
Physical Activity, Taste Preferences, Selected Socioeconomic Characteristics: Differentiate Consumer Behavior Older Adults in the Dairy Market in Poland – Pilot Study

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Article

Physical Activity, Taste Preferences, Selected Socioeconomic Characteristics: Differentiate Consumer Behavior Older adults in the Dairy Market in Poland—Pilot Study

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Abstract: The literature reports on the relationship of dairy product consumption with preferences, socio-economic characteristics, and physical activity. Little is known about buying behavior in the dairy market and its determinants, especially among older adults. The study aimed to evaluate the relationship between older adults' habitual purchase of dairy products and their liking, frequency of buying functional dairy products, physical activity, and selected socioeconomic characteristics. The cross-sectional pilot study was conducted between July and October 2024, among 310 people aged 60 and over in the Lower Silesia region of Poland. The survey collected data on the frequency of buying of dairy products (PF-DP scale), their preferences (P_DP scale), physical activity (IPAQ questionnaire), and socio-demographic and economic characteristics. The PCA analysis identified 3 patterns of buying behavior. The IPAQ procedure assessed physical activity levels in MET-minutes/week or minutes/week. The relationship between the identified buying behavior patterns and their determinants was verified using the Kruskal-Wallis test and Chi-square. It was found that high intensity of the “conventional dairy products and fats” pattern correlated with taste preferences, living with family (with or without a partner), high physical activity, including shuffling, sports, and recreational activities, and frequent purchase of different functional food groups. The financial situation described as “we live on average” was related to the high intensity of the “dairy fat” pattern and its moderate intensity to the high activity associated with movement. Only the high activity associated with housework was associated with a moderate increase in the “powdered milk, condensed and unfermented dairy drinks” pattern. With limited literature data and inconclusive survey results, evaluating the relationship, especially its causal nature, between the attitudes and buying behavior of the elderly in the dairy market, requires further research.

Keywords: consumer behavior; taste preferences; socioeconomic characteristics; physical activity; older adults

1. Introduction

Aging is an irreversible process associated with a decline in tissue and cell function and an increased risk of various age-related diseases [1–4], including musculoskeletal diseases that reduce physical fitness. The muscle mass of older people is influenced by environmental factors, factors related to physical exertion, nutritional factors, etc. [5]. Milk and dairy products are a part of better overall diet quality [6]. Dairy products are a nutrient-rich source of protein, the deficiency of which

adversely affects muscle mass and strength [7]. Dairy provides several other nutrients that potentially protect against frailty, including calcium, magnesium, and vitamin D [8–10]. In addition, milk and its products are a source of magnesium, zinc, copper, molybdenum, and vitamins A, E, B₁, B₂, B₆, B₁₂, niacin, pantothenic acid, and folate [11], which are essential in the prevention and treatment of diseases associated with changes in body composition [2,3,12–14]. Evidence shows that consumption of dairy products can help stave off movement restrictions [15,16]. Daily consumption of milk and milk products was inversely associated with functional disability in older men [17] and better women's physical performance than non-consumers [18]. The epidemiological evidence is still inconsistent regarding the relationship between intakes of dairy products and frailty risk in older adults [19,20]. Dairy products positively affect frailty and sarcopenia [21,22]. However, milk and dairy products have some limitations, including lactose intolerance and allergy to milk components [23,24]. The atherogenic properties of dairy fat remain debatable due to inconclusive research results [24,25]. Many dairy foods add a substantial amount of saturated fat to the diet, which has adverse effects on blood lipids and is positively associated with the risk of cardiovascular disease compared to unsaturated fats [26]. Other studies suggest that the consumption of dairy products by the elderly at recommended levels does not impair the body's lipid metabolism [27]. In order to reduce the adverse effects of the consumption of dairy products or increase their positive impact, functional dairy products are being introduced to the market [28,29], which are becoming more widely consumed by older adults [30]. Despite some controversy, the dietary guidelines in Poland and other countries recommend the daily consumption of dairy products as part of a healthy diet for the general population.

Many factors condition the consumption of milk and dairy products, both macroeconomic [31–33] as well as microeconomic, among which are aspects of the nature of socio-demographic and economic conditions related to the consumer [34,35], as well as their preferences [36–38]. In studies conducted in Poland, particular attention was paid to the socioeconomic structure of households, family structure, income size, education level, province, region, place of residence [34,35], and sensory preferences [34,36–38].

Evidence suggests that regular physical activity provides extensive health benefits in older adults [39]. Older adults, however, are often less physically active [40]. Only 2.5–22% of community-dwelling older adults achieve current WHO-recommended PA levels (150-min moderate-intensity PA per week) [41]. Barriers to older adults' engagement with PA included pain and discomfort, concerns with falling, and access difficulties [42]. As written earlier, the consumption of dairy products can help stave off movement restrictions [15,16], although the evidence supporting this relationship is incomplete.

Incorporating milk and dairy products into an older person's diet is practical and convenient, especially if they have the consistency to overcome specific barriers to eating, such as tooth loss and difficulty swallowing. Their nutrient-rich nature, providing high-quality protein, micronutrients, and bioactive compounds, can promote a good quality of life, including physical activity. Since their consumption is conditioned by the sociodemographic and economic characteristics of the individual, it was taken into account along with taste preferences to explain the link between the purchase of milk and dairy products, as well as milk fats and the activity of the older people. The study aimed to evaluate the relationship between older people's habitual purchase of these products and their liking, frequency of buying functional dairy products, physical activity, and selected socioeconomic characteristics.

2. Materials and Methods

2.1. Study Design and Sample

The cross-sectional pilot study was conducted between July and October 2024. All stages of the study involved 310 people aged 60 and over from the Lower Silesian province. Senior Organizations in Wrocław, i.e. „Space of the Third Age” and „ALTIUS” Association, as well as the City and

Municipality Offices in Siechnice and Święta Katarzyna, were asked to help recruit respondents. The study was conducted in three stages.

The first stage of the study included a “panel discussion” on understanding the questions. It was conducted in July 2024 among 30 people aged 60 and over at a selected Senior Club in Wrocław. This stage of the study allowed changes to be made to the content of the questions and measurement scales under the comments of potential respondents.

Pretesting was the second stage of the study and was designed to assess the relevance and reliability of the test. This stage was carried out in July 2024 in 30 people aged 60 and over at a selected Senior Club in Wrocław. The questionnaire was completed by respondents 2 weeks apart (test-retest). Pre-testing was conducted for two scales: PF_DP (*Purchasing Frequency, Dairy Products*) and P_DP (*Preferences, Dairy Products*). To verify the measurement accuracy of the tested variables, a reliability analysis was performed using Cronbach's alpha method [43]. Cronbach's alpha reliability coefficient for the PF_DP scale was estimated at $\alpha = 0.89$ and for the P_DP scale at $\alpha = 0.82$, and showed that the reliability of these measurements had satisfactory measurement accuracy [44]. A value higher than 0.70 for Cronbach's alpha reliability coefficient was considered acceptable [43,44]. Kirppendorf's alpha statistic was used to assess the accuracy of the measurement scales [45]. Very good compliance of the PF_DP scale was achieved with 14 test items, good - 3 test items; and for the P_DP scale, very good - 11 test items, good - 6 test items. The concordance of test items is very good when the score of this statistic is > 0.8 , good (0.60 - 0.80), satisfactory (0.40 - 0.59), and insufficient (< 0.40) [45]. A Kirppendorf alpha coefficient of at least 0.40 was considered acceptable.

In the third stage, the survey proper was conducted in September/October 2024. A total of 250 questionnaires were distributed during this stage of the study. The criteria for inclusion in the study were: age 60 and over, residence in the Lower Silesian Province, lack of any occupational activity (retired, pensioners or without the right to benefits), and due to the methodological criteria of the International Physical Activity Questionnaire – Polish version (IPAQ) used in the study - no illness, hospital stay, stay in rehabilitation, convalescence after illness and vacation/planned rest within 7 days before the survey [46]. The criteria for exclusion from the study were missing questionnaires (16 cases) and declaring that they did not consume any dairy products for medical or dietary reasons or of their own volition (4 cases). Ultimately, 230 questionnaires were included in the analyses. With the recruitment support of community organizations, the study was conducted in Wrocław (32.6%, $n=75$), Siechnice (23.5%, $n=54$), Święta Katarzyna (20.1%, $n=46$), Radwanice (7.8%, $n=18$), Bogusławice (7.8%, $n=18$), Żerniki Wrocławskie (4.3%, $n=10$) and Duszniki Zdrój (3.9%, $n=9$).

The study was conducted following the Declaration of Helsinki [47]. Participation in the study was voluntary. Informed consent was obtained from all participants to participate in the study. The study was approved by the Rector's Committee for Research Ethics of the University of Environmental and Life Sciences in Wrocław on 12 February 2024 on expressing an opinion on the compliance of the scientific research project with ethical principles (Resolution No. NON00000.0011.1.2.3.2024).

2.2. Questionnaire

A proprietary questionnaire assessed taste preferences and purchase frequency of selected food products. Included are 11 groups of typical dairy products, including dairy fats, i.e.: milk, including low-fat milk; condensed milk; powdered milk; dairy drinks, e.g. sweetened chocolate or fruit milk; fermented dairy drinks, e.g. yogurt, kefir, buttermilk, etc.; cottage cheese; grainy/rural cottage cheese; cottage cheese spreads for bread; yellow cheeses, including melted and molded cheeses, e.g., gouda, emmentaler, podlaski, camembert, roquefort; butter, e.g., extra, cream; cream and sour cream; and 6 groups of functional dairy products, i.e., lactose-free, e.g., milk, cream cheese, etc.; cholesterol-lowering, e.g., „Benecol” yogurt; probiotic, e.g., “Activia” yogurt; enriched, e.g., yogurts with added calcium and/or vitamins; increased protein content, e.g., protein-rich milk drinks; and immune-boosting, e.g., “Actimel.” The frequency of consumption of these products was rated on a 6-point scale: 1 - Never; 2 - Once a month or less often; 3 - Several times a month; 4 - Once a week; 5 - Many

times a week; and 6 - Daily. Concerning each food product, respondents expressed their attitude by marking their opinion on a 5-point scale, where: 1 - I like this food, it's tasty; 2 - I may or may not eat this food; 3 - I don't like this food, it's unpalatable; 4 - I've never tried this food, but would try it if given the opportunity; and 5 - I've never tried this food and don't intend to try it. During the analysis, the opinion "I like this food; it is tasty" was coded as 1, while the other opinions were coded as 0. Respondents' views on 11 groups of typical dairy products, including dairy fats, were then summed to create the variable "Taste preferences" (variable range 0 -11).

To assess the level of physical activity, the full version of the International Physical Activity Questionnaire - Polish version was used [46]. The full version of the IPAQ questionnaire consists of 5 independent parts. It includes detailed information on work-related physical activity, movement, household chores, recreation and sports, and time spent sitting or lying down [46,48,49]. General physical activity, including its movement components, housework, recreation, and sports, was assessed. Work-related activities were excluded. In addition, the activity of sitting or lying down was evaluated. Overall physical activity and its components were calculated using data on the number of days, duration in minutes per day, and MET values for different types of physical activity. The product and sum of these data allowed the assessment of physical activity in units of MET-minutes/week, according to the methodological information of the IPAQ questionnaire [46]. Activity related to sitting or lying down was calculated in units of minutes/week based on the product of days and duration of activity related to sitting or lying down and summing their values [46].

Socio-demographic characteristics asked about gender, age, place of residence, education, household composition, social activity, and family relationships in terms of economic characteristics, subjective assessment of the household's economic situation, and family and social financial support.

2.3. Statistical Analysis

Categorical variables are presented as a percentage of the sample (%), and continuous variables are presented as means with standard deviation (SD). The Kolmogorov-Smirnov test was used to test the distribution of continuous variables (activity in MET-minutes/week, activity in minutes/week, and taste preferences). These variables did not have a normal distribution, so a non-parametric test (Kruskal-Wallis test with Bonferroni correction) was used to compare mean values. For categorical variables, differences between groups were verified with the chi-square test. A significance level of $p < 0.05$ was considered significant for both tests.

Based on the purchase frequency of 11 groups of typical dairy products, including dairy fats, factor analysis was conducted using principal component analysis (PCA) to identify patterns (factors) of buying behavior. Factor rotation was performed using an orthogonal (Varimax) transformation. The number of factors was determined using the following criteria: components with eigenvalue ≥ 1 , scree plot test, and interpretability of factors. Variables (purchase frequency of particular food groups) were considered to load on the factor if the correlation coefficient took a value of at least 0.5. The selection of factors was confirmed through the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's sphericity test. Within each behavioral pattern (factor), 3 categories were created based on the tercile distribution of regression coefficients. The distinguished categories are: 1. tercile (low pattern severity), 2. tercile (moderate pattern severity), and 3. tercile (high pattern severity).

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 29.0. (IBM Corp., Armonk, NY, USA).

3. Results

3.1. Characteristics of Study Sample

The characteristics of the study group, including socio-demographic characteristics and the variable describing financial situation, are presented in Table 1. The study group comprised 82.2% women and 17.8% men aged 60-91 years, with a mean age of 70.6 years ($SD \pm 5.8$). Most had a high

school education (53.0%), lived only with a partner (45.0%), and had a positive assessment of their financial situation ("We have enough for everyday life, but we need to save for more serious purchases" – 50.0%).

Table 1. Characteristics of the study group.

Variables	Categories of variables	% (N)
Gender	women	82.2 (89)
	men	17.8 (41)
Age	60-70 years	51.7 (119)
	71-80 years	44.3 (102)
	over 80 years	4.0 (9)
Place of residence	village	37.0 (85)
	city <100,000 inhabitants	27.8 (64)
	city >100,000 inhabitants	35.2 (81)
Education	elementary	2.6 (6)
	basic vocational	15.7 (36)
	secondary	53.0 (122)
	higher	28.7 (66)
Household composition	I live alone	33.5 (77)
	I live with my partner	45.2 (104)
	I live with my family and partner	10.9 (25)
	I live with my family without a partner	10.4 (24)
Self-assessment of financial situation	we live modestly - we have to be very frugal on a daily basis	11.7 (27)
	we live on average - we have enough for our daily needs, but we need to save for more serious purchases	50.0 (115)
	we live well - enough for a lot without special saving	30.9 (71)
	we live very well - we can afford certain luxuries	7.4 (17)

3.2. Buying Behavior Patterns

Based on the frequency of buying typical dairy products, including milk fats, 3 buying behavior patterns were distinguished using principal component analysis. The factor loading matrix for the identified buying behavior patterns (factors) is shown in Table 2. The KMO value was 0.794. Bartlett's test showed significance at $p < 0.001$. The extracted buying behavior patterns explained 58.95% of the total variance (Table 2). The identified buying behavior patterns were named as: pattern - "conventional dairy products and fats" (factor 1), pattern - "powdered milk, condensed and unfermented dairy drinks" (factor 2), pattern - "dairy fats" (factor 3).

Table 2. Factor loadings matrix for buying behavior patterns (factors) identified based on principal component analysis.

Dairy products	Buying behavior patterns (factors)		
	1*	2	3
Milk, including low-fat milk	0.566	0.127	0.113
Fermented dairy drinks, such as yogurt, kefir, buttermilk, etc.	0.697	-0.106	0.043
Cottage cheese	0.721	-0.071	0.201
Grainy/rural cottage cheese	0.720	0.060	-0.072
Cottage cheese spread on bread	0.722	0.062	-0.113

Yellow cheeses, including processed and moldy cheeses, e.g. gouda, emmentaler, podlaski, camembert, roquefort, etc.	0.649	0.135	0.041
Butter, e.g. extra or cream butter	0.543	0.121	0.562
Cream and sour cream	0.551	0.135	0.625
Condensed milk	0.182	0.788	0.011
Milk powder	-0.071	0.881	-0.016
Dairy drinks such as sweetened chocolate or fruit milk	0.023	0.858	-0.048
% of variance explained	31.54	18.25	9.15
Total explained variance (%)		58.95	

*1 - patterns "conventional dairy products and fats," 2 - patterns "powdered milk, condensed and unfermented dairy drinks," 3 - patterns "dairy fats."

3.3. Buying Behavior Patterns and Their Relationship to Taste Preferences, Socioeconomic Characteristics, and Physical Activity

In the study group, taste preferences toward dairy products, which are expressed by a mean value of 6.65 (SD±2.37), differed only within the "conventional dairy products and fats" pattern. The higher the intensity of this pattern, the greater the taste preferences were recorded. In the other behavioral patterns, there were no differences in taste preferences after accounting for pattern severity (Table 3).

Table 3. Characteristics of buying behavior patterns with taste preferences (mean value; standard deviation).

Buying behavior patterns (factors)	Taste preferences		
	1. tercil	2. tercil	3. tercil
„Conventional dairy products and fats” patterns - Factor 1 (p<0.001)	5.41a*; 2.65	6.54a; 2.13	8.01a; 1.40
„Powdered milk, condenses and unfermented dairy drinks” patterns - Factor 2 (p=0.238)	6.42; 2.17	6.48; 2.50	7.05; 2.39
„Dairy fats” patterns - Factor 3 (p=0.062)	6.82; 2.12	6.72; 2.84	6.41; 2.06

* values marked with the same letters are significantly different (p<0.05), Kruskal-Wallis test with Bonferroni correction.

More people living with a family with and without a partner represented the 2nd and 3rd tercil of the "conventional dairy products and fats" pattern. In contrast, the largest number of people living without family or partners (alone) represented the 1st tercil of this pattern (Table 4). In the case of the "dairy fats" pattern, the 1st tercil was represented by the largest number of people who declared that they lived modestly or well and very well. In contrast, the 3rd tercil was represented by the largest number of people declaring that they lived moderately (Table 4). Other socio-demographic and economic characteristics did not differentiate the adherence to the extracted behavioral patterns with respect to their tercile structure.

Table 4. Characteristics of buying behavior patterns taking into account selected socioeconomic characteristics.

Variables	Categories of variables	Total % (N)	Buying behavior patterns (factors) % (N)		
			1. tercil	2. tercil	3. tercil
„Conventional dairy products and fats” patterns - Factor 1 (p=0.002*)					
Household composition	I live alone	33.5 (77)	51.9 (40)	24.7 (19)	23.7 (18)
	I live with my partner	45.2 (104)	36.4 (28)	50.6 (39)	48.7 (37)
	I live with my family and partner	10.9 (25)	9.1 (7)	11.7 (9)	11.8 (9)
	I live with my family without a partner	10.4 (24)	2.6 (2)	13.0 (10)	15.8 (12)

„Dairy fats” patterns - Factor 3 (p=0.018*)					
Self-assessment of financial situation	we live modestly - we have to be very frugal on a daily basis	11.7 (27)	14.5 (11)	9.1 (7)	11.7 (9)
	we live on average - we have enough for our daily needs, but we need to save for more serious purchases	50.0 (115)	32,9 (25)	54.5 (42)	62.3 (48)
	we live well - enough for a lot without special saving	30.9 (71)	42.1 (32)	29.9 (23)	20.8 (16)
	we live very well - we can afford certain luxuries	7.4 (17)	10.5 (8)	6.5 (5)	5.2 (4)

N – number of people; * significance level, Chi² test.

Respondents' general physical activity varied only after accounting for the severity of the “conventional dairy products and fats ” pattern, with significant differences observed between the 1st and 3rd terciles of this pattern. Individuals representing the 3rd tercile were characterized by the highest and significantly higher physical activity than the 1st tercile of this pattern. No variation was shown in the other buying behavior patterns after accounting for general physical activity. The displacement activity was higher in the 3rd tercile of the “conventional dairy products and fats” formula than in the 2nd tercile of this formula. At the same time, an inverse relationship was observed in the “dairy fats” formula. Activity related to housework was highest in the 2nd tercile of the “powdered milk, condensed milk and dairy drinks” pattern and, at the same time, significantly higher than in the 1st tercile of this pattern. In contrast, activity related to sports and recreation was highest in the 3rd tercile of the “conventional dairy products and fats” pattern, while being only significantly higher than such activity undertaken by those representing the 2nd tercile of this pattern. Respondents' lying or sitting activities showed no variation after considering the respondents' affiliation with particular patterns of buying typical dairy products and fats (Table 5).

Table 5. Characteristics of buying behavior patterns including physical activity (mean value; standard deviation).

Buying behavior patterns (factors)	Buying behavior patterns (factors)			Total
	1. tercil	2. tercil	3. tercil	
General physical activity (MET-minutes/week)				
„Conventional dairy products and fats” patterns – Factor 1 (p=0,004)	5501.9a; 6315.4	6060,1; 4480,5	8321,0a; 8922,3	
„Powdered milk, condensed and unfermented dairy drinks – Factor 2 (p=0,061)	5559.4; 3690.9	7271,6; 5238,4	7016,1; 10019,8	6620,3; 6888,9
„Dairy fats” – Factor 3 (p=0,183)	6264,1; 4147,1	8025,1; 10339,6	5567,0; 3983,2	
Movement activity (MET-minutes/week)				
„Conventional dairy products and fats” patterns – Factor 1 (p=0,028)	2185,0; 3645,8	1915,4a; 1390,1	2995,7a; 4015,1	
„Powdered milk, condensed and unfermented dairy drinks – Factor 2 (p=0,523)	1899,8; 1542,9	2460,0; 2649,5	2722,1; 4695,1	2362,6; 3247,0
„Dairy fats” – Factor 3 (p=0,004)	2322,0; 1936,4	3183,9a; 4994,8	1581,5a; 1347,6	
Activity related to work at home (MET-minutes/week)				
„Conventional dairy products and fats” patterns – Factor 1 (p=0,209)	1995,2; 1878,7	2900,9; 3307,0	3669,2; 5058,8	2851,6;
„Powdered milk, condensed and unfermented dairy drinks – Factor 2 (p=0,001)	2021,1a; 2629,0	3633,5a; 4023,4	2889,3; 4100,7	3694,8

„Dairy fats” – Factor 3 (p=0,330)	2726,4; 3331,1	3321,8; 4625,9	2504,8; 2924,8	
Activity related to sports and recreation (MET-minutes/week)				
„Conventional dairy products and fats” patterns – Factor 1 (p=0,017)	1808,2; 1872,9	1731,6a; 1798,3	2400,1a; 2015,6	
„Powdered milk, condensed and unfermented dairy drinks – Factor 2 (p=0,406)	2075,6; 1713,2	1961,6; 1809,0	1898,6; 2198,8	1978,1; 1912,4
„Dairy fats” – Factor 3 (p=0,435)	1853,0; 1488,8	2294,3; 2437,6	1785,5; 1654,2	
Activity associated with sitting or lying down (minutes/week)				
„Conventional dairy products and fats” patterns – Factor 1 (p=0,515)	752,0; 475,7	808,1; 451,3	827,0; 723,2	
„Powdered milk, condensed and unfermented dairy drinks – Factor 2 (p=0,744)	786,2; 478,9	862,9; 720,7	737,3; 441,8	795,6; 561,3
„Dairy fats” – Factor 3 (p=0,417)	829,1; 743,5	749,0; 434,1	809,1; 460,1	

* values marked with the same letters are significantly different (p<0.05), Kruskal-Wallis test with Bonferroni correction.

3.4. Buying Behavior Patterns and Their Relationship to the Buying of Functional Dairy Products

The frequency of purchases functional dairy products and its relationship with adherence to identified buying behavior patterns is shown in Table 6. More than half of the respondents have never purchases functional dairy products. Most people have never bought cholesterol-lowering dairy products (69.1%) and lactose-free products (66.1%).

Among those with a high intensity of the “conventional dairy products and fats” pattern (3rd tercile), there were more people purchasing cholesterol-lowering, probiotic, mineral- and vitamin-enriched, protein-enhanced and immune-boosting dairy products at least once a week compared to those in the 1st tercile. In contrast, the 1st tercile had the highest number of never-buyers of probiotic dairy products, enriched in minerals and vitamins, with increased protein content and immune-boosting. In contrast, the proportion of people who never buy cholesterol-lowering dairy products was similar in the 1st and 3rd terciles (72.7 and 75.0, respectively). The frequency of purchase of lactose-free dairy products did not vary among the study group after considering the intensity of the pattern “conventional dairy products and fats” and the pattern “powdered milk, condensed and unfermented dairy drinks.” In the latter pattern, the purchase of probiotic dairy products favored a higher intensity of the pattern, with 11.8% in the 1st tercile and 26.0% in the 3rd tercile of those surveyed. In contrast, the 1st tercile of this pattern had the highest number of people who had never purchased protein-enhanced dairy products (71.1%) , while the 3rd tercile had the lowest number of such people (48.1%) (Table 6).

Among those with a high intensity of the “dairy fats” pattern (3rd tercile), there was the least number of people buying immune-boosting dairy products at least once a week (11.7%) compared to those in the 1st tercile (28.9%), and also the most number of people never buying such products (66.2%). In addition, most people with a high intensity of this pattern declared not to buy lactose-free dairy products (76.6%). In comparison, the most significant number of people in the 1st tercile of this pattern consumed these products with a frequency of at least once a week (28.9%) (Table 6).

Table 6. Frequency of purchases of functional dairy products with respect to adherence to identified buying behavior patterns.

Functional dairy products	Buying frequency	Total	„Conventional dairy products and fats” pattern	„Powdered milk, condensed and unfermented dairy drinks” pattern	„Dairy fats” pattern

		1. tercil	2. tercil	3. tercil	1. tercil	2. tercil	3. tercil	1. tercil	2. tercil	3. tercil	
Lactose-free	never	66.1 (152)	66.2 (51)	64.9 (50)	67.1 (51)	64.5 (49)	70.1 (54)	63.6 (49)	53.9 (41)	67.5 (52)	76.6 (59)
	less than once a week	18.7 (43)	23.4 (18)	20.8 (16)	11.8 (9)	19.7 (15)	18.2 (14)	18.2 (14)	22.4 (17)	23.4 (18)	10.4 (8)
	at least once a week	15.2 (35)	10.4 (8)	14.3 (11)	21.1 (16)	15.8 (12)	11.7 (9)	18.2 (14)	23.7 (18)	9.1 (7)	13.0 (10)
	p-value (Chi ² test)	p=0.204			p=0.836			p=0.011			
Lowering cholesterol levels	never	69.1 (159)	72.7 (56)	59.7 (46)	75.0 (57)	71.1 (54)	77.9 (60)	58.4 (45)	65.8 (50)	67.5 (52)	74.0 (57)
	less than once a week	16.5 (38)	16.9 (13)	26.0 (20)	6.6 (5)	13.2 (10)	13.0 (10)	23.4 (18)	15.8 (12)	20.8 (16)	13.0 (10)
	at least once a week	14.3 (33)	10.4 (8)	14.3 (11)	18.4 (14)	15.8 (12)	9.1 (7)	18.2 (14)	18.4 (14)	11.7 (9)	13.0 (10)
	p-value (Chi ² test)	p=0.018			p=0.097			p=0.520			
Probiotic	never	51.3 (118)	66.2 (51)	40.3 (31)	47.4 (36)	55.3 (42)	62.3 (48)	36.4 (28)	43.4 (33)	53.2 (41)	57.1 (44)
	less than once a week	30.4 (42)	26.0 (20)	40.3 (31)	25.0 (19)	32.9 (25)	20.8 (16)	37.7 (20)	32.9 (25)	32.5 (25)	26.0 (25)
	at least once a week	18.3 (42)	7.8 (6)	19.5 (15)	27.6 (21)	11.8 (9)	16.9 (13)	26.0 (20)	23.7 (18)	14.3 (11)	16.9 (13)
	p-value (Chi ² test)	p=0.002			p=0.009			p=0.377			
Enriched with vitamins and minerals	never	50.0 (115)	58.4 (45)	41.6 (32)	50.0 (38)	59.2 (45)	51.9 (40)	39.0 (30)	48.7 (37)	45.5 (35)	55.8 (43)
	less than once a week	32.2 (74)	31.2 (24)	40.3 (31)	25.0 (19)	25.0 (19)	32.5 (25)	39.0 (30)	32.9 (25)	36.4 (28)	27.3 (21)
	at least once a week	17.8 (41)	10.4 (8)	18.2 (14)	25.0 (19)	15.8 (12)	15.6 (12)	22.1 (17)	18.4 (14)	18.2 (14)	16.9 (13)
	p-value (Chi ² test)	p=0.048			p=0.151			p=0.747			
Protein-rich	never	60.9 (140)	70.1 (54)	51.9 (40)	60.5 (46)	71.1 (54)	63.6 (49)	48.1 (37)	59.2 (45)	59.7 (46)	63.6 (49)
	less than once a week	23.9 (55)	23.4 (18)	32.5 (25)	15.8 (12)	13.2(10)	23.4 (18)	35.1 (27)	26.3 (20)	27.3 (21)	18.2 (14)
	at least once a week	15.2 (35)	6.5 (5)	15.6 (12)	23.7 (18)	15.8 (12)	13.0 (10)	16.9 (13)	14.5 (11)	13.0 (10)	18.2 (14)
	p-value (Chi ² test)	p=0.007			p=0.021			p=0.649			
Immune- enhancing	never	52.2 (120)	64.9 (50)	39.0 (30)	52.6 (40)	57.9 (44)	57.1 (44)	41.6 (32)	39.5 (30)	50.6 (39)	66.2 (51)
	less than once a week	28.3 (65)	23.4 (18)	42.9 (33)	18.4 (14)	26.3 (20)	24.7 (19)	33.8 (26)	31.6 (24)	31.2 (24)	22.1 (17)
	at least once a week	19.6 (45)	11.7 (9)	18.2 (14)	28.9 (22)	15.8 (12)	18.2 (14)	24.7 (19)	28.9 (22)	18.2 (14)	11.7 (9)
	p-value (Chi ² test)	p<0.001			p=0.245			p=0.012			

The frequency of buying functional dairy products did not vary by socio-demographic and economic characteristics. Only some products showed variation in physical activity (Table 7). People

buying lactose-free dairy products at least once a week were characterized by significantly higher physical activity than those buying these products less than once a week. Those who never bought immune-boosting dairy products had substantially less activity related to moving around and doing chores around the house than those who did such activities at least once a week.

Table 7. Frequency of purchases of functional dairy products by physical activity (mean value; standard deviation).

Functional dairy products	Frequency of buying			Total
	never	less than once a week	at least once a week	
	General physical activity (MET-minutes/week) p=0.018			
Lactose-free	6352.6; 5943.9	6501.4a; 10533.4	7928.9a; 4800.8	6620.3; 6888.9
	Movement activity (MET-minutes/week) p=0.020			
Immune-enhancing	2180.2a; 3131.3	1899.3; 1351.4	3518.3a; 4891.1	2362.6; 3247.0
	Activity related to work at home (MET-minutes/week) p=0.050			
Immune-enhancing	2717.1a; 3495.7	2668.5; 3352.1	3474.7a; 4600.1	2851.6; 3694.8

* values marked with the same letters are statistically significantly different, Kruskal-Wallis test with Bonferroni correction.

4. Discussion

The paper identifies the buying behavior patterns of the older people in the dairy market in Poland. An attempt was made to differentiate the identified buying patterns by taste preferences, selected socioeconomic characteristics, and level of physical activity. In addition, the frequency of buying of functional products was assessed, taking into account adherence to distinguished behavioral patterns and their selected determinants.

Three buying behavior patterns emerged in the study. The “typical” dairy product pattern was described as “conventional products and dairy fats.” The patterns included milk, fermented milk beverages, cottage cheese and curds, yellow cheese, butter, cream, and sour cream. Previous studies have reported that these are products frequently purchased and consumed by older people in Poland [35]. The report, titled “The Milk Market - Status and Prospects,” showed that pensioner households in Poland, compared to other households, consumed the total milk, cheese, cottage cheese, yogurt, and cream in 2023 [50]. Butter, cream, and sour cream, which are included in the “dairy fats” pattern, are also products commonly purchased and consumed by this age group [35], and the highest consumption was for sour cream [32]. The identification of the “milk powder, condensed and unfermented milk drinks” pattern was not expected. The literature says little about the older adults' acquisition and consumption of such dairy products. Also, reports based on data from the Central Statistical Office in Poland on the milk market do not indicate the amount of purchase and consumption of such dairy products among older people [25,32,50–52]. Little is also known about the factors that differentiate their consumption or purchase. Our study did not identify any factor differentiating buying behavior within this pattern.

The study findings showed that more than half of the respondents had never purchased functional dairy products, with the highest number of people having never purchased cholesterol-lowering dairy products (69.1%) and lactose-free products (66.1%). Even though dairy products are the dominant group of functional products in the food market [53] and the most commonly associated with this food group [54], the level of acceptance of these products is still low [55]. Older consumers approach them with great skepticism [54]. A low level of acceptance of lactose-free dairy products has been shown among the elderly [56], which may confirm the reason for not buying this food group,

even though it is mainly dedicated to them, due to frequent lactose intolerance. An earlier study in a group of German consumers reported that margarine or fat blends and dairy products that lower blood cholesterol were preferred in older adults [57], but this was not confirmed in our study. In contrast, a high preference level was shown for functional calcium-enriched dairy products [58]. This may be due to the high knowledge of the importance of calcium-rich dairy products in preventing osteoporosis, especially among older women [55]. The high intensity of the "conventional dairy products and fats" pattern was associated with more frequent purchases (at least once a week) of many functional dairy products. This result may suggest that the pro- or anti-purchase behavior of older people in the dairy market applies to most products uniformly and not only to selected groups.

The purchase of most dairy products is among routine purchases due to the high frequency of such purchases and the constancy of the needs met in this way [38]. Among the top reasons for purchasing dairy products in Poland are shelf life [34,37,38], price, and brand [34], but also sensory impressions, especially taste and smell [36,38]. The present study also reported on the association of taste preferences ("I like this food, it's tasty") with high intensity (3rd tercile) of the "conventional dairy products and fats" pattern. Previous studies have reported that the elderly's response, "I like this food a lot, it's tasty," referred most to natural yogurt, buttermilk, and butter [56], which may confirm the association of taste preferences with this buying behavior pattern. No relationship was shown between taste preferences and the intensity of other patterns, even though in another study, butter had a high level of preference among older people [56]. For this, butter and sour cream were frequently purchased [32,35].

Financial situation differentiates the consumption of dairy products in Polish households, with the highest consumption of these products being in households with the highest income [35]. However, the study's results did not confirm the differences in the purchase of "conventional products and dairy fats" considering self-assessment of the material situation, while there were differences in the "dairy fats" pattern. Most respondents in 3rd tercile declared that they "live on average." Murawska's research [35] showed that the highest consumption of butter and cream was observed in the households of pensioners, which confirms the identification of the "milk fats" pattern in the group of older consumers. However, this study did not show any differentiation of purchasing behaviors related to this group of products due to the level of income. In European countries, income is less important in differentiating the consumption behavior of dairy products [59]. The most significant differences in dairy consumption by income are observed in Middle Eastern, Asian, African, and South American countries [60].

Older respondents living with their family, both with and without a partner, represented the 2nd and 3rd tercile of the "conventional dairy products and fats" pattern. In contrast, living alone (without family or partner) was associated with this pattern's low intensity (1 tercile). Many studies suggest that family size affects the increase in dairy consumption [60,61]. This is due to the perception of dairy products as essential components of the diet and the presence of children [62]. While overall consumption of milk and milk products in large families is increasing per family member, this is no longer so evident [60,63,64]. As family size increases, the consumption of dairy products per family member may decrease. The problem arises mainly in families with the lowest incomes, where there is a decline in the consumption of dairy products per family member and their overall consumption [64,65]. This may suggest that the higher intensity of the "conventional dairy products and fats" pattern among older adults living with their families is not necessarily associated with higher consumption. In addition, a study by Roustae et al. [60] found that older family members (60+) in the household were associated with lower yogurt and cheese consumption.

One Polish study showed that older people tend to be in the upper tertile of the "healthy eating and high physical activity" pattern, which is conducive to their better health [39]. At the same time, previous studies showed that low physical activity was associated with a low intake of milk and dairy products, and vice versa, but usually, these studies involved children [41,66,67]. However, higher physical activity among older adults was also associated with a dietary pattern based on dairy products [68,69]. In addition to inadequate consumption of milk and dairy products, low physical

activity is also the reason for lower consumption of legumes, fruits, meat, vegetables, and cereals [67]. While studies indicate an association of dairy product consumption with physical fitness in older people [16], no studies indicate an association between the frequency of purchase of these products and physical activity. Our study showed that lower overall physical activity and activity related to movement, sports, and recreation were accompanied by a lower intensity of the “conventional dairy products and fats” pattern. This relationship may result from the poorer physical condition of people who consume small amounts of dairy products. For example, from a prospective study in the Spanish Senior-ENRICA cohort, it is known that consumption of seven or more servings of low-fat dairy products, particularly low-fat milk per week versus less than one serving, was associated with a lower incidence of frailty syndrome, including loss of physical function [15,21,70]. Moreover, it was observed that older people in the highest tercile, compared to those in the lowest tercile of dairy consumption, had significantly higher grip strength and lower probability of poor performance in the standing up and walking time trials, while no differences were observed in the incidence of falls [18]. In further studies, it is necessary to jointly examine the relationship between physical activity and milk and dairy consumption and between physical activity and the purchase of these products. This is particularly important in the group of older people, whose milk and dairy consumption may be lower due to difficulties in making food purchases.

To the best of our knowledge, the relationships between milk and dairy product buying behaviors, physical activity, taste preferences, and socioeconomic characteristics of older Polish people were not examined. The results thus complement the knowledge in this field and can be used in various activities aimed at older people. However, the study has several limitations. First, the study is cross-sectional, so assessing the direction of influence and causal relationship between variables is impossible. In addition, the non-probabilistic sampling method did not allow a representative sample to emerge. Moreover, the overrepresentation of female respondents may have unexpectedly affected the relationship between these determinants and purchasing behavior.

5. Conclusions

The buying behavior of older people in the dairy market appears to be related to taste preferences, household structure, self-assessment of the household's financial situation, and level of physical activity, and this relationship does not apply to all dairy product groups in the same way. It was most related to the “conventional dairy products and fats” behavioral pattern, where the high intensity was related to taste preferences, living with family (with or without a partner), physical activity, including mobility activities, and sports and recreation. In addition, the high intensity of the “milk fat” pattern was associated with physical activity but at a lower level. It was also associated with a financial situation described as “we live on average.” There was no relationship between the intensity of the pattern “milk powder, condensed and unfermented milk drinks” and other variables, with one exception. The average intensity of this pattern was accompanied by higher housework-related activity. The respondents were characterized by low interest in functional dairy products. The high intensity of the “conventional dairy products and fats” pattern was accompanied by more frequent purchases (at least once a week) of many products from the functional dairy products group. In addition, higher physical activity among the study sample corresponded with a higher frequency of purchasing lactose-free and immune-boosting dairy products. Given the limited research results, further studies are needed to assess the relationship between socio-demographic and economic conditions, preferences, and especially physical activity and the behavior of older people in the dairy market. To determine the causal relationship between buying behavior and its determinants, it is vital to conduct prospective cohort studies in a representative group of older people. This will help determine the dairy industry's marketing strategies and forms of effective education for older consumers.

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