Journal of Applied Economic Sciences
Volume XXI, Special Issue, 1(91), 2026

Market Availability and Household Consumption of Pasteurized Milk: A Propensity Score Matching Analysis in Sri Lanka

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Article's history:
Received 31st of October, 2025; *Revised* 29th of November, 2025; *Accepted* 1st of March, 2026; *Available online*: 15th of March, 2026. *Published* as article in the Volume XXI, Special Issue 1(91), 2026.

Suggested citation:
Krishnapillai, S., Sathiyamoorthy, S., Sivakumar, S., & Kulasekaram, L. (2026). Market Availability and Household Consumption of Pasteurized Milk: A Propensity Score Matching Analysis from Sri Lanka. *Journal of Applied Economic Sciences*, Volume XXI, Special Issue, 1(91), 337 – 350. https://doi.org/10.57017/jaes.v21.1(91).17

Abstract:

This paper examines the impact of daily availability of pasteurized milk on household consumption in Sri Lanka. Data were collected from 230 randomly selected households in the Jaffna and Nallur Divisional Secretariat divisions. To address potential selection bias in market availability, the analysis employs nearest-neighbour propensity score matching (PSM) to estimate the Average Treatment Effect (ATE) and the Average Treatment Effect on the Treated (ATET). The results show that daily availability of non-flavoured pasteurized milk increases household consumption by approximately 238 ml per week for the overall population and by 214 ml per week among households with access to daily supply. These findings indicate that limited market availability represents a significant constraint on pasteurized milk consumption in Sri Lanka, contributing to the continued reliance on milk powder. The results highlight importance of improving distribution systems and retail availability to promote the consumption of nutritious fresh milk and strengthen the domestic dairy sector.

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Keywords: pasteurized milk consumption; dairy market; propensity score matching; treatment effects; household demand; Sri Lanka.

JEL Classifications: D12; Q11; C21.

Introduction

Sri Lanka's dairy sector is shaped by both local and multinational firms, including Cargills, Lanka Milk Foods, Pelwatte, Milco, Lucky Lanka, Maliban, and Fonterra. These companies produce a wide range of dairy products such as milk, butter, cheese, yogurt, ice cream, and milk powder. In the non-flavoured pasteurized milk segment, Cargills and Ambewela lead distribution, followed by Pelwatte, Milco (Highland), Lucky Lanka, and Maliban. By 2024, farm-gate milk prices average around LKR 200 per liter, while marketing margins vary by product: non-flavoured pasteurized milk (LKR 160–220), flavoured milk (LKR 220–300), UHT milk (LKR 180–350), curd (LKR 280–380), and milk powder (LKR 500–600) per litter equivalent (Department of Census and Statistics, 2025). Multiproduct dairy firms, including the state-owned Milco (Pvt), have reduced the supply of non-flavoured pasteurized milk due to higher margins in other products. To protect consumers during inflation, the government imposed maximum retail prices in 2013, 2014, 2017, and 2021. At present, there are no direct price controls on pasteurized milk, though regulators monitor prices closely. Historically, price controls have focused more on imported milk powder than on fresh milk, as part of broader efforts to manage food inflation.

The market is currently facing a shortage of non-flavoured pasteurized milk, while supplies of other dairy products remain stable. This shortage arises because the price of non-flavoured pasteurized milk, as indicated on packets, is set below the equilibrium level. As a result, deadweight loss occurs, reflecting the welfare lost when markets cannot function at their natural equilibrium. This loss represents the value of mutually beneficial transactions that fail to take place due to the shortage. Producers, in response, divert milk into higher-margin products such as flavoured milk, UHT milk, curd, butter, cheese, and milk powder. Consequently, many consumers who place high value on fresh milk are unable to obtain it. Non-flavoured pasteurized milk holds a unique position in affordability and daily diets, yet substitutes are often more expensive or less nutritious. Consumers are therefore compelled to purchase alternatives, such as imported milk powder or flavoured milk, at higher prices.

Producers also forfeit potential revenue from selling fresh milk at equilibrium prices, while resources are misallocated toward products with greater margins rather than meeting demand for non-flavoured pasteurized milk. This under-supply prevents society from maximizing welfare. Wealthier households can absorb the cost of substitutes, but poorer households face exclusion from adequate nutrition.

Moreover, reliance on imported milk powder heightens vulnerability to global price fluctuations and foreign exchange risks. Sri Lanka's five main non-flavoured pasteurized milk plants are located in just three districts, Nuwara Eliya, Gampaha, and Colombo, out of the country's 25 districts. Operated by major dairy companies such as Milco (state-owned) and Cargills, these plants process milk supplied by thousands of small-scale farmers nationwide. High marketing margins are largely driven by logistics, with significant costs tied to transport, cold-chain maintenance, and distribution to urban markets. Beyond logistics, reliance on smallholder production, inefficiencies in processing, and limited economies of scale also contribute to elevated costs.

These firms, regardless of ownership, employ business strategies to maximize profit rather than promote the consumption of pasteurized milk, which is a healthier and more nutritious product among milk variants. In contrast, in many developed and developing countries, consumers prefer liquid milk over milk powder due to its availability and their preferences for pasteurized milk. In Sri Lanka, multinational companies and state-owned firms do not prioritize promoting pasteurized milk consumption and restrict the availability of non-flavored pasteurized milk as part of their business strategies. Therefore, it is important to investigate the reasons behind the low consumption of pasteurized milk compared to milk powder in Sri Lanka and the impact of pasteurized milk availability on its consumption. This investigation aims to develop appropriate policies to enhance pasteurized milk consumption, improve the domestic dairy industry, and boost the nutrition of the Sri Lankan population. The primary objective of this study is to estimate the effect of pasteurized milk availability on its consumption in the urban areas of the Jaffna district in Sri Lanka.

2. Literature Review

One of the most vital foods for humans is milk, which provides an abundance of vital elements like vitamins, calcium, and proteins (Ma & Barbano, 2020). Pasteurized milk consumption has generally increased in emerging nations as a result of increased supply chains, urbanization, and increased health consciousness. (Rabbani, 2025). The Food and Agriculture Organization (FAO) states that because milk has a high bioavailability of calcium and other vital elements, dairy consumption is essential to nutritional security in developing nations like Sri Lanka, especially for children and pregnant women (FAO, 2019).

The global demand for dairy products has experienced significant growth over the past few decades, driven by factors such as rising incomes, urbanization, and increasing awareness of nutritional benefits (FAO, 2019). In many developed nations, pasteurized milk is the dominant choice due to stringent food safety regulations and widespread health campaigns emphasizing the dangers of raw milk. For instance, in the United States and Europe, over 90% of milk consumed is pasteurized (Murphy et al., 2016). In an industrialized nation like England, where milk is delivered as UHT (8.7%) and pasteurized (87%), (Kapaj, 2018). Sri Lanka is one of the very few countries in the world that still consumes a large proportion of its milk in the form of powdered milk (Mendis & Edirisinghe, 2014). The open economic policy has brought in the flow of international dairy companies and brands. The strong brand name, commercial advertisement and high quality of milk powder significantly influence the consumer purchasing decision.

Foreign multinational companies dominate the dairy industry, and 88,481.83 MT of milk and milk products were imported in the year 2021. Also, Sri Lanka has been spending a considerable amount of money on powdered milk importation since 1977, to fill the gap between demand and supply. In 2021, 63 billion rupees were spent on milk products importation. Of the total milk products importation expenses, Sri Lanka spends a higher expenditure on milk powder fat > 1.5% and milk powder fat < 1.5% (Department of Animal Production and Health,2020). Among the imported milk and milk products, powdered milk is the main product. In Sri Lanka, the annual per capita consumption of milk and milk products was 47.47 Kg in 2021, and this amount was low compared to some other South Asian countries like India (143.81 Kg) and Pakistan (231 Kg).

According to the food-based dietary guidelines for Asian countries, the recommended level of dairy intake is 300 g/day (Comerford et al., 2021). However, the dairy intake in Sri Lanka was 130 g/day in 2021, considerably lower than the recommended level. In addition, Sri Lanka is currently experiencing difficulties in importing essential goods, including milk powder, due to the depreciation of the Sri Lankan currency value against the US dollar, which could result in a decline in the per capita consumption of milk and milk products. Notably, the per capita intake of milk products in Sri Lanka is already much below the advised level, and the ongoing economic crisis has further lowered consumption, especially for children and low-income households. In contrast to the overall increase in the per capita intake of milk products, liquid milk consumption has declined. It is important to note that, Sri Lanka will benefit from increasing domestic liquid milk consumption in several ways. It could help the growth of the domestic dairy industry, resulting in more job opportunities and rural development. Also, it would lessen the reliance on imported dairy products.

In Sri Lanka, a few demand studies have been conducted to estimate the demand for milk and milk products (Nirmali & Edirisinghe, 2015; Edirisinghe, 2014; Lokuge et al., 2019; Pallegedara, 2019; Sivakumar et al., 2025). Sahn (1988) examined the own-price, cross-price and expenditure elasticities for milk in each area and income group using data from the 1980/81 Labour Force and Socio-Economic Survey. Sahn (1988) employed a two-stage approach, using a probit model in the first step and an ordinary least squares regression (OLS) in the second step. Sahn (1988) findings reveal that milk appeared to be luxury goods with elastic own-price elasticities across all areas and income groups. Notably, the findings of this study revealed that during the 1980s milk and milk products showed more responsiveness to price changes. Moreover, Sahn (1988) suggested that the own-price elasticities for milk in urban, rural, and estate regions were elastic over the period 1980/81. In addition, the own price elasticity for milk was elastic among the different income level groups (i.e., low, middle & high). Though the milk showed high responsiveness to price changes in all regions, the responsiveness to price changes varied with income level.

Education plays an important role in shaping consumer preferences for pasteurized milk. Consumers with higher levels of education tend to exhibit greater awareness of the health risks associated with raw milk and are consequently more likely to opt for pasteurized alternatives. Educated consumers in urban areas, in particular, are more aware of food safety guidelines and the protective role of pasteurization in eliminating harmful bacteria such as *E. coli* and *Salmonella*. Urban households generally favour pasteurized milk, largely due to higher health awareness and easier access to processed dairy products (Sagarika Hitihamu, 2021).

In urban areas such as Jaffna and Nallur, where educational attainment is comparatively higher than in rural regions, pasteurized milk consumption is more prevalent. Educated consumers are also more responsive to public health campaigns and nutritional information disseminated by health authorities and retail marketing channels (Perera et al., 2020). The availability of pasteurized milk in supermarkets and convenience stores is often accompanied by informational labelling and promotional messaging, which educated consumers are better equipped to interpret and act upon.

Conversely, among less educated populations, the perception of raw milk as “natural” or “unprocessed” remains strong, thereby limiting the adoption of pasteurized alternatives. Limited awareness of the potential health risks associated with unpasteurized milk further constrains behavioural change in these communities. This underscores the importance of

targeted health education initiatives aimed at improving food safety awareness and promoting informed consumption decisions (Ranganathan, 2017).

Age is another significant demographic factor influencing milk consumption patterns. Younger consumers, particularly those in urban households with young children, tend to prefer pasteurized milk due to its perceived safety and nutritional benefits. Parents in urban areas are often more concerned about food safety and the health risks associated with raw milk, making pasteurized milk the preferred choice for children and infants. Older generations, on the other hand, may be more resistant to adopting pasteurized milk, often due to deeply ingrained cultural beliefs and preferences for traditional, locally sourced raw milk. While urbanization and modernization are shifting preferences in younger populations, these changes are slower among older generations. Household composition also influences preferences. Larger families with children tend to prioritize health and safety, making them more likely to consume pasteurized milk. Pasteurized milk is safe but costly and requires refrigeration, raw milk is affordable, powdered milk is convenient with a long shelf life for low- and middle-income consumers, and UHT milk is readily available but may be too expensive (Bandara et al., 2021).

In Sri Lanka, the consumption of fresh liquid milk is very low compared to other Asian countries like India, Pakistan, Bangladesh, and Nepal, but milk powder consumption is high compared to other countries. Sri Lanka is one of the very few countries in the world that still consumes a large proportion of its milk in the form of powdered milk (Mendis & Edirisinghe, 2014). Especially multinational companies are spending massive sums of money on powdered milk commercials, which has significantly changed consumers' preference for fresh milk (i.e., shifting them from fresh milk to milk powder) (Korale-Gedara et al., 2023). Even though liquid milk has a higher nutritional value when compared to powdered milk, consumers in Sri Lanka consume relatively more powdered milk than liquid milk. This low liquid milk consumption may be due to the market environment of all milk products, the government policy towards imported and domestic milk products, and issues with the liquid milk marketing channels, such as food safety issues and the limited availability of processed liquid milk in the market.

3. Research Methodology

In Sri Lanka's Northern Province, there are 15 Divisional Secretariat divisions. Among these, the Jaffna and Nallur divisions stand out as urban areas, making them significant for research. Both divisions reflect a dynamic blend of cultural heritage and modern living, with growing interest in health and nutrition. This focus on urban settings provides an opportunity to explore how the availability of pasteurized milk affects its consumption patterns, contributing to public health insights in these communities. The Jaffna and Nallur Divisional Secretariat divisions in Sri Lanka encompass a combined area of approximately 1,042 square kilometres. The Jaffna DS Division covers about 1,020 square kilometres, making it the larger of the two, while the Nallur DS Division spans around 22 square kilometres. In selecting households from the Jaffna and Nallur Divisional Secretariat divisions, a proportional approach ensures a representative sample. The total number of households in Jaffna is 16,474, while Nallur has 20,728, making a combined total of 37,202. The proportions for household selection are approximately 44.2% for Jaffna and 55.8% for Nallur. Accordingly, 100 households will be selected from Jaffna and 130 from Nallur. To achieve this, random sampling methods will be employed, utilizing random number generators to ensure unbiased selection of household. The personal interview method was used to collect respondent’s data such as age, gender,

education level, income, family size, refrigerator ownership and consumption of non- flavoured, flavoured pasteurized milk, milk powder, local unprocessed fresh milk and UHT milk.

In this study, nearest-neighbour propensity score matching (PSM) is employed to construct comparable groups and estimate the treatment effect of daily availability of pasteurized milk on household consumption. To understand this relationship, it is essential to compare the consumption outcomes of households that have access to pasteurized milk with those that do not. However, only the outcomes of households with access to pasteurized milk can be directly observed, which complicates the analysis. Moreover, the impact of daily availability on consumption will likely vary across different households, reflecting diverse preferences, needs, and circumstances. This heterogeneity suggests that the influence of pasteurized milk availability is not uniform, highlighting the importance of considering individual household contexts in evaluating consumption patterns.

This study utilizes two key measures to evaluate the impact of pasteurized milk availability on consumption: the average treatment effect (ATE) and the average treatment effect on the treated (ATET). The ATE examines the influence on the consumption of a randomly selected household from the population, while the ATET focuses specifically on households who were considered in this study. The relationship unfolds in two stages: first, the availability of pasteurized milk is established, followed by the actual consumption. However, selection bias may arise when factors influencing milk availability also affect consumption outcomes. Unobservable characteristics related to milk availability can skew results, leading to biased estimates unless these sample selection issues are adequately addressed. In this analysis, a binary treatment approach is applied, with a dummy variable (Di) defined as 1 for treated individuals and 0 for those not receiving the treatment. The potential outcomes depend on the treatment, Qi(Di), for individual *i*. The treatment effect for an individual *i* can be defined as:

$$\boldsymbol{\tau}_i = \mathbf{Q}_i(\mathbf{1}) - \mathbf{Q}_i(\mathbf{0}) \quad (1)$$

Only one outcome is observed for each individual i. The unobserved outcome is needed to estimate the individua treatment effect, $\boldsymbol{\tau}$i. The Average treatment effect on the treated (ATET) can be defined as:

$$\boldsymbol{\tau ATET} = \boldsymbol{E}(\boldsymbol{\tau}|\boldsymbol{D} = \mathbf{1}) = \boldsymbol{E}(\boldsymbol{Q}(\mathbf{1})|\boldsymbol{D} = \mathbf{1}) - \boldsymbol{E}(\boldsymbol{Q}(\mathbf{0})|\boldsymbol{D} = \mathbf{1}) \quad (2)$$

The unobserved outcome for those being treated is defined as

$$\mathbf{E}(\mathbf{Q}(\mathbf{0})\,|\,\mathbf{D}=\mathbf{1}) \quad (3)$$

As the outcomes of individuals from treatment would differ from the outcomes of individual from comparison group even in the absence of treatment, there would be self-selection bias. The true parameter ATE is only identified if `self-selection bias's is equal to 0.

$$\boldsymbol{\tau ATE} = \boldsymbol{E}(\boldsymbol{Q}(\mathbf{1}) - \boldsymbol{Q}(\mathbf{0})) - [(0)||D = 0] = 0 \quad (4)$$

To solve `self-selection bias' problem, some identifying assumptions should be made. The average of differences between the outcomes of treated and non-treated is the mean effect of treatment. Average treatment effect (ATE) is defined as:

$$\boldsymbol{\tau ATE} = \boldsymbol{E}(\boldsymbol{Q}(\mathbf{1}) - \boldsymbol{Q}(\mathbf{0})) \quad (5)$$

In this study, the method of matching is employed to create comparable groups for evaluating the treatment effect of pasteurized milk availability. By identifying individuals in the comparison group who share similar observable characteristics with each member of the treatment group, reliable estimates can be obtained. Rosenbaum & Rubin (1983) established that matching on all covariates through a single index based on the probability of participation, known as propensity score matching, yields accurate treatment effect estimates. To generate a propensity score for each observation, a logit regression model is developed with daily availability of non-flavoured pasteurized milk as the dependent variable and the potential covariates such as age, gender, education level, income, family size, refrigerator ownership, and consumption of flavoured milk, milk powder, local unprocessed fresh milk, and UHT milk as explanatory variables.

4. Results and Discussions

This section presents the empirical findings of the study in a structured sequence, beginning with descriptive statistics, followed by the estimation of the propensity score model, balance diagnostics, and finally the causal treatment effect estimates. The analysis proceeds systematically to ensure that identification assumptions underlying propensity score matching are satisfied before interpreting the estimated impact of daily availability on pasteurized milk consumption.

Table 1 shows the description and descriptive statistics of variables. It shows that 78 % of respondents are male and 22 % are female. 82 % of households own refrigerator. Only 47% of respondents state that pasteurized milk is available daily in shops in the study area. Average weekly consumption of non-flavoured milk, flavoured pasteurized milk, UHT milk and unprocessed fresh milk is around 200 ml, 75 ml, 100 ml and 1000 ml respectively. Average weekly consumption milk powder is around 390 grams.

Table 1: Descriptive Statistics of Variables

Variable	Description	Obs	Mean	Std	Min	Max
age	age (years)	230	48.51	13.71	19	86
gen	Gender, Male =1, Female = 0	230	0.78	0.41	0	1
edu	education level (years)	230	12.83	2.85	5	19
inc	Monthly income (LKR}	230	83,726.09	59,316.03	15,000	378,000
fsize	family size (numbers)	230	3.85	1.24	1	7
ref	refrigerator, yes =1, no = 0	230	0.82	0.39	0	1
nfmilk	non-favored milk (ml/week)	230	201.22	512.06	0	3,000
fmilk	flavored milk (ml/week)	230	74.26	284.21	0	2,500
mpowder	milk powder (g/week)	230	388.48	325.90	0	2,000
uht	UHT milk (ml/week)	230	108.57	445.43	0	5,000
lmilk	unprocessed fresh milk (l/week)	230	1.02	2.19	0	14
avail	daily availability, yes = 1 , no = 0	230	0.47	0.50	0	1

Note: Variables describe household characteristics and weekly milk consumption. Binary variables are coded as 1 = yes and 0 = no.

Source: Authors' calculations based on household survey data

While Table 1 provides a descriptive overview of household characteristics and milk consumption patterns, causal inference requires addressing potential selection bias in the availability of pasteurized milk. To address potential selection bias in treatment assignment, a logit model is estimated to derive propensity scores. Table 2 reports the estimated coefficients of the availability model, which forms the basis for subsequent matching procedures.

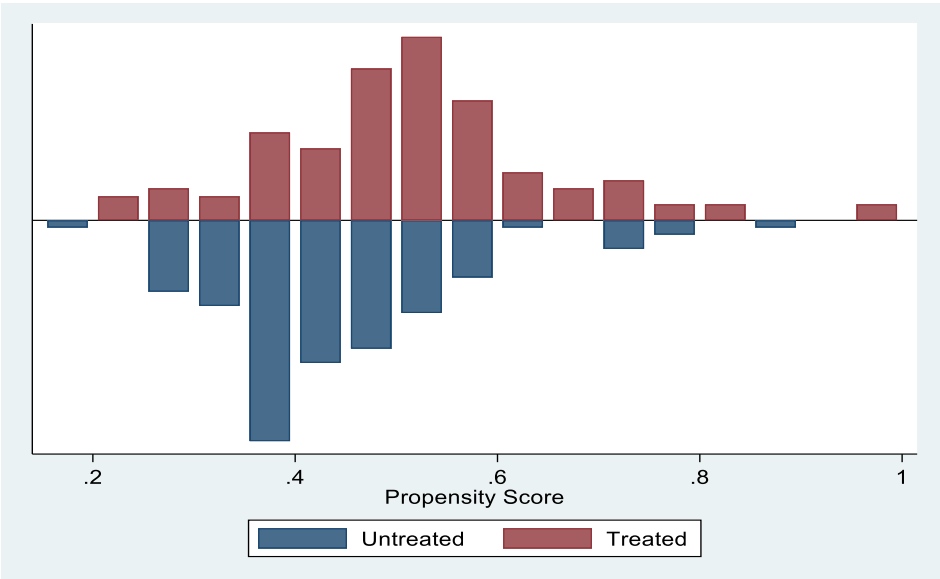
Table 2: Logit Model for the Availability of Non-Flavoured Pasteurized Milk

Variable	Coefficient	Std. Err.	z	P>|z|	95% Conf. Interval
age	0.0027	0.0109	0.20	0.839	-0.0191; 0.0235
gen	0.4261	0.3479	1.22	0.221	-0.2557; 1.1070
edu	-0.0204	0.0579	-0.35	0.724	-0.1340; 0.0931
inc	0.0000034	0.0000029	1.18	0.237	-0.0000022; 0.0000091
fsize	0.1713	0.1193	1.44	0.151	-0.0625; 0.4052
ref	-0.2897	0.3758	-0.77	0.441	-1.0260; 0.4469
fmilk	0.0013	0.0007	1.73	0.084	-0.0001; 0.0027
mpowder	0.0005	0.0004	1.20	0.200	-0.0003; 0.0015
lmilk	-0.0505	0.0677	-0.75	0.456	-0.1832; 0.0822
uht	-0.0001	0.0003	-0.47	0.636	-0.0007; 0.0004
_cons	-1.2400	1.1220	-1.11	0.269	-3.4390; 0.9586

Note: Logit model estimates used to compute propensity scores for the matching procedure.
Source: Authors' calculations based on household survey data.

Following the estimation of the propensity scores, it is essential to assess the common support condition and examine whether sufficient overlap exists between treated and control households. Figure 1 illustrates the distribution of propensity scores across both groups. The distribution indicates adequate overlap between treated and control households across five propensity score blocks, satisfying the common support condition. This ensures that treated observations can be meaningfully compared with observationally similar control units.

Figure 1: Propensity Score Distribution for Treatment and Comparison Groups (Non-Flavoured Milk)



Note: Distribution of propensity scores for treated and control households.
Source: Authors' calculations.

While Figure 1 confirms adequate overlap between treated and control observations, formal validation of the balancing property requires statistical assessment. Table 3 therefore reports the sample distribution before and after matching. Table 3 compares the sample composition before and after matching. While the raw sample contains 108 treated and 121 control observations, the matched sample achieves exact numerical balance (108 treated and 108 controls), indicating successful implementation of the matching algorithm.

Table 3: Covariate Balance Summary for Non-Flavoured Pasteurized Milk Consumption

	Raw	Matched
Number of obs	229	216
Treated obs	108	108
Control obs	121	108

Note: Sample composition before and after nearest-neighbour matching.
Source: Authors' calculations based on household survey data.

Table 4 further confirms covariate balance between treated and control groups, as post-matching means and variances exhibit no systematic divergence. This supports the validity of the conditional independence assumption required for unbiased treatment effect estimation.

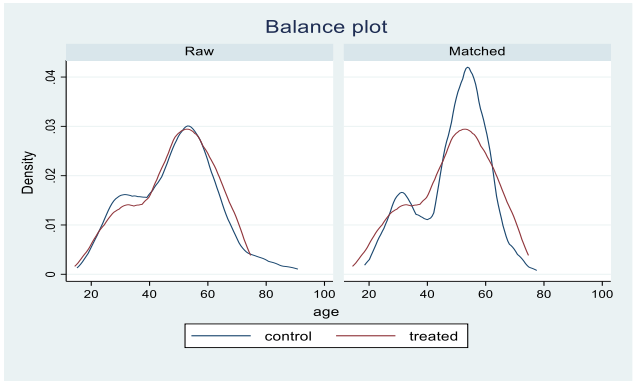
Table 4: Covariate Balance Between Control and Treated Groups (Non-Flavoured Pasteurized Milk)

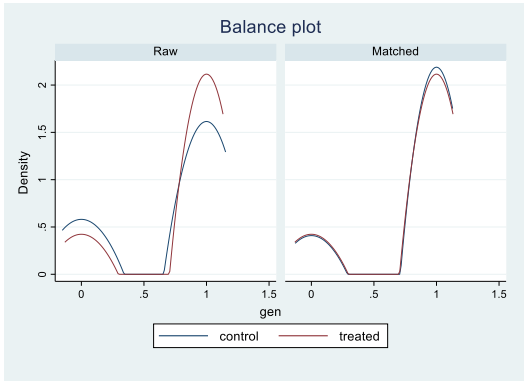
Variable	Means		Variances	
	Control	Treated	Control	Treated
avail	0	1	0	0
age	48.50	48.40	200.50	175.60
gen	0.73	0.83	0.19	0.14
edu	12.81	12.79	8.23	7.95
inc	76,917.00	90,277.00	3.07e+09	3.87e+09
fsize	3.67	4.03	1.40	1.62
ref	0.83	0.79	0.13	0.16
fmilk	32.23	122.00	22,635.00	143,130.00
mpowder	347.00	431.00	78,887.00	133,491.00
lmilk	1.16	0.87	5.37	4.13
uht	113.00	104.00	264,823.00	127,478.00

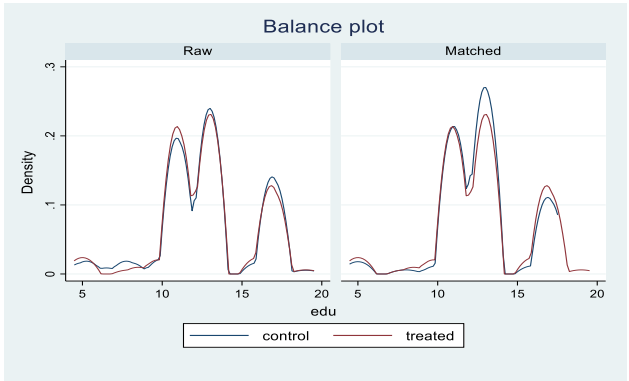
Note: Covariate means and variances for treated and control groups after matching.
Source: Authors' calculations based on household survey data.

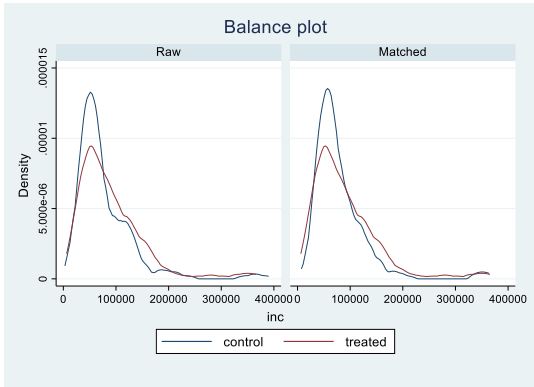
To complement the numerical balance diagnostics presented in Table 4, Figure 2 provides a graphical representation of standardized covariate differences before and after matching.

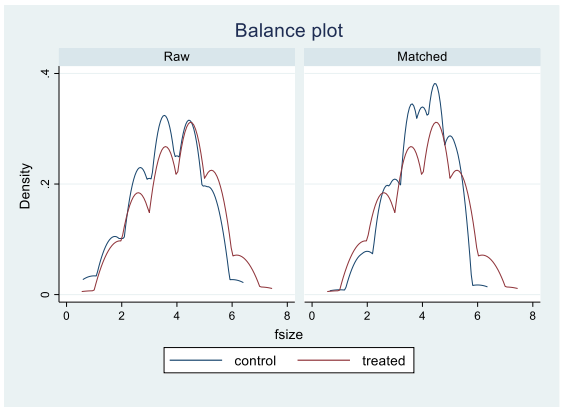
Figure 2: Balanced Plot of Covariates

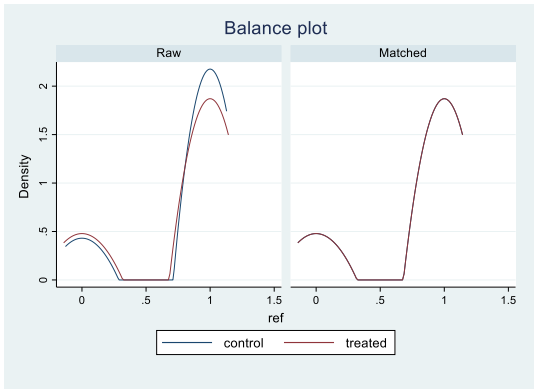


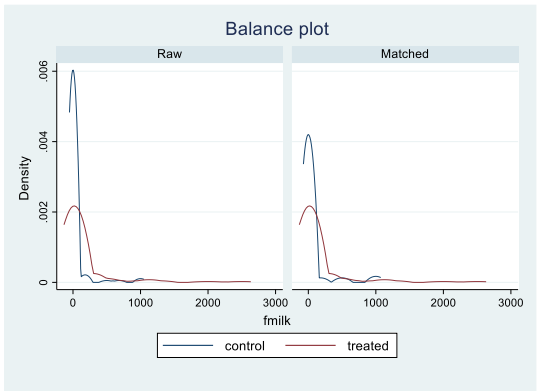


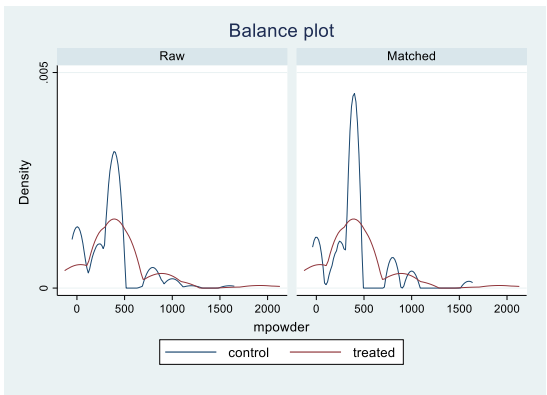


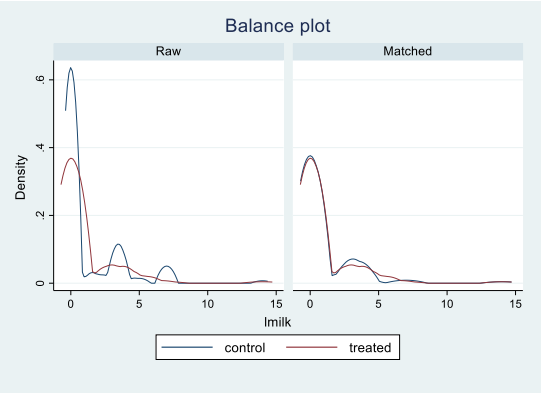


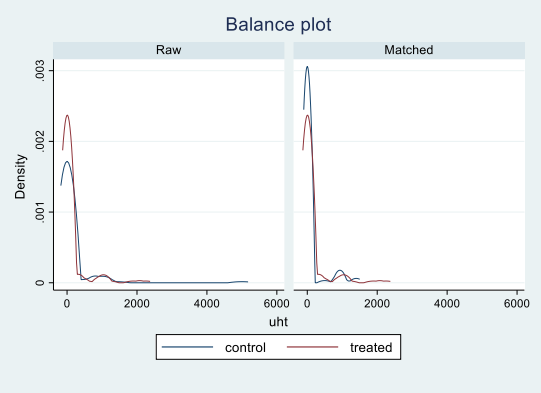












Note: Standardized covariate differences before and after matching.
Source: Authors' calculations.

Having established common support and covariate balance, the analysis proceeds to estimate the causal effect of daily availability on non-flavoured pasteurized milk consumption. Table 5 reports nearest-neighbour propensity score matching estimates of the Average Treatment Effect (ATE) and the Average Treatment Effect on the Treated (ATET).

Table 5: Nearest-Neighbour Matching Estimates of the Effect of Daily Availability on Non-Flavoured Pasteurized Milk Consumption

Treatment Effect	Coefficient (ml/week)	Robust Std. Err.	z-statistic	P>|z| (p-value)	95% Confidence Interval
ATE (avail 1 vs 0)	238.07***	74.63	3.19	0.001	91.79 - 384.35
ATET (avail 1 vs 0)	213.89***	68.62	3.12	0.002	79.38 - 348.39

Note: ATE denotes the Average Treatment Effect and ATET denotes the Average Treatment Effect on the Treated. Estimates are obtained using nearest-neighbour propensity score matching (PSM). Robust standard errors are reported. *** $p < 0.01$.
Source: Authors' calculations based on household survey data.

The nearest-neighbour matching estimator yields an Average Treatment Effect (ATE) of 238 ml per week ($p < 0.01$), indicating that availability increases weekly household purchases across the full population. The Average Treatment Effect on the Treated (ATET) is 214 ml per week ($p < 0.01$), reflecting the causal effect among households exposed to daily availability.

The consistency between ATE and ATET estimates suggests robustness of the treatment effect across both the full population and the treated subgroup. The slightly lower ATET relative to the ATE may reflect heterogeneity in baseline consumption patterns or differential selection into treatment.

Overall, the matching results provide strong evidence that availability exerts a positive and economically meaningful impact on weekly household consumption. The similarity between the ATE and ATET estimates further supports the robustness of the results, suggesting that the positive impact of daily availability on pasteurized milk consumption is consistent across both the overall population and the treated households. In addition, the balancing diagnostics and common support condition confirm that the matching procedure successfully reduced selection bias.

Conclusion

This study provides empirical evidence that the daily availability of non-flavoured pasteurized milk exerts a statistically and economically significant impact on household purchasing behaviour. Using nearest-neighbour propensity score matching with AI-robust standard errors, the results indicate that the Average Treatment Effect (ATE) amounts to 238 ml per week and is significant at the 1% level. This suggests that, on average, the availability of non-flavoured pasteurized milk increases weekly household purchases by approximately 238 ml across the full population.

Similarly, the Average Treatment Effect on the Treated (ATET) is estimated at 214 ml per week and is also significant at the 1% level. This implies that among households exposed to daily availability, weekly purchases increase by about 214 ml. The consistency between the ATE and ATET estimates confirms the robustness of the treatment effect and indicates that improved availability produces meaningful gains in consumption both at the population level and among treated households.

From a market perspective, the fixed pricing structure, irregular supply, and limited retail availability of non-flavoured pasteurized milk in Sri Lanka may partly explain the country's comparatively low per capita consumption relative to neighbouring and more developed economies. In contrast, milk powder consumption remains substantially higher, reflecting substitution patterns driven by availability and supply stability rather than consumer preference alone.

The findings therefore highlight the structural importance of supply-side interventions in the dairy market. Policies aimed at improving distribution efficiency, strengthening cold-chain logistics, and ensuring consistent retail availability of non-flavoured pasteurized milk could significantly increase household consumption. Such measures would not only improve dietary quality and nutritional outcomes but also support the development of the domestic dairy sector and reduce reliance on imported milk powder in Sri Lanka.

Credit Authorship Contribution Statement

The authors contributed to this work in various capacities. Krishnapillai, S. was responsible for conceptualization, methodology, analysis and writing the original draft. Sathiyamoorthy, S. contributed through conceptualization, analysis, and writing the original draft, and writing through review and editing. Sivakumar, S. participated in conceptualization, data curation and analysis, and writing the original draft. Kulasekaram, L. contributed to data collection and curation, and validation. All authors have read and approved the final version of the paper.

Acknowledgments/Funding

The authors state that no financial assistance was received for the work.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data Availability Statement

Data are available from the corresponding author upon reasonable request.

Ethical Approval Statement

This study was conducted in accordance with accepted ethical research standards for social science research involving human participants. Data were collected through voluntary household interviews conducted in the Jaffna and Nallur Divisional Secretariat divisions of Sri Lanka. All respondents were informed about the purpose of the study prior to participation, and verbal informed

consent was obtained from each participant. No personal identifying information was recorded, and all data were anonymized prior to analysis to ensure participant confidentiality.

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