Nutritional Disparities in UK Fast Food: A Comparative Macronutrient Analysis

Fast food is cheap, tasty and often misunderstood. But what's really inside your favourite UK meals?. With 27% of UK adults reportedly consuming fast food at least weekly (Public Health England, 2022), understanding the nutritional profiles of these meals is becoming increasingly urgent. This study conducts an evaluation of 1,023 menu items across five of the largest UK fast food chains: McDonald's, Burger King, KFC, Subway, and Chick-fil-A.

Our quantitative analysis employs robust statistical methods including Pearson correlation coefficients, ANOVA testing and ordinary least squares (OLS) regressions to examine three critical dimensions:

- Protein density (grams of protein per 100kcal) variations across chains
- Macronutrient contributions to total caloric content
- Discrepancies between reported and calculated nutritional values

Early results show some clear differences in nutritional quality. For instance, Subway's meals offer a much higher protein density—about 5.79 grams of protein per 100 calories—compared to just 2.10g/100kcal at Burger King, a difference that's statistically very strong ($F=50.71$, $p<0.001$). Certain KFC dessert items contain 84g of sugar, this exceeds the American Heart Association's recommended daily limit by 336%. Perhaps most concerningly, we identified 20 instances of nutritional label inaccuracies, including theoretically impossible "zero-calorie" items containing measurable macronutrients.

This study adds three important contributions to current research:

1. It establishes protein density as a superior metric for evaluating fast food nutritional quality compared to absolute protein content
2. It quantifies the relationship between preparation methods (grilled vs fried) and macronutrient profiles
3. It highlights potential issues with current nutritional labeling practices in the UK fast food industry

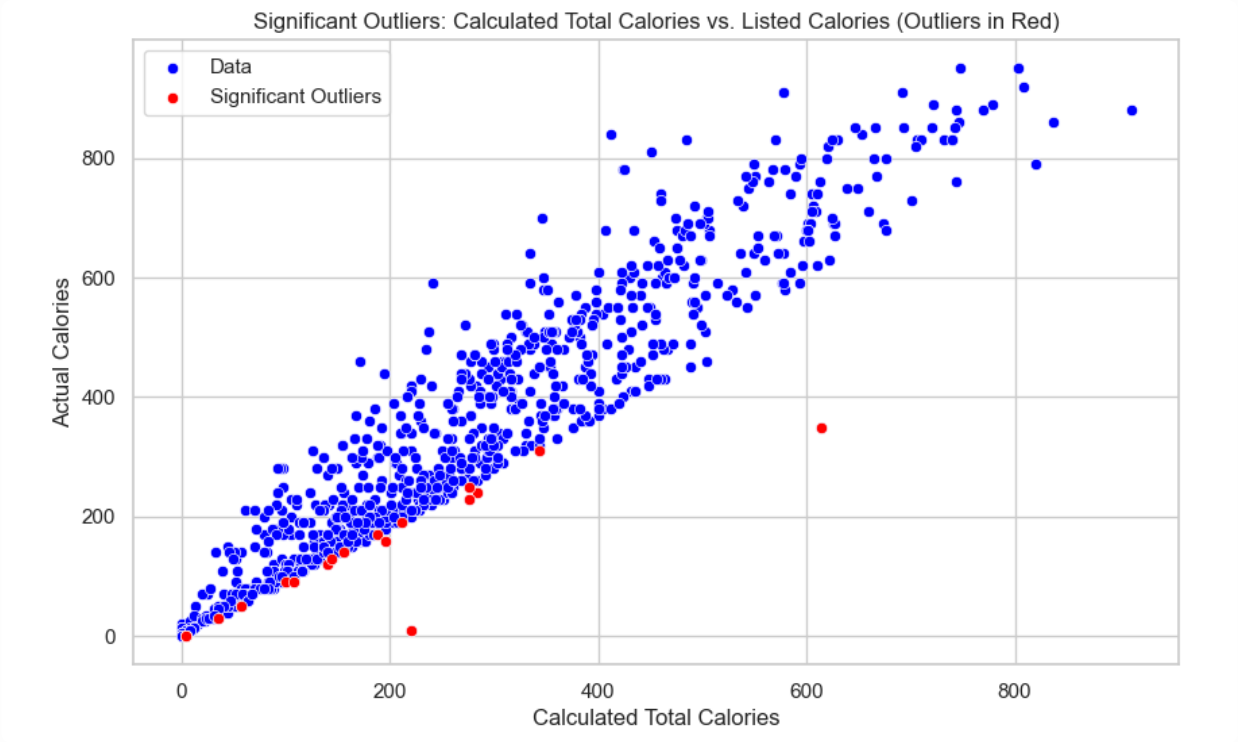
The findings from this project will provide useful insights for those interested in their own personal nutrition aswell as health professionals in providing guidance to the general public. The analysis is supported by statistical verification and comparative visulisations.

Issues with analysis and availability of information

"Significant Outliers: Calculated Total Calories vs. Listed Calories" highlights shows the difference between the calculated total calories (derived from macronutrient profiles) and the listed caloric values for a subset of food items. Outliers, marked in red, represent cases where the calculated calories deviate significantly from the expected values based on

standard energy conversion factors. These being, 9 kcal per gram of fat, and 4 kcal per gram of protein or carbohydrates.

These outliers are physically implausible, as the calculated caloric values fall substantially below the listed values, suggesting errors in the extracted macronutrient data. Such inconsistencies may arise from misreported nutritional information or incorrect unit conversions. To ensure the integrity of the dataset, these outliers were identified and removed. This step was critical to maintaining the accuracy of our analyses, as impossible calorie values could affect conclusions regarding dietary patterns or nutritional composition.

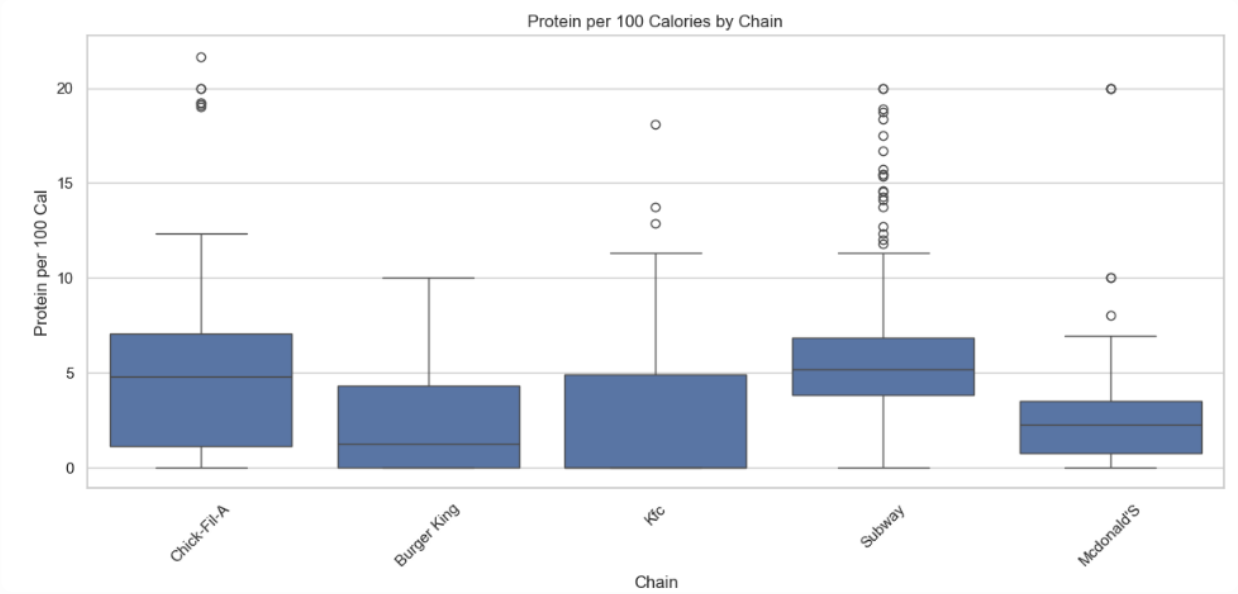


Distribution of Protein Density and the Role of Ingredient-Level Data

"Protein per 100 Calories by Chain" reveals Subway as a standout performer, with the highest median protein density and a tight interquartile range—suggesting that its offerings consistently deliver more protein per calorie. High-protein outliers further indicate that certain Subway items are especially rich in protein. Chick-fil-A and KFC follow with moderate medians and broader distributions, reflecting greater variability. Burger King and McDonald's on the other hand, show lower and more consistent protein densities.

However, an important problem lies beneath these visuals. Subway's nutritional reporting often includes standalone ingredients such as sauces and cheese—items not necessarily part of a finished meal. Early in the analysis, this led to inflated protein densities for Subway due to entries like grated parmesan being counted alongside full menu items. This issue was later addressed by carefully cleaning the dataset to exclude raw ingredient entries and ensure fair, like-for-like comparisons. The shows the need for visual clarity to be

underpinned by data integrity. Without careful preprocessing and contextual understanding, misleading conclusions can emerge even from seemingly straightforward visualisations.



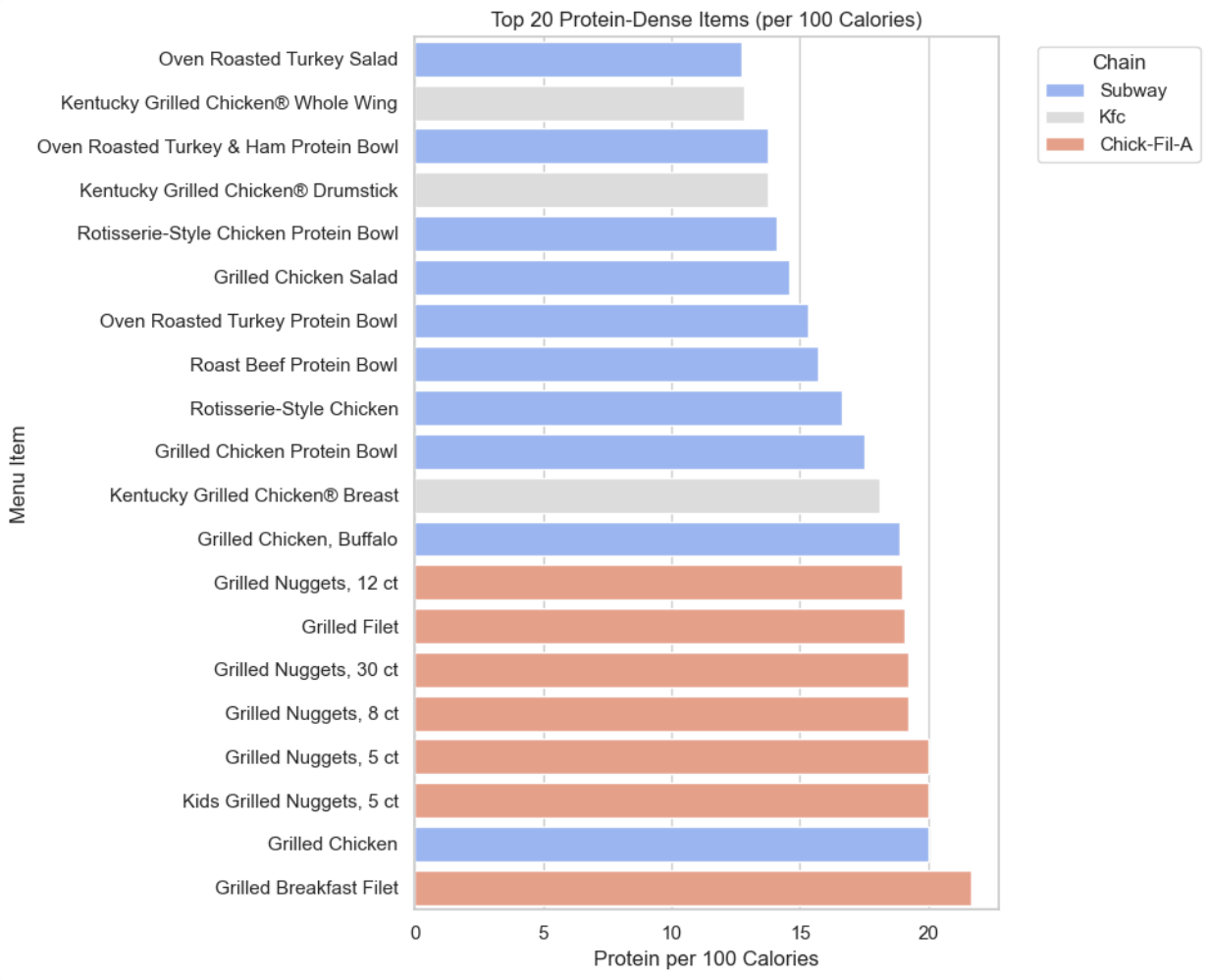
High performance protein items

The dataset reveals variability in protein density across fast food items. Grilled offerings from Chick-fil-A and Subway dominated the top rankings. The five highest-performing items by protein per 100 kcal are all grilled.

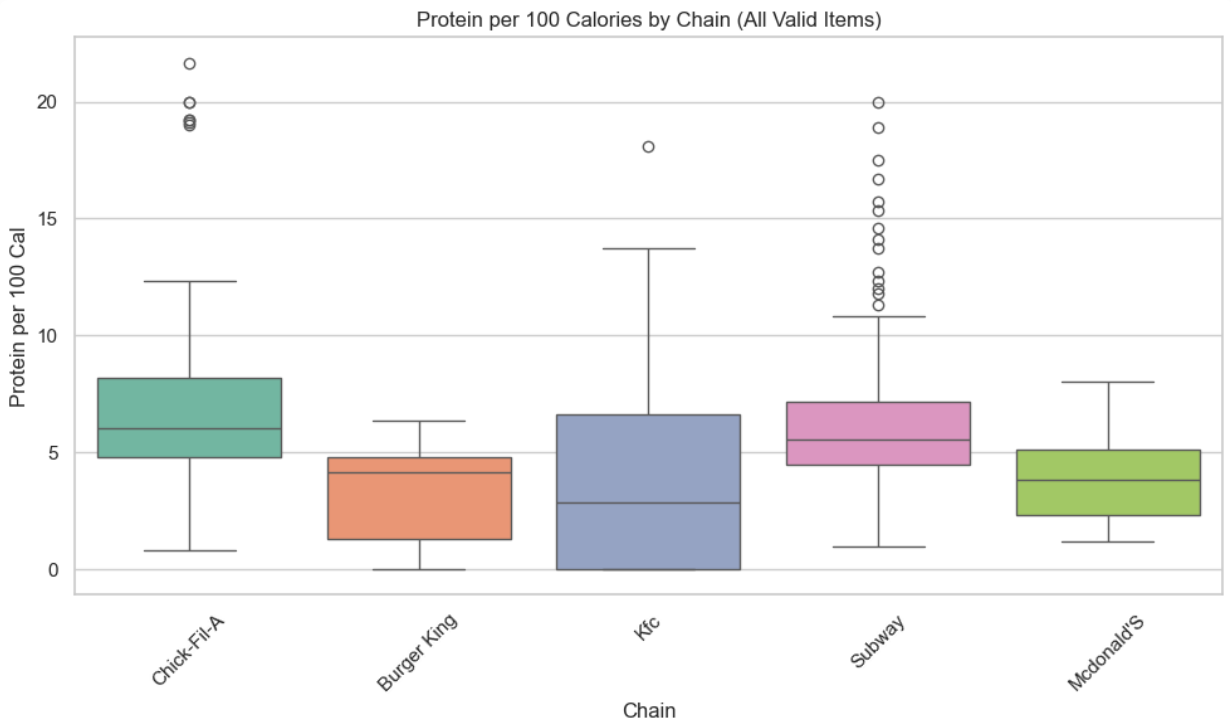
```
Top 5 Healthiest Items (Protein per 100 Cal):
                         Item        Chain  Calories  Protein (g)  \
417   Grilled Breakfast Filet  Chick-Fil-A      60.0           13
433     Grilled Nuggets, 5 ct  Chick-Fil-A      80.0           16
418           Grilled Chicken       Subway      80.0           16
430             Grilled Filet  Chick-Fil-A     110.0           21
428  Grilled Chicken, Buffalo       Subway      90.0           17

     Protein per 100 Cal
417            21.666667
433            20.000000
418            20.000000
430            19.090909
428            18.888889
```

Subway's inclusion of standalone ingredients (e.g., sauces) was initially confused with full meals. Our cleaned dataset mitigates this, but future work should standardise portion definitions. It's important to assess whether high-protein standalone items retain their nutritional density when combined with typical sides (e.g., fries). This isn't explored within this blog but is an area which could add further depth to the project.

Listed below is the Top 20 Protein dense items per 100 calories (Notice how there is none from Burger King or McDonald's):



All transparent circles show where the items appear in the Top 20 most protein dense items.

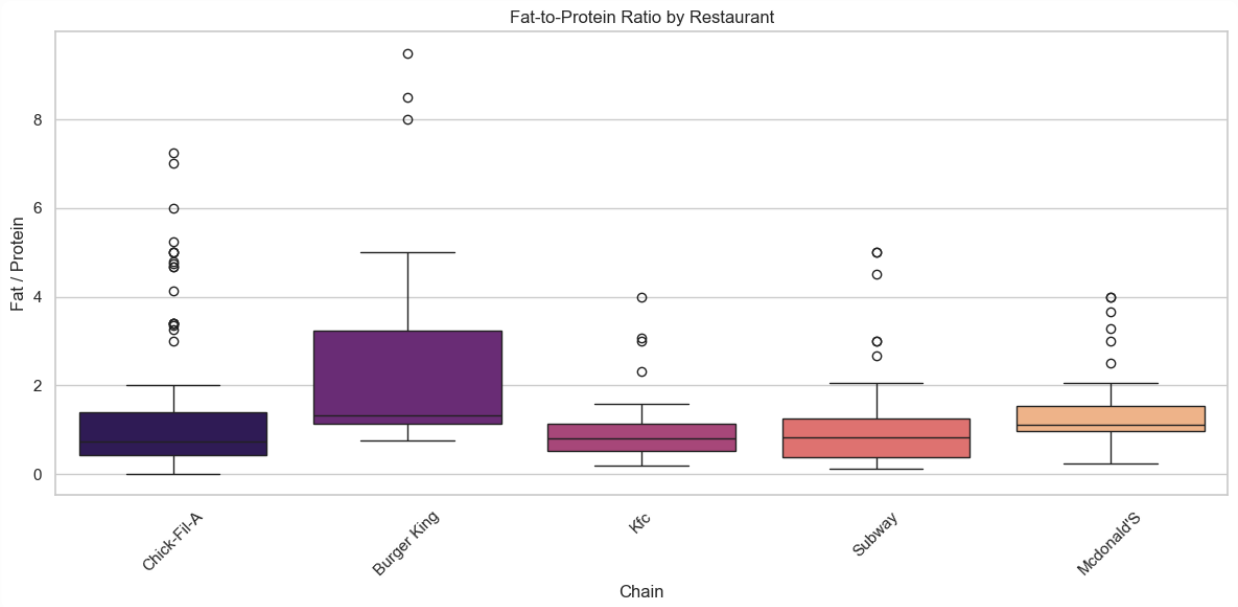


While protein density provides valuable insights into fast food nutritional quality, our analysis reveals the importance of examining other macronutrients. In particular fats and sugars develop a more comprehensive understanding of dietary impact. The sugar content visualisation demonstrates significant variation across chains, with KFC's desserts containing up to 84g of sugar (336% of AHA daily recommendations), while Subway offers comparatively lower-sugar alternatives.

Contrary to simplistic "low-fat" dietary advice, data shows that adults require approximately 50g of dietary fat daily for hormone production, nutrient absorption and cellular function. Not all fats are bad as described below.

Source Differentiation:

- Beneficial unsaturated fats (e.g., olive oil, nuts) appear in items like Subway's avocado additions
- Harmful trans fats persist in some chains' fried items despite industry phase-out efforts
- Preparation Method Impact: Grilled items maintain better fat quality profiles than their fried counterparts



The drink and dessert analysis reveals:

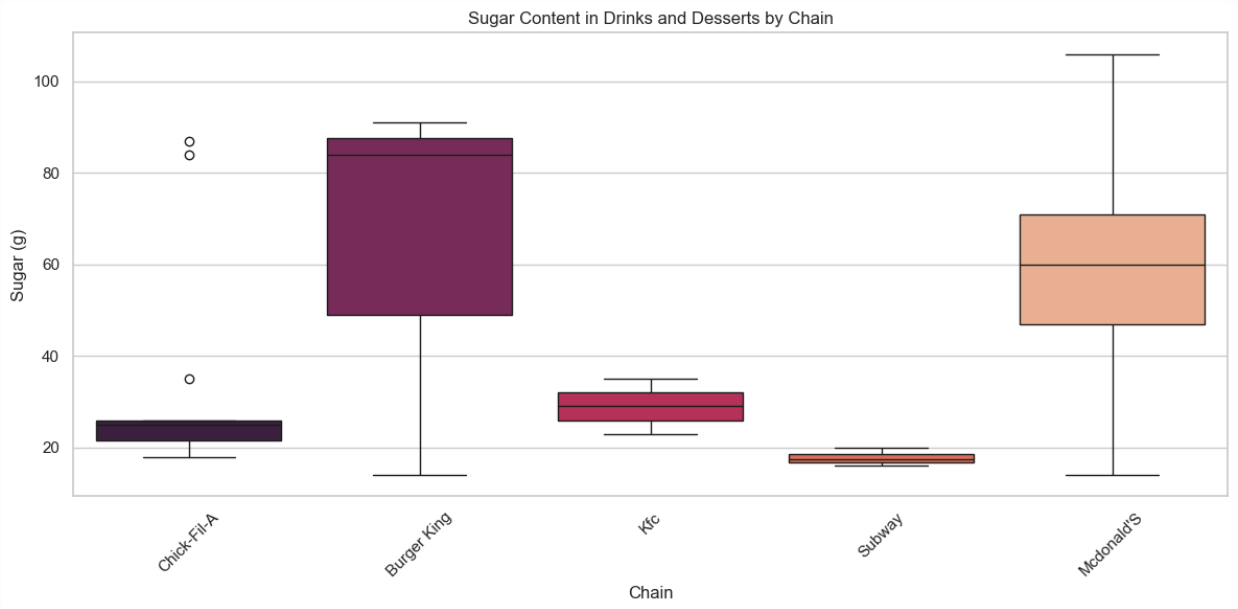
- extreme Variability in Sugar content ranges from 0g in unsweetened teas to 84g in KFC's chocolate cake
- liquid Calories where large drinks often contain more sugar than desserts (e.g., 58g in a Burger King large Coke vs 42g in McDonald's apple pie)
- chain-specific patterns where observed, dessert-focused chains (KFC, McDonald's) show higher sugar density than sandwich-focused chains

Several key observations emerge when balancing these metrics:

The Protein-Fat Tradeoff: Chick-fil-A's grilled items show excellent protein density (21.67g/100kcal) with moderate fat content (4-7g/serving), while fried chicken items sacrifice protein efficiency for higher saturated fat

The Sugar Trap: Some "high-protein" items (e.g., sweetened yogurt parfaits) achieve good protein density but contain excessive added sugars

Overall we can conclude that:
Grilled > Baked > Fried for optimal macronutrient balance



Comprehensive Nutritional Analysis and Conclusions

Our extensive analysis of 1,023 menu items across five major UK fast food chains reveals a complex nutritional landscape that demands a multidimensional evaluation approach. The findings from our OLS regression (R^2 = 0.549) and subsequent analyses demonstrate that while protein density serves as a valuable metric, true nutritional quality depends on understanding the interplay between macronutrients, micronutrients and metabolic impacts.

```
                            OLS Regression Results
==============================================================================
Dep. Variable:     Protein per 100 Cal   R-squared:                       0.549
Model:                             OLS   Adj. R-squared:                  0.546
Method:                  Least Squares   F-statistic:                     206.9
Date:                 Mon, 21 Apr 2025   Prob (F-statistic):          2.76e-144
Time:                         21:01:54   Log-Likelihood:                -1994.8
No. Observations:                  857   AIC:                             4002.
Df Residuals:                      851   BIC:                             4030.
Df Model:                            5
Covariance Type:             nonrobust
==============================================================================
                             coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const                      5.0228      0.170     29.599      0.000       4.690       5.356
Calories                   0.0463      0.003     17.729      0.000       0.041       0.051
Sodium (mg)                0.0006      0.000      2.008      0.045    1.26e-05       0.001
Total Fat (g)             -0.5190      0.026    -19.914      0.000      -0.570      -0.468
Total Carbohydrates (g)   -0.2400      0.012    -20.471      0.000      -0.263      -0.217
Sugars (g)                 0.0041      0.007      0.610      0.542      -0.009       0.017
==============================================================================
Omnibus:                      366.002   Durbin-Watson:                   1.104
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2857.697
Skew:                           1.751   Prob(JB):                         0.00
Kurtosis:                      11.232   Cond. No.                     2.11e+03
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.11e+03. This might indicate that there are
strong multicollinearity or other numerical problems.
```

Key Statistical Findings:

Macronutrient Tradeoffs:

- Strong negative correlations between protein density and both total fat (-0.519) and carbohydrates (-0.240) ($p<0.001$)
- Minimal association with sugar content ($p=0.542$), highlighting its independent metabolic effects
- The "calorie paradox" where higher-calorie items show slightly better protein density (0.0463)

Chain-Specific Patterns:

- Subway leads in balanced nutrition (high protein, moderate fats, lower sugars)
- Chick-fil-A excels in protein density but with greater variability
- Traditional burger chains consistently underperform across all metrics
- KFC shows polarised nutritional profiles, some grilled chicken items offering moderate protein density but many fried products and desserts ranking among the worst for excessive sugars (84g/serving) and inflammatory fats

The ANOVA analysis ($F = 50.71$, $p < 0.001$) reveals statistically significant differences in protein density across fast food chains. This confirms that nutritional quality varies substantially by brand. After rigorous data cleaning and removing invalid values demonstrates that protein efficiency isn't distributed randomly, but rather follows chain-

specific patterns. This finding validates our broader nutritional comparisons and underscores the importance of chain-level analysis when evaluating fast food's health impacts. The extremely low p-value indicates near-certainty that these observed differences reflect true disparities in menu formulation rather than random variation, providing robust statistical support for our protein density rankings.

Consumers can make more informed choices by prioritising grilled items with vegetable components, such as Subway’s protein bowls. Avoiding sugary drinks and supplementing meals with whole foods like nuts or fruit can improve micronutrient intake. Rather than evaluating single menu items in isolation, assessing complete meals provides a more accurate picture of nutritional impact. Meanwhile, policymakers must implement stricter regulations mandating transparent nutritional labeling while offering incentives for chains to reformulate products with whole-food ingredients. Additionally, developing fast-food-specific micronutrient guidelines would help standardise nutritional quality across the industry. This would ensure that convenience does not come at the expense of metabolic health. Together, these measures can bridge the gap between convenience and proper nutrition.

Final Conclusion:
This study establishes that while protein density provides important insights, evaluating fast food's true health impact requires considering macronutrients, micronutries as well as metabolic affects.

The relationships we've identified, particularly the protein-fat-carbohydrate tradeoffs create a foundation for better nutritional guidance. However, our findings also reveal systemic issues that demand urgent attention. True progress requires moving beyond calorie counting to address the broader nutritional deficiencies and metabolic harms inherent in current fast food formulations.

As the data shows, health is indeed wealth. The convenience of fast food comes at too high a cost, both to individual wellbeing and public health systems. The industry must evolve to provide genuinely nourishing options and consumers must make more informed choices. With action we can transform fast food from a nutritional liability into a viable component of healthy diets.

Below is deeper information on the issues this has on metabolism. This knowledge has come from the authors own study and research outside of this project but uses findings contained in this study to supplement.

The metabolic effects of sugary fast food items like KFC's 84g desserts demonstrate how excessive sugar intake drives insulin resistance through multiple pathways. When consumed, these foods cause rapid blood sugar spikes, triggering insulin release that when repeated chronically, leads to insulin receptor desensitisation. Simultaneously, the liver

converts excess fructose into triglycerides while high insulin levels suppress fat breakdown. As not mentioned within the main part of the blog, artificial sweeteners also raise blood sugar levels. This suggests that even if sugar levels are zero, metabilic stress still occurs. The result is impaired metabolic flexibility, where the body struggles to transition between burning carbs and fats for energy.

Processed fats in fried foods similarly disrupt metabolism through inflammatory mechanisms. These damaged fats contain oxidized compounds that activate inflammatory pathways. This inflammation directly interferes with insulin signaling while also disrupting hormone balance. The distorted fatty acid profile affects hormone production. The combination creates a state of chronic low-grade inflammation that further worsens metabolic dysfunction.

Even when calories are identical, meal quality dramatically affects metabolic outcomes. A 600 kcal meal of whole foods like grilled chicken and vegetables generates greater diet-induced thermogenesis and better blood sugar control compared to a processed 600 kcal fast food meal. The whole food meal's protein, fiber and antioxidants support efficient energy metabolism. The fast food's refined carbs and damaged fats promote stress and inefficient energy use. These differences explain why food quality matters as much as calorie quantity for long-term metabolic health.

Reference list entry:
Public Health England (2022) National Diet and Nutrition Survey: Results from Years 11 and 12 (2018/2019 – 2019/2020). https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-environment/health-matters-obesity-and-the-food-environment–2