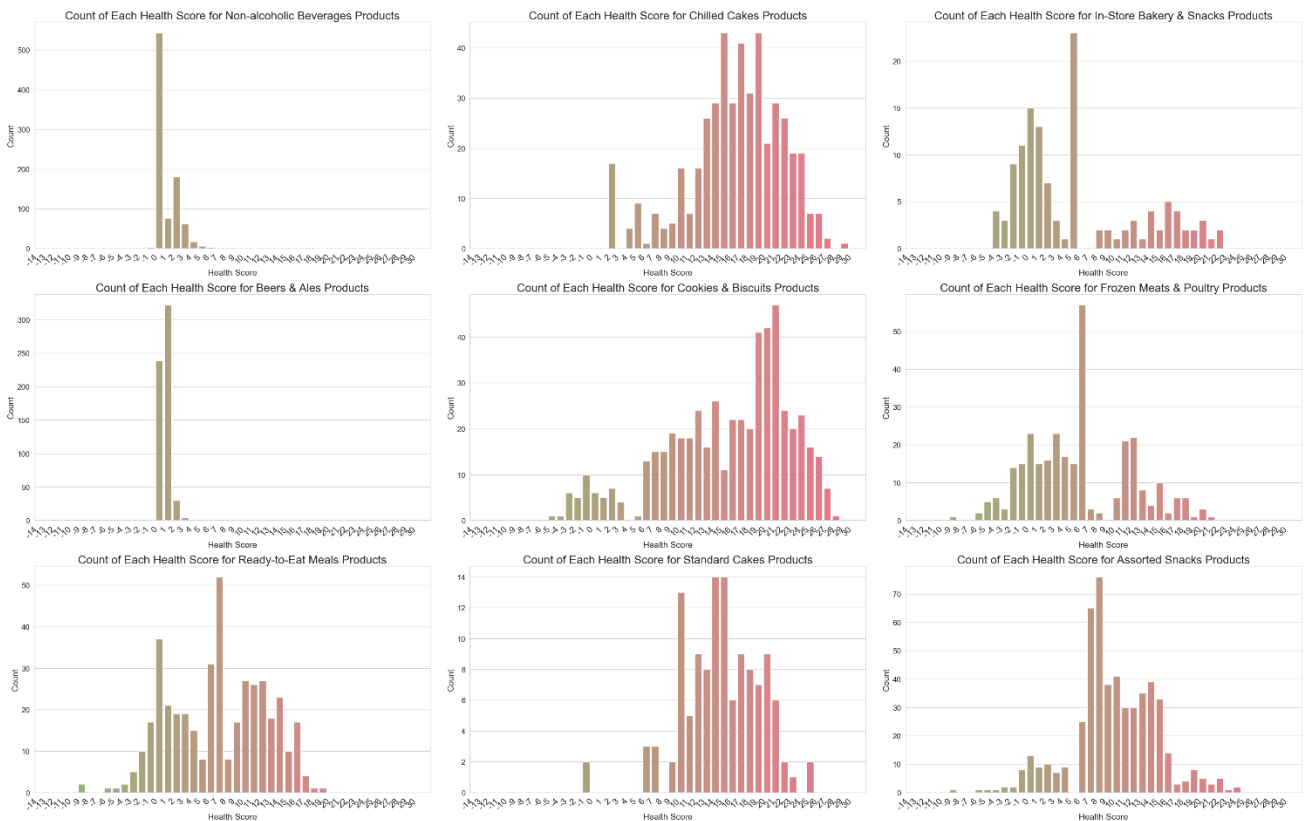


Figure 8: Count of Health Scores for Products Across All Categories (Full distribution details available in the Python Notebook)



Figure 9: Average NPM Score by Food and Drink Category at Morley Store

The average NPM score in different category varied.

Rank	Unhealthy Category	Average NPM Score	Rank	Healthy Category	Average NPM Score
1	Pre-Packaged Cheeses	18.07	27	Chips, Potatoes & Vegetables	-0.2
2	Chilled Cakes	15.83	28	Fresh Potatoes	-2.55
3	Cookies & Biscuits	14.96	29	Fresh Salads	-2.66
4	Standard Cakes	14.19	30	Specialty Fruits & Nuts	-4.44
5	Cooking Condiments	10.95	31	Fresh Vegetables	-7.38
6	Desserts and Ice Cream	10.07			
7	Pre-Packaged Cooked Meats	9.7			
8	Fresh Pizza	9.66			
9	Assorted Snacks	9.2			
10	Pre-Packaged Pies	9.18			

Table 1: Average NPM Scores for Unhealthy and Healthy Product Categories

Although ASDA Morley offers a higher number of unhealthy products, the price difference between healthy and unhealthy food is minimal, with unhealthy products often priced higher. Additionally, healthy foods not only receive more discounts but also benefit from a broader range of discount percentages. These pricing and discount strategies are a positive step toward promoting healthier options. However, most categories in the store still have an unhealthy average NPM score, indicating that there is room for improvement in the store's overall product offerings.

4.3 Meat Choices as an Example of Comparing Healthy and Unhealthy Options

While the overall prices and discount percentages for healthy and unhealthy products do not differ significantly, there are price variations within the same product categories that may limit customers' choices.

Taking meat as an example, there are four main categories available at the store: "Brought-In Fresh Meat," "Frozen Meats & Poultry," "Brought-In Bacon & Sausages," and "Pre-Packaged Cooked Meats." All of these categories have unhealthy average NPM scores. "Pre-Packaged Cooked Meats" has the highest average NPM score, indicating it is the least healthy option, yet it also has the lowest average price and the highest sales volume. In contrast, the relatively healthier "Brought-In Fresh Meat" category has an average sale price that is nearly double that of "Pre-Packaged Cooked Meats." This observation aligns with The Food Foundation's report that healthy food is more expensive than unhealthy food.

Category	Average NPM Score	Average Sale Price (£)	Average Quantity Sold
Pre-Packaged Cooked Meats	9.7	1.96	339
Brought-In Bacon & Sausages	9.05	2.37	240
Brought-In Fresh Meat	5.43	4.38	253
Frozen Meats & Poultry	5.15	3.45	254

Table 2: Comparison of Average NPM Scores, Sale Prices, and Quantities Sold for Different Meat Categories

Among the top five best-selling meat products in the store, only the first one, "Lean Beef Mince" in the "Brought-In Fresh Meat" category, is considered healthy, while the others significantly exceed the healthy threshold (NPM score > 4).

Product Name	Brand Name	Category	NPM score	Healthy? (Y/N)	Average Sale Price (£)	Total Quantity Sold
Lean Beef Mince (Typically Less Than 5% Fat)	ASDA Butcher's Selection	Brought-In Fresh Meat	-2.0	Y	3.37	11,563

10 Unsmoked Back Bacon Rashers	ASDA Butcher's Selection	Brought-In Bacon & Sausages	14.0	N	1.85	11,004
10 Smoked Back Bacon Rashers	ASDA Butcher's Selection	Brought-In Bacon & Sausages	14.0	N	1.85	7,999
Thick Sliced Corned Beef 4 Slices	ASDA	Pre-Packaged Cooked Meats	14.0	N	1.42	6,001
6 Thick Cut Unsmoked Back Bacon Rashers	ASDA Butcher's Selection	Brought-In Bacon & Sausages	14.0	N	1.80	5,591

Table 3: NPM Scores, Health Status, and Sales Data for the Top Five Best-Selling Meat Products

This suggests that while making their selections, customers' choices may be influenced by price, potentially leading them to opt for less healthy options.

4.4 The Customer Choice in Healthiness and Their Shopping Behavior

Four Distinct Basket Types in ASDA Morley Store

The transaction data at ASDA Morley Store reveals four distinct shopping behaviours, each represented by a specific basket type. These basket types are named according to their shopping characteristics: Premium Health (Type 0), Economy Less Healthy (Type 1), Moderate Balance (Type 2), and Value Discount (Type 3).

The most common is the **Economy Less Healthy (Type 1)** basket, which accounts for over 65% of all shopping sessions. This basket type is characterized by the highest standardised NPM score, indicating it is the least healthy. These baskets also have the lowest total spending and the fewest products, with healthy items comprising only one-third of the total products.

On the other hand, the **Premium Health (Type 0)** basket, which represents 8.3% of all baskets, is the healthiest. It has a significantly lower health score than the other types, the highest total spending, and the largest number of products. Notably, nearly half of the items in these baskets are healthy. The **Moderate Balance (Type 2)** basket, accounting for 23.1% of shopping sessions, strikes a balance between healthy and unhealthy products, with moderate spending and a mid-range health score. Lastly, the **Value Discount (Type 3)** basket, which makes up 3.2% of all baskets, is focused on discounts. Although this type has the highest average discount (14.7%), it is the second least healthy of the four basket types.

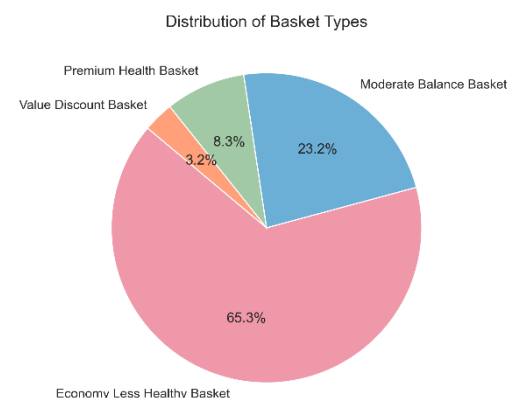


Figure 10: Distribution of Basket type

Basket Type	0	1	2	3
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Basket Name	Premium Health	Economy Less healthy	Moderate Balance	Value Discount
Number of Baskets	30,775 (8.3%)	241,276 (65.3%)	85,297 (23.1%)	11,889 (3.2%)
Standardised NPM Score	-20.49	-0.69	-7.0	-4.09
Total Spending	69.02	9.22	35.23	46.86
Total Discount	-2.25 (3.2%)	-0.26 (2.8%)	-0.97 (2.7%)	-6.87 (14.7%)
Number of Products	43.62	5.17	21.19	27.71
Proportion of Healthy Products	19.67 (45.09%)	1.74 (33.66%)	8.53(40.25%)	9.74(35.15%)
Percentage of Unhealthy Baskets per Type	2.42%	36.41%	16.46%	27.13%

Table 4: Characteristics of Different Basket Types by Healthiness, Spending, and Product Composition

The analysis indicates that Type 1 (Economy Less Healthy) baskets contain a higher proportion of unhealthy items compared to other types, suggesting that this shopping behaviour is more likely to result in unhealthy purchases. In contrast, Type 0 (Premium Health) baskets have the lowest proportion of unhealthy items, indicating a stronger preference for healthier shopping choices.

Overall, shopping behaviors

associated with Type 1 (Economy Less Healthy), characterized by lower spending and fewer products, are more likely to result in unhealthy baskets compared to those associated with other types.

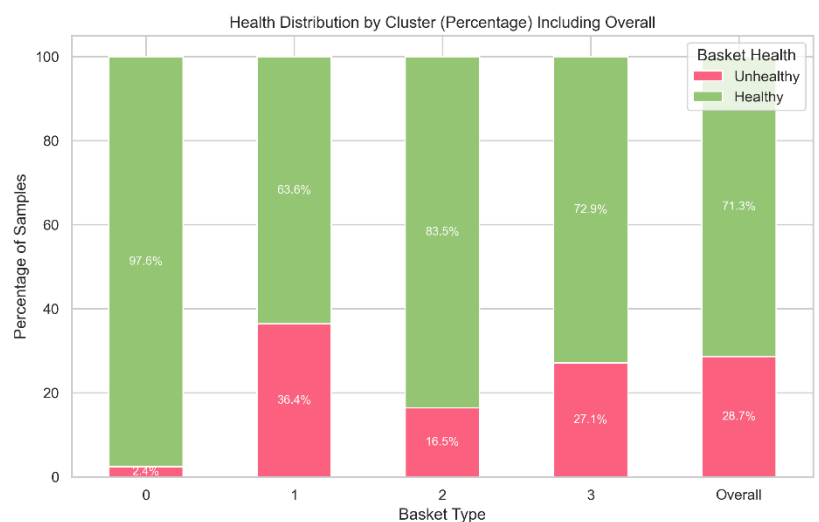


Figure 11: Health Distribution by Basket Cluster

Insights into Customer Shopping Behaviour from Basket Composition

The analysis of shopping behaviour through basket composition reveals the distribution of various basket types. It is noteworthy that **customers do not consistently adhere to a single basket type**; rather, their basket compositions vary. Customers who primarily use **Basket Type 1 (Economy Less Healthy)** are unlikely to also use **Basket Type 0 (Premium Health)**, indicating that those who tend to choose healthier products are less likely to have unhealthy baskets. On the other hand, **Basket Type 3 (Value Discount)** suggests that discount-driven shopping is not strongly linked to the other basket types.

The plot illustrates the top 30 most common customer shopping behaviour compositions at ASDA Morley Store, with the **top four combinations alone accounting for more than half of the observed patterns**.

Basket Type 1 (Economy Less Healthy) and Basket Type 2 (Moderate Balance) emerge as the most frequently observed, appearing in various combinations and constituting approximately half of all

customer behaviours. This suggests that the majority of customers tend to purchase a limited number of products with moderate spending, where health considerations may not be the primary focus.

Basket Type 0 (Premium Health), representing the healthiest shopping behaviour, typically appears in only 10-20% of basket combinations when it does occur. In contrast, Basket Type 3 (Value Discount) is the least prevalent among the popular basket combinations, generally not appearing until after the top 15, and features in only 10-20% of cases. Overall, the findings suggest that while health-conscious shopping exists, it is not the predominant behaviour among the majority of customers.

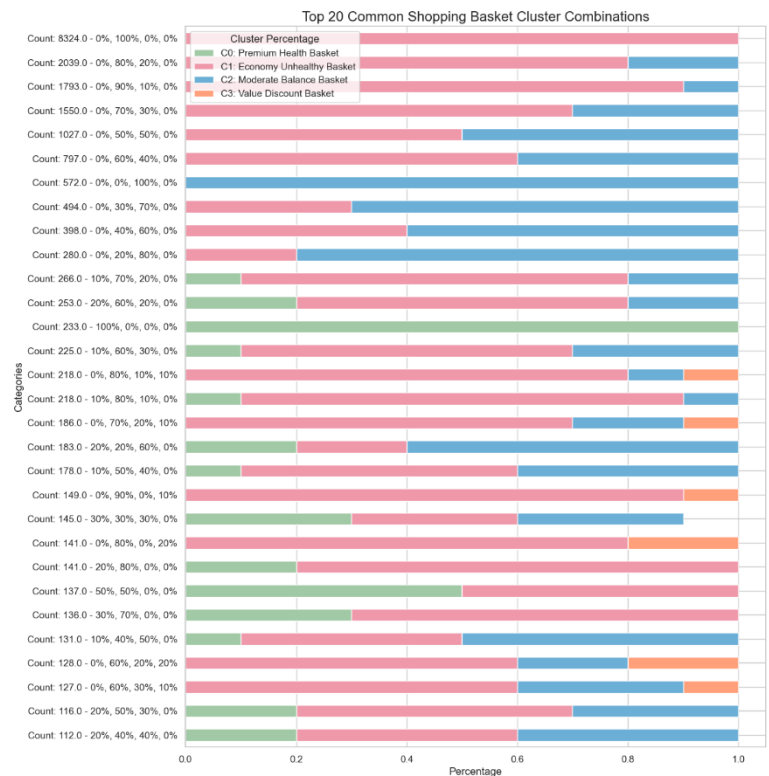


Figure 12: Top 20 Common Shopping Basket Cluster Combinations

Four Distinct Customer Types by basket type composition

Basket composition offers valuable insights into customer shopping habits. Customers were categorised into four distinct types based on the contents of their baskets, each reflecting different purchasing behaviours: Health-Conscious Shoppers (Type 0), Cost-Driven, Less-Health-Conscious Shoppers (Type 1), Cost-Conscious Balanced Shoppers (Type 2), and Balanced Economy Shoppers (Type 3). Approximately 40% of customers fall into the Cost-Driven, Less-Health-Conscious (Type 1) category, while around 10% are identified as Health-Conscious Shoppers (Type 0).

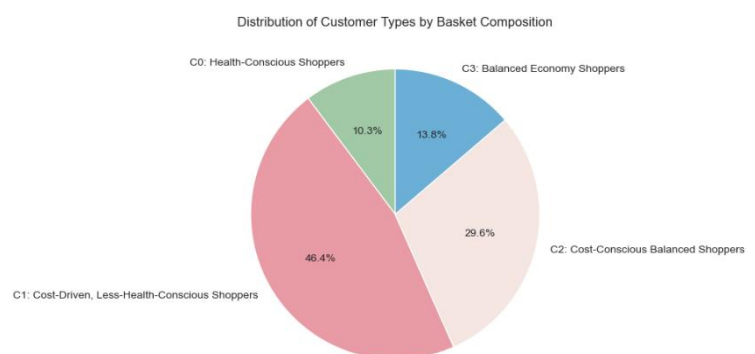


Figure 13: Distribution of Customer Type by Basket Composition

Customer Type	0	1	2	3
Customer Type Name	Health-Conscious Shoppers	Cost-Driven, Less-Health-Conscious Shoppers	Cost-Conscious Balanced Shoppers	Balanced Economy Shoppers
Number of Customers	2739 (9.45%)	12,341 (42.68%)	3664 (12.66%)	7,877 (27.22%)
Basket Type 0: Economy Less healthy	19%	94%	58%	19%
Basket Type 1: Premium Health	50%	1%	5%	7%
Basket Type 2: Moderate Balance	18%	4%	31%	68%
Basket Type 3: Value Discount	9%	1%	4%	5%
Percentage of Unhealthy Customer per Type	3.9%	30.7%	13.9%	12%

Table 5: Customer Type Distribution by Basket Composition

These shopper types exhibit markedly different behaviours. For Cost-Driven, Less-Health-Conscious Shoppers (Type 1), the Economy Less Healthy basket dominates, with 94% of their purchases in this category. This group is characterised by lower spending, fewer products, and minimal focus on health. In contrast, other shopper types display more diverse purchasing patterns, often incorporating a mix of basket types. Cost-Conscious Balanced Shoppers (Type 2) primarily use the Economy Less Healthy basket but also include more balanced shopping in their habits. Health-Conscious Shoppers (Type 3) most frequently choose the Premium Health basket, although 20% of their purchases still consist of the Economy Less Healthy basket.

Overall, 20% of customers in the store are classified as unhealthy. The Cost-Driven, Less-Health-Conscious Shoppers (Type 1) group is the only type with a higher percentage of unhealthy customers (31%) than the store average, indicating a strong tendency towards unhealthy shopping behaviour. Conversely, only 4% of Health-Conscious Shoppers (Type 0) are classified as unhealthy. In conclusion, **Cost-Driven, Less-Health-Conscious Shoppers (Type 1) exhibit the unhealthiest shopping behaviour, while Health-Conscious Shoppers (Type 0) represent the healthiest.**

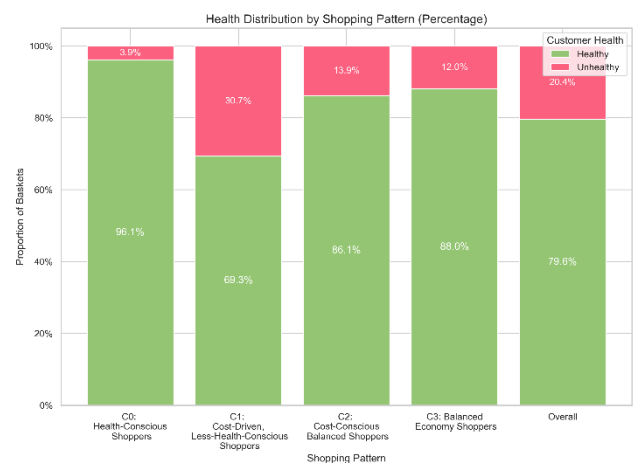


Figure 14: Health Distribution of Customer Types by Shopping Pattern

4.5 Three Distinct Customer Types by visiting frequency

Customers were categorised into three distinct types based on their visiting frequency: occasional shoppers, frequent shoppers, and consistent shoppers. **Occasional shoppers visit the store approximately once every three weeks. Frequent shoppers make regular visits, averaging about two purchases per week, while consistent shoppers visit even more frequently, with around four purchases per week.**

Occasional shoppers are the most prevalent, accounting for over 80% of the customer base, whereas only 2.3% of customers fall into the consistent shopper category.

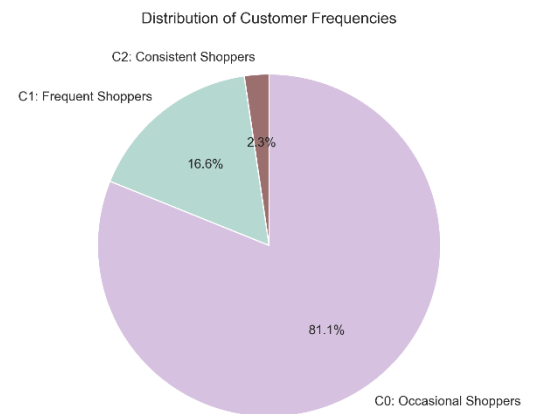


Figure 15: Health Distribution of Customer Types by Visiting Frequency

Customer Type	0	1	2
Customer Type Name	Occasional Shopper	Frequent Shoppers	Consistent Shoppers
Number of Customers	21,591 (81.1%)	4,412 (16.6%)	618 (2.3%)
Average Baskets per Week	1.18	2.01	4.22
Total Baskets per Week	0.35	1.45	3.82
Description	Infrequent visitors, making few purchases as needed	Regular visitors, making about two purchases per week.	Highly engaged, with consistent and frequent purchases nearly every week.
Proportion of Unhealthy Customers per Type	21.9%	14.3%	11.8%

Table 6: Customer Type Distribution by Visiting Frequency

Despite being the least common, consistent shoppers have a higher proportion of healthy customers compared to the other groups. In contrast, occasional shoppers, who form the majority, have the lowest proportion of healthy customers. This suggests that more frequent store visits are associated with healthier shopping habits.

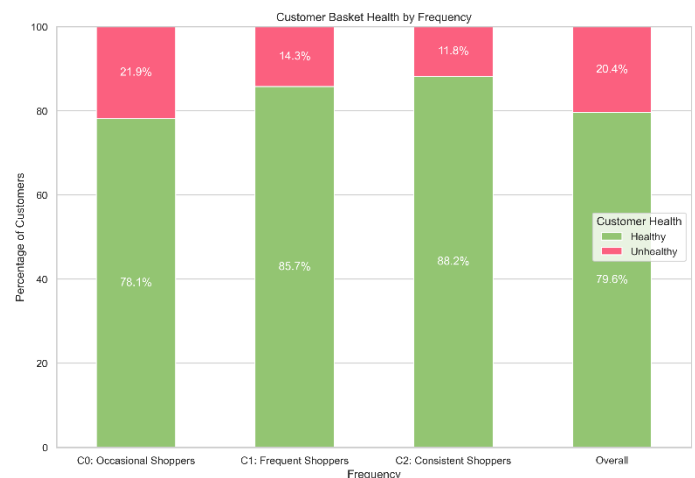


Figure 16: Distribution of Customer Type by Visiting Frequency

4.6 Geographical Distribution of Customer Types Compared with IMD, PPFI, and Demographic Data

The ASDA Morley store is located in postcode district LS27, which has the highest number of customers. Nearby areas such as WF17 and WF3 also have a relatively high customer count due to their proximity to the store.

Postcode District	Number of Customers	Number of Transactions
BD11	35	623
LS10	56	563
LS11	30	439
LS12	35	445
LS27	223	5,403
WF17	79	1,081
WF3	88	2,080
Total	546	10,634

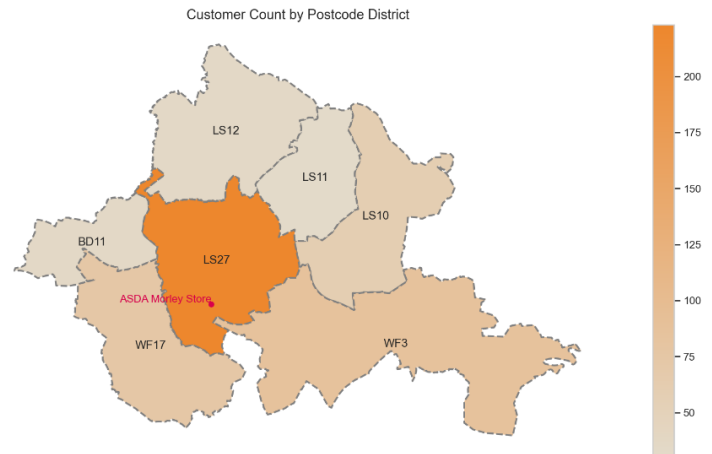


Table 7: Customer and Transaction Count by Postcode District

Figure 17: Customer Counts by Postcode District

After identifying the customer types most inclined towards unhealthy shopping (Cost-Driven, Less-Health-Conscious Shoppers - Type 0) and those with a tendency towards healthier choices (Health-Conscious Shoppers - Type 3), maps were created to display their geographical distribution by postcode district.

From the maps, LS10 stands out as the only postcode where the percentage of Cost-Driven, Less-Health-Conscious Shoppers exceeds the overall percentage, and it also has the lowest proportion of Health-Conscious Shoppers. This suggests that residents in LS10 tend to have less healthy shopping behaviours. In contrast, shoppers in LS11 show a higher inclination towards healthier food choices ; however, it is crucial to consider that the sample size from LS11 consists of only 30 customers, which may limit the reliability of these findings.

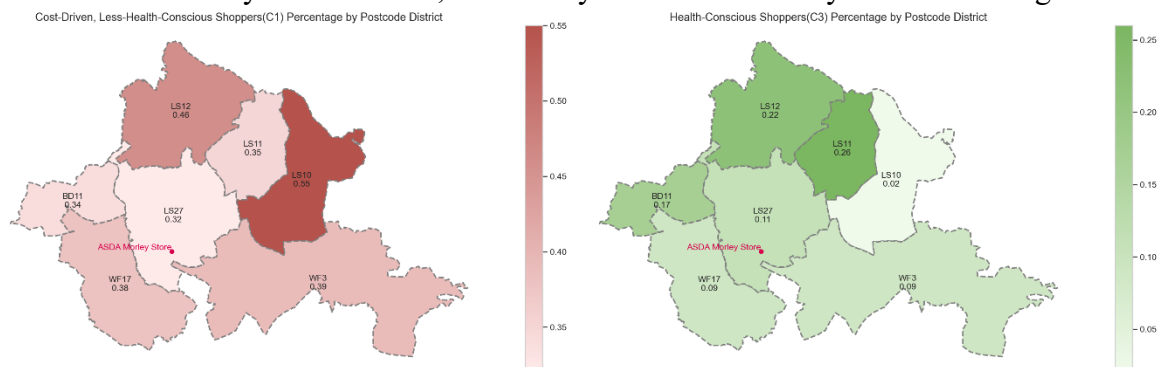


Figure 18: Cost-Driven, Less-Health-Conscious Shoppers (C1) Percentage by Postcode District

Figure 19: Health-Conscious Shoppers (C0) Percentage by Postcode District

In terms of shopping frequency, over 60% of shoppers in all postcodes are occasional shoppers. LS10 and LS11 have the highest proportion of occasional shoppers, while LS27, where the ASDA Morley store is located, has a higher number of frequent shoppers, likely due to its proximity to the store. Consistent shoppers are the least common, making up around 10-20% of shoppers in each postcode district.

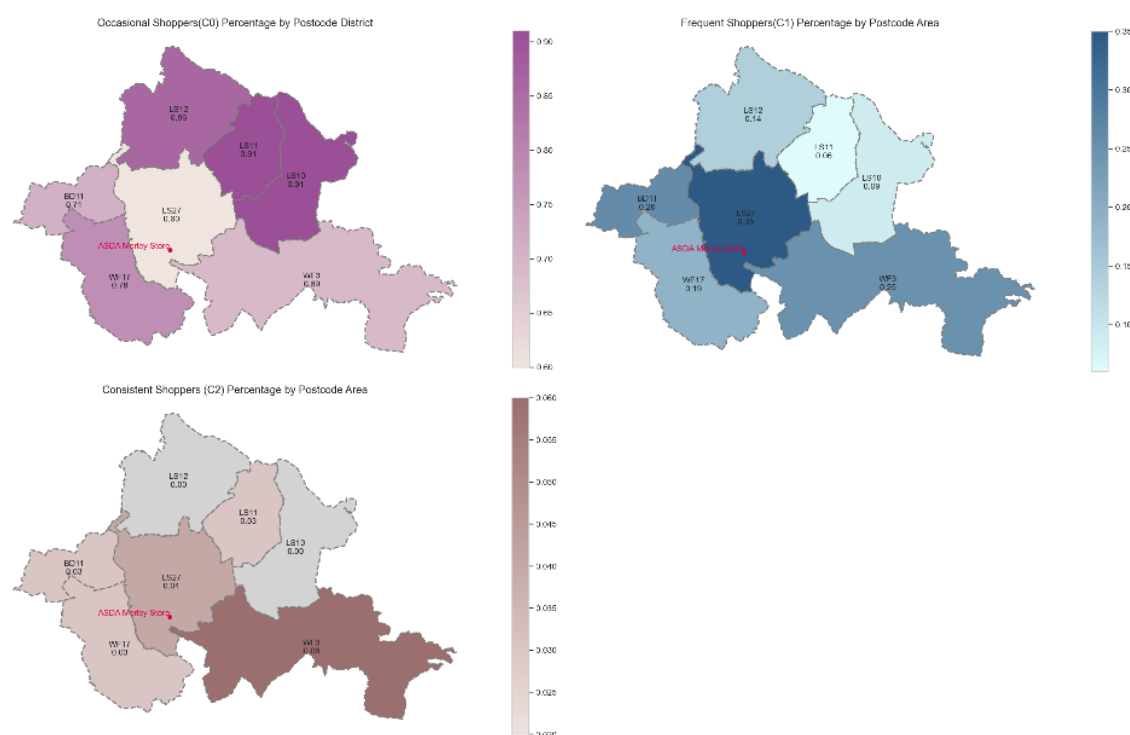


Figure 20: Occasional Shoppers (C0) Percentage by Postcode District

Figure 21: Frequent Shoppers (C1) Percentage by Postcode District

Figure 22: Consistent Shoppers (C2) Percentage by Postcode District

LS10 exhibits all the characteristics associated with a higher tendency for unhealthy shopping. The following section provides a comparison with IMD, PPFI, and demographic data.

4.7 Comparison with IMD, PPFI, and Demographic Data

The analysis indicates that customers in the LS10 area exhibit a higher tendency to purchase unhealthy food. This aligns with existing research showing that individuals with lower incomes are more likely to engage in unhealthy shopping behaviours. When compared to the Index of Multiple Deprivation (IMD) scores, LS10 is predominantly covered by LSOAs (Lower Layer Super Output Areas) within the most deprived decile. Additionally, the Priority Places for Food Index (PPFI) highlights LS10 as a high-priority area for food accessibility, further supporting the correlation between food insecurity and unhealthy shopping behaviour.

IMD Decile Map with Postcode Boundaries around ASDA Morley Store

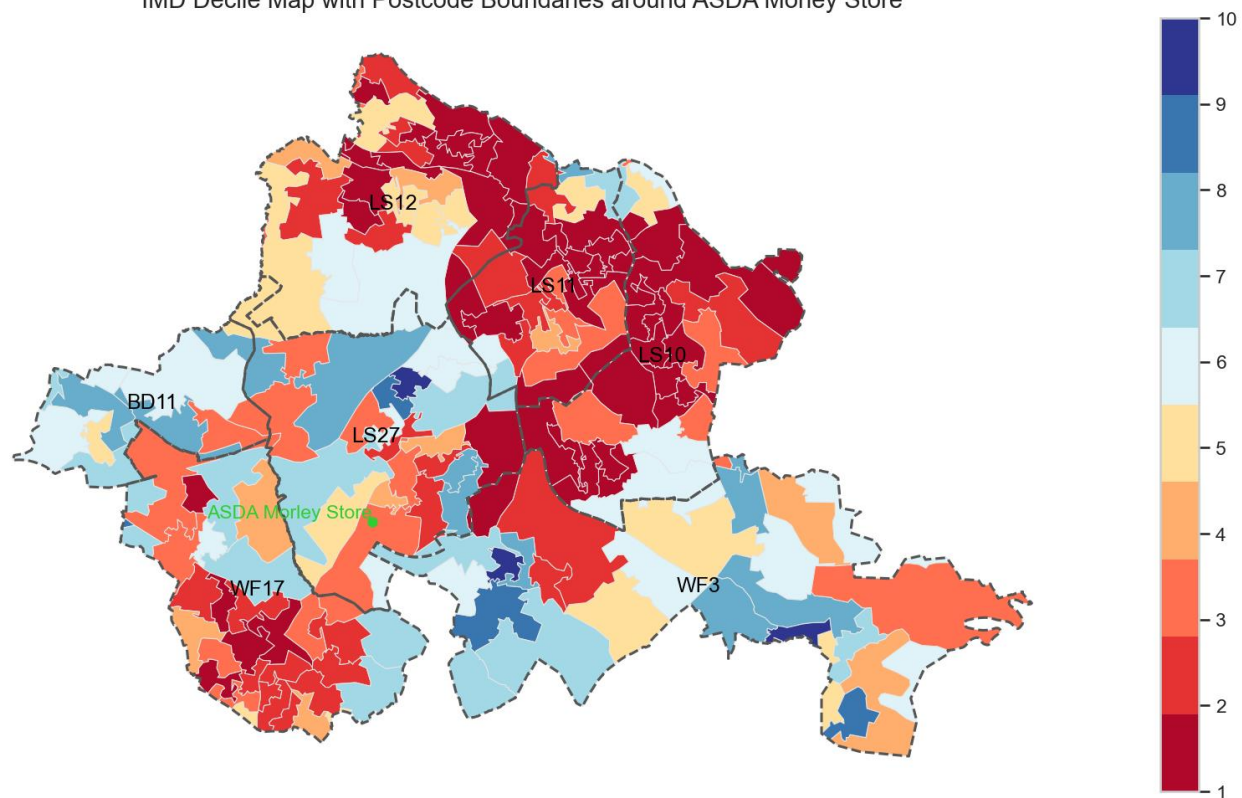


Figure 23: IMD Decile Map with Postcode Boundaries Around ASDA Morley Store

Priority Places for Food Index (PPFI) Around ASDA Morley Store

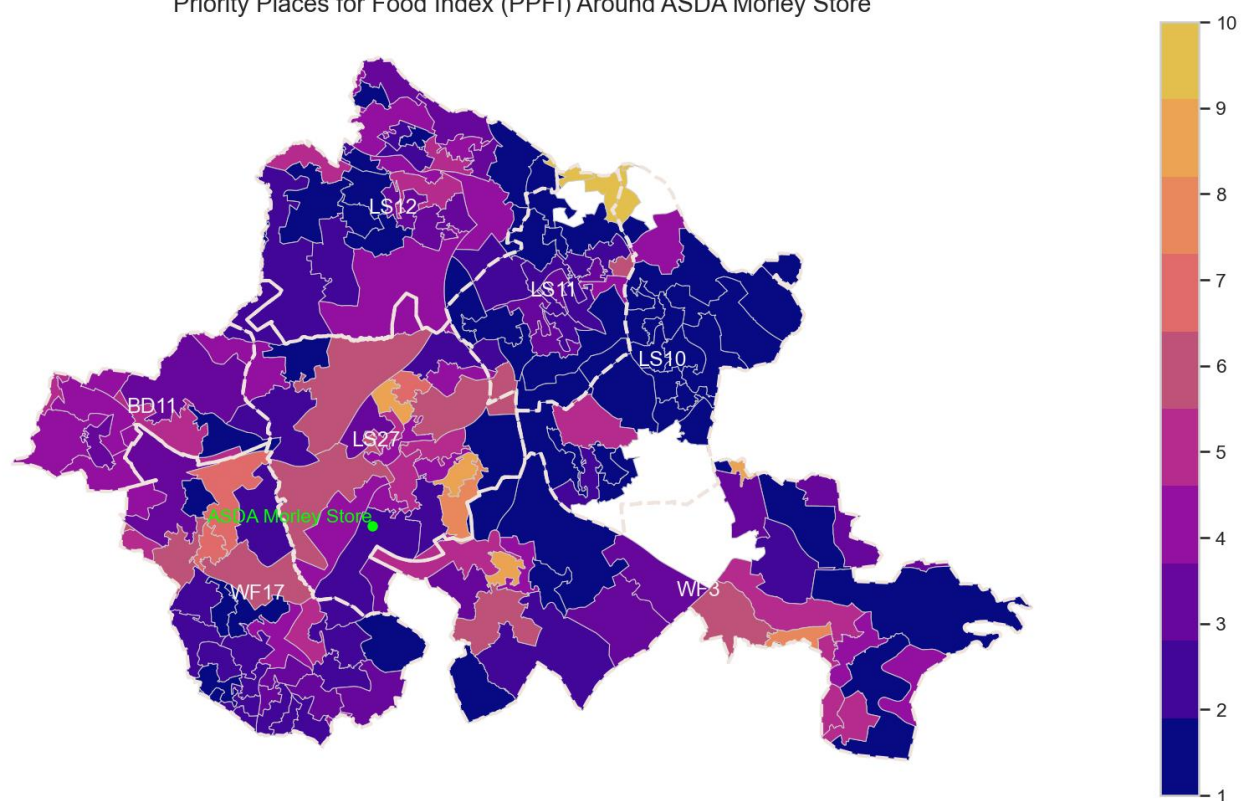


Figure 24: Priority Places for Food Index (PPFI) with Postcode Boundaries Around ASDA Morley Store

Car ownership, which reflects both mobility and economic status, is also lower in LS10 compared to other postcode districts. The education level in LS10, specifically the percentage of residents with qualifications at Level 4 and above, is generally below 20% in most LSOAs. Although the distribution of good and bad health does not show significant variation across the seven postcodes, this aspect requires further investigation. Overall, in the case of LS10, the higher tendency towards unhealthy shopping is consistent with current research, where factors such as high deprivation, limited food accessibility, and low education levels contribute to less healthy food choices.

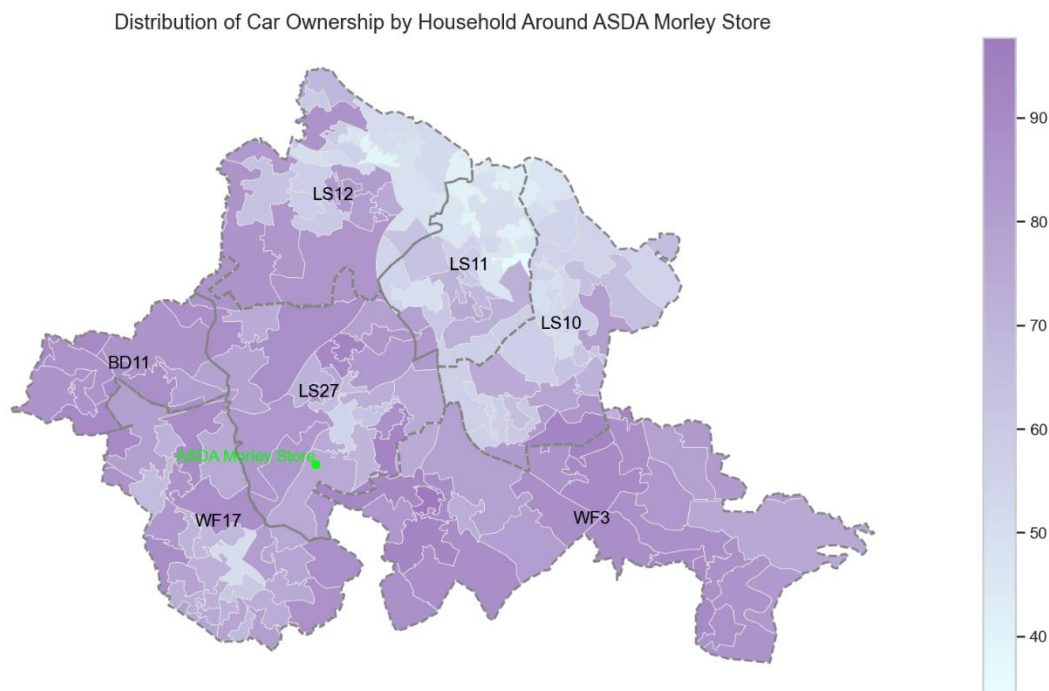


Figure 25: Distribution of Car Ownership by Household Around ASDA Morley Store

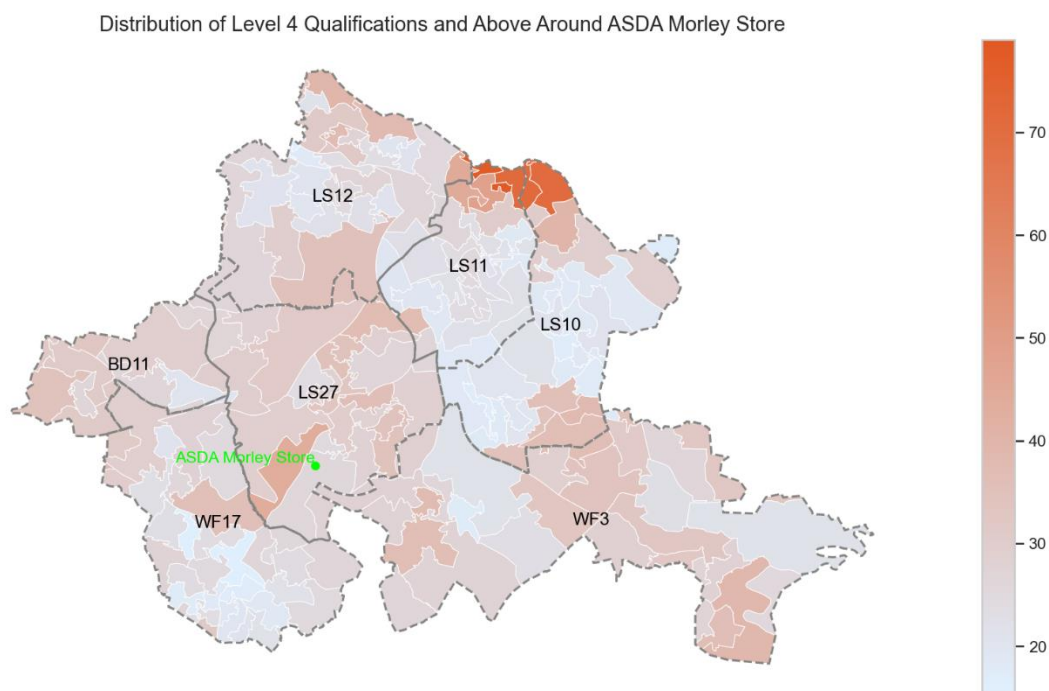


Figure 26: Distribution of Level 4 Qualifications and Above Around ASDA Morley Store

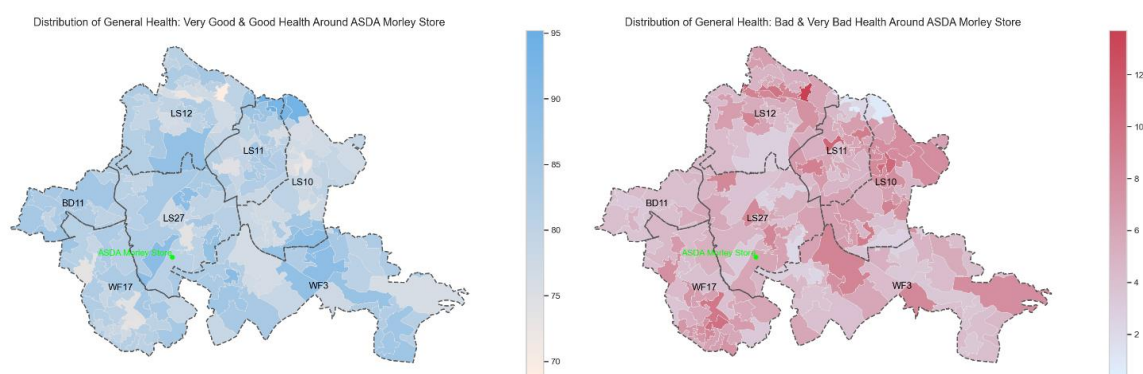


Figure 27: Distribution of General Health: Bad & Very Bad Health Around ASDA Morley Store

Figure 28: Distribution of General Health: Very Good & Good Health Around ASDA Morley Store

5. Implications for Policy/practice

The findings from this study highlight several areas where improvements can be made to encourage healthier shopping behaviours:

Increasing the Proportion of Healthy Foods and Improving Health Scores Across Categories in the Grocery Stores

By evaluating the NPM scores of all products, the overall healthiness of a store can be assessed. At ASDA Morley, nearly 60% of the products sold are classified as unhealthy. To promote healthier shopping environments, the government should consider regulating the proportion of healthy versus unhealthy foods available in stores. In addition to addressing the overall health score of the store, it is essential to focus on the health scores within specific food and drink categories, ensuring that each category offers healthy options.

Enhancing Product Health Knowledge: Simplifying Health Information on Labels

While all products are required to display nutritional information on their labels, it can be challenging for consumers to determine whether a product is healthy or not. The calculation of NPM scores is complex, making it difficult for customers to make informed decisions while shopping. Despite similar pricing and discounting between healthy and unhealthy products, consumers on a limited budget may still gravitate towards unhealthy options, possibly because they are unaware of the health implications of their purchases. This is supported by the fact that most of the top 10 unhealthy products, with the exception of "Milk Chocolate Digestives" and "Bourbon Biscuits," are everyday essentials.

Simplifying health labels to clearly indicate a product's healthiness could empower consumers to make healthier choices. Grunert and Wills (2007) demonstrated that simplified labels are effective, though the design of these labels requires further investigation. While

Borgmeier and Westenhoefer (2009) found the traffic light system to be the most effective, its impact on consumer choice remains limited. Turnwald and Crum (2019) recommended considering taste-focused labeling as an alternative, which may be more effective in promoting healthy food choices. Increasing transparency in this way would not only support healthier shopping habits but also encourage manufacturers to reformulate their products to improve their nutritional quality.

Product Name	Brand Name	Category	NPM score	Total Quantity Sold	Average Sale Price (£)
Whole Milk	ASDA	Dairy Products	2.0	19,195	1.62
Whole Milk	ASDA	Dairy Products	2.0	12,501	2.38
10 Unsmoked Back Bacon Rashers	ASDA Butcher's Selection	Brought-In Bacon & Sausages	14.0	11,004	1.84
Orange Juice from Concentrate	ASDA Smart Price	Dairy Products	2.0	9,559	0.89
Grated Cheddar	ASDA Smart Price	Pre-Packaged Cheeses	21.0	8,727	2.71
Milk Chocolate Digestives	ASDA	Cookies & Biscuits	20.0	8,041	0.78
10 Smoked Back Bacon Rashers	ASDA Butcher's Selection	Brought-In Bacon & Sausages	14.0	7,999	1.85
Bourbon Biscuits	ASDA	Cookies & Biscuits	15.0	7,863	0.6
Granulated Sugar	Silver Spoon	Beverages & Sweeteners	11.0	7,523	1.18
Grated Mozzarella Cheese	ASDA	Pre-Packaged Cheeses	20.0	7,062	2.21

Table 8: Top 10 Unhealthy Products Sold at ASDA Morley Store. Blue represents daily essentials, while pink denotes snacks.

Note: In the NPM definition, food with a score over 4 is considered unhealthy; drinks with a score over 1 are considered unhealthy.

Balancing the Price of Healthy and Unhealthy Products

Although the overall analysis of products in the ASDA store did not show a significant price difference between healthy and unhealthy options, specific product categories, such as meat, reveal that healthier options can indeed be more expensive. To address this disparity and make

healthier foods more accessible, the government could consider reducing taxes on healthy options to enhance affordability. Additionally, providing targeted subsidies to households in need, specifically for essential healthy foods, could help alleviate the financial burden of choosing healthier options. Such a policy would encourage healthier shopping habits by making nutritious choices more affordable.

6. Future Work

The methodology developed from the analysis of the ASDA Morley store can be applied to other grocery stores, allowing retailers to evaluate the healthiness of their product offerings. This approach includes assessing the balance between healthy and unhealthy products and evaluating the nutritional quality of customer purchases. By calculating an overall health score for each store, greater transparency can be offered to customers, enabling them to make more informed decisions regarding the healthiness of their shopping environment. Both the UK Government's 2022 food strategy and recommendations from The Food Foundation (2022) advocate for increased transparency within the food system to encourage healthier diets.

For grocery store owners, the methods used to analyse basket compositions and categorise customer types are valuable tools for assessing the effectiveness of health-focused marketing strategies. Monitoring changes in key metrics—such as average Nutrient Profile Model (NPM) scores, the proportion of healthy versus unhealthy baskets, and shifts in customer behaviour—can offer insights into the impact of these initiatives. Extending the observation period could further enhance understanding of long-term customer behaviour and the sustainability of healthier shopping habits.

For policymakers, the nationwide application of this method to calculate health scores for food items, baskets, and entire stores can aid in evaluating the effectiveness of implemented policies. The effectiveness of policies such as the 2019 ban on promoting HFSS (high fat, salt, sugar) foods can be assessed more efficiently using this methodology, reducing the reliance on waiting for long-term health outcomes from the affected regions.

7. Conclusion

Customer shopping behaviour at the ASDA Morley store, like in many retail environments, is complex and influenced by various factors. Despite this complexity, clear patterns in food choices emerge, highlighting opportunities for targeted policy interventions. By tailoring policies to address the specific needs of different customer groups—particularly those who exhibit a tendency towards unhealthy purchasing behaviours—these interventions can be more effectively designed and implemented. Understanding the preferences and motivations behind customer choices is crucial for making these policies impactful.

Moreover, grocery stores themselves have a pivotal role in promoting healthier shopping habits. They are responsible for providing a diverse range of healthy options across all product categories and ensuring that product information is presented in a way that is easy for customers to understand. By addressing both consumer behaviour and the retail environment, it is possible to create a more supportive framework for healthier food choices, ultimately benefiting both customers and public health.

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