GLP-1 Medication Adoption and Household Demand for Ultra-Processed Foods *

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Abstract

This paper investigates how the introduction of Glucagon-Like Peptide-1 receptor agonist (GLP-1) medications affects household food-at-home purchasing behavior. Using household scanner data, we link detailed food purchases with household prescription purchases to identify the timing of GLP-1 adoption on food purchasing behaviors. To measure shifts in food processing levels, we classify more than five million products into four NOVA categories (i.e., minimally processed, culinary ingredients, processed and ultra-processed) using a hybrid system that combines best-practice hand classification with a high-accuracy machine-learning algorithm based on product descriptions and ingredient lists. We estimate causal effects of GLP-1 on food purchasing behaviors using the staggered-adoption difference-in-differences approach, comparing GLP-1 adopters with households initiating non-GLP-1 diabetes medications. We find that the introduction of GLP-1 leads to a statistically significant reduction of approximately $56 per month in total food spending and induces a systematic reallocation of the household food budget away from ultra-processed foods and toward minimally processed foods. Although dollar-value changes in ultra-processed purchases exhibit heterogeneity, the decline in the budget share of ultra-prcocessed foods and the increase in minimally processed foods are robust across specifications. These findings suggest that GLP-1 medications generate meaningful improvements in dietary composition, with implications for public health policy and for food manufacturers likely to be affected by shifts in consumer demand as GLP-1 adoption increases.

1 Introduction

Glucagon-Like Peptide-1 receptor agonists (GLP-1s) were first introduced in the mid-2000s as an innovative class of drugs for the treatment of type 2 diabetes, beginning with FDA approval of exenatide (Byetta) in 2005 Sheahan et al. (2020). Over the following decade, additional formulations (e.g.,bliraglutide (Victoza), dulaglutide (Trulicity), and semaglutide (Ozempic)), established GLP-1s as highly effective glucose-lowering therapies with proven cardiovascular benefits. By 2014, their potential adoption for weight management was increasingly apparent, leading to the approval of liraglutide 3.0 mg (Saxenda) specifically for obesity treatment U.S. Food and Drug Administration (2021). Over the next decade, regulators approved semaglutide 2.4 mg (Wegovy) in 2021 and tirzepatide-based Zepbound in 2023 Han et al. (2024); Singh et al. (2022). As clinical trials documented clinically meaningful and sustained weight loss—far exceeding lifestyle interventions or previous pharmacotherapies– the popularity of GLP-1 drugs expanded beyond diabetic care into mainstream public attention. By 2024, demand surged dramatically. The GLP-1 medications have been described as "blockbuster drugs," reshaping clinical practice, consumer behavior, and expectations about obesity treatment Commission (2024).

The rapid expansion of GLP-1 use focused intense policy interest on increasing accessibility to these medications. In 2024, U.S. House and Senate members questioned pharmaceutical manufacturers about high prices and limited insurance coverage, noting that restrictive formularies and high out-of-pocket costs prevented many eligible individuals from accessing effective weight-management medications U.S. Senate Committee on Health, Education, Labor, and Pensions (2024). Policymakers argue expansion of GLP-1 access could reduce long-run health-care costs associated with obesity-related comorbidities, including hypertension, cardiovascular disease, and type 2 diabetes. States have also begun considering coverage mandates or expanding Medicaid formularies, motivated by e arly evidence showing significant improvements in weight loss, metabolic markers, and diabetes remission. Such

policy engagement reflects the belief that GLP-1 medications could play an important role in addressing the United States' persistent obesity epidemic, which has so far been largely resistant to current obesity interventions like nutrition education campaigns, increased access to dietary information, food labeling reforms, and behavioral interventions.

Despite widespread awareness of the health risks of excess weight, the United States continues to experience rising obesity prevalence, with current estimates showing that more than 42% of adults have obesity—nearly triple the rate of the 1980s Hales et al. (2020). Notably, this rise has occurred even as average caloric intake has remained stable or even declined modestly over time, giving rise to the so-called "calories paradox" Mozaffarian (2022). A growing body of research suggests that the issue may be driven less by the quantity of calories consumed and more by the quality and processing level of those calories. Ultra-processed foods (UPFs), which account for roughly 58% of calories consumed by U.S. households Steele et al. (2016), have received particular scrutiny. Experimental evidence demonstrates that UPF diets lead to higher energy intake, greater eating speed, and rapid weight gain even when matched on macronutrients and calories (Hall et al., 2019). Observational studies link higher UPF consumption to poorer dietary quality (Liu et al., 2022), greater risk of metabolic disease, and higher all-cause mortality (Taneri et al., 2022). These findings have shifted attention toward food processing as a potential mechanism behind rising obesity trends and have motivated upstream policy proposals such as UPF labeling requirements Texas Legislature (2025), sugar-sweetened beverage taxes Lauber et al. (2022), and restrictions in schools.

Against this backdrop, the rising popularity of GLP-1 medications raises important questions about their broader behavioral effects, not only on weight loss, but also on consumer food choices. If GLP-1s suppress appetite and reduce cravings for calorie-dense foods, they may shift household demand away from UPFs and toward healthier alternatives. Understanding these effects is critical for several reasons. First, policymakers considering expanded GLP-1 coverage require evidence on whether these medications indirectly promote healthier

diets, potentially generating nutritional spillovers beyond weight loss. Second, food manufacturers, retailers, and agricultural producers may face substantial demand shifts as GLP-1 use becomes more widespread. Producers heavily reliant on sales of snacks, sweets, convenience foods, and other ultra-processed categories may experience declining demand, while markets for minimally processed products could expand. Third, these shifts could inform broader debates about obesity interventions—whether pharmacological approaches complement or substitute for existing food policies. This paper addresses these issues by estimating the causal effect of GLP-1 initiation on household purchases of foods across NOVA processing categories.

This research contributes to several strands of literature. First, it complements the growing body of work examining the behavioral impacts of GLP-1 medications. Survey-based studies show that GLP-1 users report consuming significantly fewer calories and reducing purchases of calorie-dense foods (Dilley et al., 2025; Hristakeva et al., 2024), but causal evidence from household scanner data remains limited. Second, the paper builds on research analyzing UPF consumption and health outcomes, which documents strong associations between UPF intake and weight gain, metabolic dysfunction, and mortality (Hall et al., 2019; Liu et al., 2022; Taneri et al., 2022). Third, by linking the introduction of GLP-1 with demand for foods classified by processing level, the paper bridges medical, nutritional, and economic literatures, contributing to a deeper understanding of how pharmacological innovations can shape food markets. Finally, the study contributes to empirical industrial organization and household demand research by leveraging a newly constructed large-scale NOVA classification system combining hand-coding and machine learning, addressing long-standing concerns about product-level measurement in food processing studies.

2 Data

To estimate the effect of GLP-1 medication on household food demand, we use household-level scanner data from Circana (formerly IRI), one of the largest commercial datasets of U.S. consumer packaged-goods purchases. Circana's Consumer Panel provides detailed UPC-level records on all food-at-home purchases made by participating households, including product identifiers, quantities, prices, store formats, and purchase dates. The dataset also contains rich demographic and socioeconomic characteristics, such as household size and composition, geographic location, age and gender of the household head, and indicators of household income and wealth, such home and vehicle ownership. In addition, the Circana panel includes household prescription information, allowing us to identify the timing of GLP-1 adoption at the individual or household level. We infer the month in which a household begins GLP-1 treatment by observing the first appearance of a new prescription in the panel, treating this as the start of exposure. This structure enables construction of a longitudinal household panel with clear pre- and post-treatment periods suitable for difference-in-differences estimation.

Because the rapid growth in GLP-1 use coincided with the approval of semaglutide 2.4 mg (Wegovy) for weight management in 2021, our analytic sample spans the period from 2019 through the end of available data in 2023. This window captures both the pre-approval period—when GLP-1s were primarily used for diabetes management—and the subsequent surge in weight-loss prescriptions following the FDA's obesity-indication approval. Descriptive patterns in the data show substantial increases in GLP-1 initiation over this period for both diabetes- and obesity-related prescriptions (Figure 1). Although GLP-1 medications were historically prescribed almost exclusively for diabetes, the 2021 approval for chronic weight management led to a sharp rise in obesity-related prescriptions, reflected in the growing share of households entering treatment for weight loss. Nevertheless, the majority of new GLP-1 prescriptions in the panel continue to originate from diabetes-related indications (Table 1), consistent with the broader national landscape where GLP-1 adoption is expand-

ing across both populations but remains anchored in diabetes care.

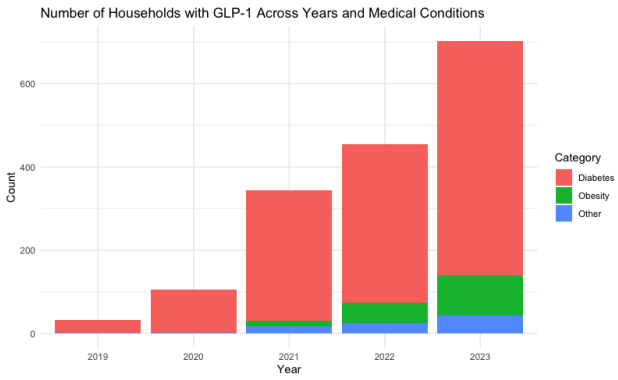

Figure 1: The Number of households starting GLP-1 medication by year

Table 1: Households on a new GLP-1 prescription

	Category	Count
Condition		
	Diabetes	943
	Obesity	123
	Other	74
Gender		
	Female	735
	Male	406
Out-of-Pocket		
	Mean	$61.6
	Median	$25
Age		
	Mean	57
Household Size	Median	59
	1	271
	2	498
	3	188
	4+	184
Total Number of Households		1140

To estimate the effects of GLP-1 initiation on household demand for ultra-processed foods, we classify every product purchased in the Circana scanner data according to its

processing level. We rely on the NOVA food classification system, originally developed by Monteiro and colleagues, which groups foods based on the extent and purpose of industrial processing. NOVA defines four mutually exclusive categories: (1) unprocessed or minimally processed foods, such as fresh fruits, vegetables, meat, and plain dairy; (2) processed culinary ingredients, including oils, butter, sugar, and salt; (3) processed foods, such as canned vegetables, cheeses, and breads made with minimally processed and culinary ingredients; and (4) ultra-processed foods (UPFs), which include industrial formulations made primarily from substances not used in home cooking—such as emulsifiers, colorings, stabilizers, and artificial flavorings—and typically found in snacks, ready-to-eat meals, sweetened beverages, and flavored dairy products. This system is the most widely used in public health, nutrition, and increasingly economics for studying consumer outcomes associated with food processing.

Our classification process follows best-practice guidelines developed by the researchers who established and refined the NOVA system Monteiro et al. (2010). These guidelines recommend assigning products to NOVA groups based primarily on their product category—for example, fresh produce, raw meats, and dry beans consistently fall into NOVA 1; oils and sweeteners fall into NOVA 2; and many packaged breads and cheeses fall into NOVA 3. However, certain categories require more granular, specification-level evaluation because processing levels differ within the same product type. For instance, plain yogurt with no added ingredients is classified as NOVA 1, while flavored yogurt often containing added sugars, stabilizers, and flavor enhancers—is classified as NOVA 4. Breakfast cereals, snack bars, frozen meals, and dairy-based desserts also frequently require examination of ingredient lists. For this reason, category-level classification alone is insufficient for scanner data, and additional item-level analysis is needed.

To classify the remaining products not uniquely determined by product category, we develop a supervised machine-learning model using natural language processing (NLP) ap-

plied to product descriptions and ingredient lists. Following the methodology used in recent computational nutrition research, we construct a balanced training set of 2,000 hand-coded products across the four NOVA groups. We use language-based features extracted from multiple fields in the Circana and USDA Branded Food Database: UPC description, ingredient lists, aisle, and department. Pre-processing includes removing filler words, numbers, punctuation, and tokens appearing in fewer than 1 percent of products. We train a bag-of-words Random Forest classifier on this corpus. Although Random Forests are more computationally intensive than simpler classifiers, we select this algorithm for two reasons. First, its depth and ensemble structure increase robustness to changes in reporting standards—important because Circana modified its product reporting structure twice during our sample period. Second, Random Forests demonstrate strong performance in food-categorization tasks with heterogeneous text formats, allowing future Circana data users to retrain the model even when metadata fields evolve.

Table 2: Machine Learning Classification Metrics by NOVA Group

Metric	NOVA 1	NOVA 2	NOVA 3	NOVA 4
Sensitivity	0.94	0.99	0.98	0.94
Specificity	0.98	0.99	0.98	0.99
Balanced Accuracy	0.96	0.99	0.98	0.96

The machine-learning model demonstrates strong performance across all NOVA categories (Table 2). Sensitivity exceeds 0.94 for NOVA 1 and 4, and reaches 0.99 for NOVA 2, indicating excellent ability to correctly identify products belonging to each group. Specificity is similarly high, ranging from 0.98 to 0.99 across categories, meaning the model rarely misclassifies items outside their true NOVA group. Balanced accuracy scores range from 0.96 to 0.99, reflecting robust and symmetric performance even in categories with complex product heterogeneity. These results indicate that the classification system effectively differentiates

processing levels using text-based features and is suitable for large-scale economic analysis of food-purchase behavior.

3 Methods

To estimate the causal effect of GLP–1 initiation on household spending and food-processing outcomes, we use the difference-in-differences (DiD) estimator developed by Callaway and Sant'Anna (2021). This estimator is designed for settings with staggered treatment timing, where different households begin treatment in different months. The Callaway and Sant'Anna approach constructs group-time average treatment effects, denoted $ATT_{g,t}$, which compare households first treated in period g with an appropriate comparison group in post-treatment period t. The group-time ATT is defined as:

$$ATT_{g,t} = E\left[\left(G_g - \frac{P_g C}{1 - P_g}\right)(Y_t - Y_{g-1} - E[Y_t - Y_{g-1} \mid C = 1])\right]$$

where G_g indicates households first treated in period g, C denotes never-treated households, and P_g is the generalized propensity score estimated from pre-treatment covariates. To obtain an overall treatment effect, Callaway and Sant'Anna aggregate the group-time effects across all treatment cohorts using time-period weights:

$$ATT = \sum_g \sum_{t \geq g} \omega_{g,t}\, ATT_{g,t},$$

where $\omega_{g,t}$ are weights proportional to the share of treated units in group g and the number of post-treatment periods. This approach flexibly estimates the dynamic causal effects of GLP–1 adoption while avoiding the known biases of traditional two-way fixed-effects DiD models under staggered treatment adoption.

Identification of the Callaway–Sant'Anna estimator relies on two key assumptions. First, we require a conditional parallel trends assumption, meaning that in the absence of GLP-1

adoption, treated households would have followed the same evolution in outcomes as the chosen control group after conditioning on observable characteristics. Second, we require limited treatment anticipation, meaning households do not substantially alter their food purchasing behavior prior to initiating GLP-1 medication. To further minimize bias arising from changes in spending behavior due to physician counseling, diagnostic shocks, or worsening health, we define the control group as households that begin using non-GLP-1 diabetes medications during the same time frame. These households face similar medical environments, doctor interactions, and health-management requirements but do not receive a GLP-1 prescription. This control structure strengthens the credibility of the identifying assumptions by ensuring that treated and control households experience comparable health-care interactions and contemporaneous medical changes unrelated to GLP-1 treatment.

4 Results

To estimate of the effect of GLP-1 medication on household food-purchasing behavior, we examine changes in both the total amount of money spent on food-at-home and the budget share allocated to each NOVA processing group. Table 3 reports the estimated treatment effects using the Callaway and Sant'Anna difference-in-differences estimator. The left panel presents effects on total monthly spending in dollars while the right panel presents effects on the proportion of the household's food budget spent on unprocessed (NOVA 1), processed culinary ingredients (NOVA 2), processed foods (NOVA 3), and ultra-processed foods (NOVA 4).

Table 3: The Effects of GLP-1 on Spending and Budget-Shares of NOVA Groups

	Total Spending		**Budget Share**	
	Estimate	**Std. Error**	**Estimate**	**Std. Error**
NOVA 1	9.73***	2.95	0.03***	0.0076
NOVA 2	-2.53	6.09	-0.009	0.0094
NOVA 3	-5.14	4.08	-0.005	0.0087
NOVA 4	-42.19	30.40	-0.02**	0.0090
Total Spending	-56.11*	33.72	–	–
N = 56,305				

Note: *p<0.1; **p<0.05; ***p<0.01.

The results indicate a statistically significant decrease in overall monthly food spending, with GLP-1 initiation reducing total expenditures by approximately $56 (p ¡ 0.10). Households also increase their spending on minimally processed foods (NOVA 1) by nearly $10 per month (p ¡ 0.01). While the point estimate for NOVA 4 (ultra-processed foods) suggests a sizable negative change of roughly –$42, the estimate is not statistically significant, indicating substantial heterogeneity in how households reduce UPF purchases. However, when examining budget shares, we observe a consistent pattern: the share spent on NOVA 4 declines significantly (–2 percentage points, $p < 0.05$), and the share spent on NOVA 1 increases significantly (+3 percentage points, $p < 0.01$). This contrast suggests that even though total dollar reductions in UPF spending vary across households, the reallocation of spending away from UPFs and toward minimally processed foods is systematic and statistically robust.

To evaluate the conditional parallel-trends assumption underlying our empirical strategy, we estimate an event-study model and plot the dynamic treatment effects surrounding the month of GLP-1 initiation (Figure 2). The event-study coefficients show no statistically significant differences between treated households and the comparison group in any pre-treatment period, indicating that households starting GLP-1 medications were following

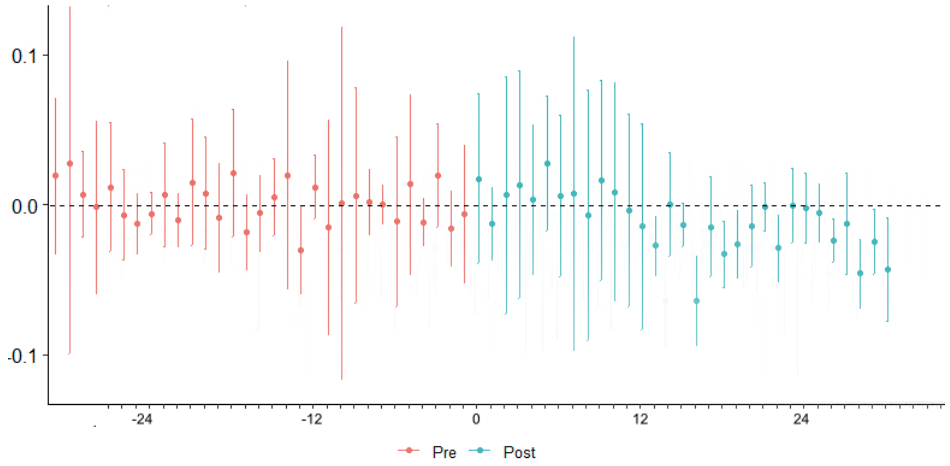

Figure 2: Event-Study of the Effects of GLP-1 on the Share of UPF

similar trends in food-purchasing behavior prior to treatment. This supports the validity of the identification strategy and suggests that the post-treatment changes can reasonably be attributed to GLP-1 initiation rather than pre-existing trends.

To assess the limited-anticipation assumption—which requires that households do not significantly alter their purchasing behavior immediately before starting GLP-1 medication—we re-estimate the effects using a three-month anticipation window. Under this specification, shown in Table 4, the decline in the NOVA 4 budget share becomes larger and remains statistically significant (–6.5 percentage points, $p < 0.05$), while none of the other NOVA groups show significant changes. This suggests two implications. First, the earlier detected increase in NOVA 1 may partly reflect anticipatory shopping behavior (e.g., households increasing healthier purchases after receiving medical advice but before filling their prescription). Second, the absence of offsetting increases in other NOVA groups suggests that households reduce UPF purchases in a heterogeneous manner—substituting them with different food types—yet the decline in UPF share itself remains consistent across specifications, reinforcing the robustness of the main findings.

	Estimate	Std. Error
NOVA 1	0.014	0.0078
NOVA 2	0.007	0.0094
NOVA 3	-0.0104	0.0084
NOVA 4	-0.0652**	0.025
N =	56,305	

Note: *p<0.1; **p<0.05; ***p<0.01.

Table 4: Effect of GLP-1 Prescription on Budget Share by NOVA Level with 3 Month Anticipation.

5 Discussion and Conclusion

The findings of this paper highlight meaningful adjustments in household food purchasing behavior following the initiation of GLP-1 medications. The consistent decline in the budget share of ultra-processed foods (NOVA 4), accompanied by an increase in the share devoted to minimally processed foods (NOVA 1), suggests that GLP-1 medications do more than reduce overall appetite and body weight—they also shift dietary composition in ways consistent with healthier eating patterns. Even though the dollar-value reduction in UPF purchases is heterogeneous and imprecisely estimated, the clear and statistically robust decline in the share of the food budget devoted to UPFs indicates that GLP-1 users reallocate their food spending toward less processed products. This real-world behavioral change aligns closely with clinical evidence showing reduced cravings, slower eating, and improved satiety among GLP-1 users.

These results carry implications for both public health and economic behavior. From a public health perspective, the dietary improvements implied by the budget-share shifts suggest that GLP-1 medications may produce beneficial nutritional spillovers beyond weight loss itself. Households with an individual who begins GLP-1 therapy appear to naturally move toward dietary quality improvements without explicit dietary counseling, potentially amplifying the health effects of pharmacological treatment. Such behavioral changes may help explain why GLP-1 trials find improvements in metabolic biomarkers that exceed what would be expected from weight loss alone. If sustained over time, these changes could trans-

late into meaningful reductions in the incidence of diet-related chronic conditions, including type 2 diabetes, hypertension, and cardiovascular disease.

From an economic standpoint, widespread adoption of GLP-1 medications may meaningfully reshape demand in the U.S. food sector. Ultra-processed foods—including snacks, sweetened dairy, baked goods, frozen meals, and sugary beverages—represent a substantial share of revenue for major food and beverage manufacturers. A systematic reduction in demand for these products could reshape product portfolios, advertising strategies, and innovation pipelines, particularly if GLP-1 adoption continues to accelerate. Similarly, producers of minimally processed foods—such as fresh produce, plain dairy, unprocessed meats, and staple ingredients—may benefit from increased demand. Retailers may also respond by reallocating shelf space or adjusting pricing strategies to reflect shifting purchasing patterns among GLP-1 users. Understanding these adjustments will be crucial for anticipating the long-run equilibrium effects of pharmacological interventions on consumer markets.

At the same time, the results also reveal important heterogeneity. While UPF budget shares decrease consistently, the total spending reductions in UPFs are more variable across households. This suggests that households substitute away from UPFs in different ways: some shift toward fresh foods, others toward simple processed items, and others reduce overall food purchases. Moreover, the anticipation analysis suggests that a portion of the increased spending on minimally processed foods (NOVA 1) may occur before households fill their first GLP-1 prescription, possibly after receiving medical advice or anticipating lifestyle changes. This underscores the importance of accounting for short-run behavioral responses and reinforces the need for robust identification strategies, such as the anticipation window analysis implemented here.

The study also contributes methodologically by demonstrating that robust and high-performing NOVA classification is achievable at scale using a hybrid approach that pairs hand-coding with machine-learning techniques. Accurate classification is essential for partitioning household spending across processing levels, and the strong performance metrics

of the Random Forest model show that text-based classification using product descriptions and ingredient lists is feasible even when scanner data formats change over time. This offers a practical framework for future researchers using Circana, NielsenIQ, or similar datasets to examine food processing, nutrition, or household demand.

There are several limitations to consider. Household-level purchases do not perfectly map to individual consumption, and the behavioral effects of GLP-1 may be diluted in multi-person households. The scanner data also lacks direct measures of nutritional intake or preparation behavior, meaning dietary changes must be inferred indirectly from purchasing patterns. Additionally, product-level metadata for private-label and random-weight items is limited, though the machine-learning classifier partially addresses this constraint. Nevertheless, the convergence of spending and share results across specifications increases confidence in the substantive conclusions.

In conclusion, this paper provides some of the first causal evidence on how GLP-1 medication initiation affects household food purchasing behavior in a real-world, nationally representative context. GLP-1 initiation leads households to reduce total food spending and to meaningfully reallocate their food budgets away from ultra-processed foods and toward minimally processed products. These findings have important implications for public health, policy design, and the food industry. As GLP-1 adoption continues to expand, future research should examine the persistence of these effects over time, the heterogeneity across demographic groups, and the degree to which purchasing changes translate into sustained improvements in dietary quality and health outcomes. The growing intersection of pharmacological therapy, nutrition, and consumer behavior presents a fertile area for interdisciplinary economic research.

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