



RESEARCH ARTICLE

Beyond borders: A cross-cultural analysis of consumption and purchase behaviour of sweeteners in yoghurts

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Abstract

The study explored the sociocultural influences on sugar consumption in three distinct countries: New Zealand, France, and Singapore. It employed the theory of planned behavior (TPB) alongside consumer perception and acceptance factors, such as sugar consciousness, product labeling, sugar substitution with sweeteners, and perceived flavor, to investigate participants' behaviors regarding various yogurt types. Data was gathered through web surveys in each country, analyzed through partial least squares (PLS)–confirmatory factor analysis to create country-specific conceptual frameworks, and then validated using PLS-path modeling to assess the correlations between TPB and consumer perception constructs. The results indicated that perceived behavioral control positively influenced intentions to reduce sugar intake in participants from New Zealand and Singapore. Sugar consciousness exhibited a positive correlation with behavioral intentions across all three countries, suggesting heightened awareness of sugar intake motivates individuals to cut back. Notably, the presence of labels and claims showed negative correlation with perceived flavor, among the participants from New Zealand and France, suggesting that food researchers must navigate a delicate balance between labels and flavor to successfully design and market sugar-reduced products. Further analysis, PLS-multigroup analysis revealed significant difference in the impact of subjective norms on attitude between participants from different countries. Singaporeans placed stronger value on others' approval for consuming less sugar-sweetened yogurt, whereas French and New Zealand participants had a more neutral stance. This study's novelty lies in its comprehensive exploration of sociocultural factors, integration of TPB with consumer perception constructs, and tailoring of analysis to each country's cultural context, thereby enhancing our understanding of multicultural sugar consumption patterns.

KEYWORDS

cross-cultural, perceived flavor, product labels and claims, sugar consciousness, theory of planned behavior

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1 | INTRODUCTION

According to the World Health Organization (WHO), the average adult consumes between 13% and 25% of their daily energy intake from sugar (Bassett et al., 2020). This is double the recommended daily energy intake of no more than 5%–10% for sugars. Recently, WHO has specifically issued guidelines to reduce the consumption of free sugars, which include refined sugars (brown and white sugar). Therefore, reduction of sugar is an international priority as it can contribute to substantial economic and public health benefits (Vreman et al., 2017).

The current research used yoghurt as a model food for studying consumers behavior and intention toward sugar reduction because of its global prevalence and cultural significance. Yoghurt's popularity transcends geographical and cultural boundaries, allowing for a comprehensive examination of consumer responses in different contexts. The revenue in the yoghurt market amounts to US\$3.20 bn, US\$192.00 m, and US\$18.75 m in 2023 in France, New Zealand, and Singapore, respectively (Statista, 2023). Moreover, the market is expected to grow annually by 2.21%, 4.29%, and 1.90% (Compound Annual Growth Rate 2023–2028) in France, New Zealand, and Singapore, respectively (Statista, 2023). Additionally, the cultural significance of yogurt in different societies aligns with our goal of exploring how cultural factors influence health-related decisions, especially in the context of sugar reduction. For instance in Singapore, due to the nation's multicultural identity, yoghurt is embraced as a versatile food item that aligns with the preferences of various ethnic communities (Reddy & van Dam, 2020). In France, yoghurt is popular not only for its rich taste but also for its perceived health benefits. This is evident in the French dining philosophy, characterized by a commitment to balance and moderation, by the inclusion of yogurt as a healthy dessert alternative (Sheree, 2022). Recent research conducted with New Zealand Europeans residing in New Zealand found that the main reason for the consumption of yoghurt is because "it is nutritious and a source of calcium" (de Matos et al., 2021). This is evident through Beck et al. (2018) research as well as they found that consumption of yoghurt as a meal for breakfast forms is an indicator of "healthy" dietary pattern for New Zealand adults. However, it should be noted that along with nutritional benefits, New Zealand Europeans also considered sensory characteristics (taste, texture, and flavor) as the main reason for consuming yoghurt as they believe that food that tastes good is related to well-being and pleasure (de Matos et al., 2021).

It is important to examine consumer behavior toward sweetened yoghurts to understand how they can be persuaded to make healthier choices. This is more effective than simply increasing awareness about the health risks associated with overconsumption of yoghurts formulated with high sugar content. The theory of planned behavior (TPB) is the most widely used theory to predict human behavior. The TPB states that the intention to perform a specific behavior is influenced by three components: attitude, perceived behavioral control, and subjective norms (Zoellner et al., 2012). Attitude refers to an individual's evaluation of the positive and negative outcomes of a specific behavior. Subjective norms refer to an individual's perception of what other individuals think about their behavior and their

motivation to conform to those perceptions. Perceived behavioral control refers to the perceived difficulty or ease of performing a specific behavior.

Past research has successfully applied TPB to understand consumer behavior and intention toward the increased sugar consumption. Zoellner et al. (2012) used TPB to understand the sugar sweetened beverages (SSB) consumption. They found that behavioral intentions (aimed toward limiting the intake of SSB) showed the strongest relationship with SSB consumption, followed by attitudes, perceived behavioral control and subjective norms. The efficacy of three interventions based on TPB for motivating the reduction of SSB consumption in 430 participants has been evaluated (Gregorio-Pascual & Mahler, 2020). The first intervention, which consisted of information about the health consequences of consuming SSB, was intended to generate a positive attitude about SSB reduction. The second intervention, which consisted of information regarding peers' approval of drinking less SSB and making efforts to reduce SSB consumption, was designed to alter existing subjective norms. The third intervention, which involved participants planning on how, when, and where to reduce their SSB consumption, how to resist them in tempting situations, was aimed at increasing the perceived behavioral control. The authors reported that these interventions, either individually or in combination, resulted in significant and positive intentions to reduce SSB consumption in future. This effect was mediated by the effect of interventions on the TPB constructs. This research employed the TPB to understand participants' consumption and purchase behavior with regards to different kinds of yoghurt (sugar-sweetened, sugar-reduced, artificially sweetened, and naturally sweetened).

Although the TPB has received empirical support from researchers working in the field of human behavior prediction, some researchers have criticized its limited use in predicting complex behaviors, such as food choices (Dunn et al., 2011; Paul et al., 2016). Therefore, to improve the predictive power of the framework, researchers have applied the use of additional constructs along with the TPB (Contini et al., 2020; Nguyen et al., 2019; Yadav & Pathak, 2016). McCormick et al. (2021) applied the TPB along with other constructs, such as health literacy, public health literacy, media literacy, caregiver rules, and behavior, and at home availability of SSB, to identify the factors associated with the SSB consumption among 790 adolescents (mean age-12 years) of rural Appalachia, United States. The authors found that average SSB intake was 433.4 kcal/day, and constructs such as at home availability as well as caregiver behavior and rules were the significant and strongest predictors for SSB intake, followed by interpersonal factors, such as health literacy and behavioral intentions (McCormick et al., 2021).

Predictive power of the TPB framework can be improved by incorporating additional constructs. In this study, constructs, such as sugar consciousness, product label and claims, substitution of sugar with sweeteners, and perceived flavor, were included. Product labels and claims (e.g., "no added sugar," "naturally sweetened," "nutritional table/list of ingredients") can be described as information disclosure of extrinsic attributes (Prada et al., 2021). This construct can positively affect consumers' behavioral intentions to reduce their sugar intake by attracting them toward perceived healthier options and

empowering them to make informed choices (Kaur et al., 2017; Talati et al., 2017). Acton and Hammond (2018) found that “high sugar” nutrient warning reduced the likelihood of purchasing a sugary drink among the 675 participants (aged 16 years and older) and encouraged them to purchase the drinks formulated with less sugar. Ballico et al. (2020) further reported that yoghurts labeled with nutritional and health claims received significantly increased visual attention and consumer preference for healthy foods compared to unlabeled yoghurts. Perceived flavor was investigated in the current study because the negative expectation with regards to the flavor of products can prove to be an important obstacle in reducing the quantity of sugar added to food products. A study conducted by Prada et al. (2021) found that participants expected products like yoghurts, ice-cream, and breakfast cereals labeled with sugar-related claims (0% sugar, sugar-free, no added sugar, and low-sugar) to be of inferior flavor, which reduced the intention of consuming these reformulated products.

Governments worldwide are increasingly proactive in implementing measures to combat the rising prevalence of diet-related chronic diseases, such as obesity and diabetes, linked to excessive sugar consumption. Consequently, food companies are under constant pressure to reformulate their products by replacing sucrose with noncaloric sweeteners to support the government initiative. Hence, the influence of substitution of sugar with sweeteners on the participants' consumption and purchase behavior was evaluated in the current research. No research to date has applied the TPB cross-culturally to understand how consumer behavior and intentions for reducing sugar intake vary between consumers from different countries. The present research is a cross-cultural research study conducted in three diverse countries: New Zealand, France, and Singapore. The aim of the current research is to explore these distinct cultural settings to gain valuable insights into how sociocultural factors influence sugar consumption patterns. The inclusion of multiple countries in this study provides a unique opportunity to assess the universality of the TPB model and consumer's perception and acceptance constructs, while also examining country-specific variations in consumer behavior. The findings from the current research lay the groundwork for tailored public health interventions, dietary guidelines, and industry strategies, thus ultimately contributing to the global effort to promote healthier eating behaviors and reduce excessive sugar intake.

2 | METHODOLOGY

2.1 | Ethics statement

Ethics approval was obtained the Auckland University of Technology Ethics Committee for participants participating from New Zealand and France (20/73) and from the A*STAR Institutional Review Board (Reference Number: 2022-109), Singapore, for participants in Singapore. All participants gave written informed consent prior to the start of the study.

2.2 | Participants

The research was open to all adults aged 18–65 years old in New Zealand and France, and adults aged 21–65 years old in Singapore. Participants from New Zealand and France were recruited online using an advertisement posted on social networking sites like Facebook and Instagram. Singaporean participants were recruited by Qualtrics Research Services using their internal database.

Participants who expressed an interest in participating in the study were screened for the eligibility criteria that included the frequent consumption of yoghurt (daily/weekly/fortnightly). Those who reported allergy to sweeteners were excluded from the current study. Screened participants were briefed about the study, and informed that their participation was voluntary, anonymous, and confidential. They were also under no obligation to participate in the research and were allowed to withdraw at any stage. Screened participants from New Zealand, France, and Singapore were able to access the online web survey using an anonymous link generated by Qualtrics after providing their written consent. The participants from New Zealand and France were rewarded with gift vouchers as a token of appreciation. Singaporean participants were reimbursed according to their existing agreement with Qualtrics Research Services. A total of 204 participants were recruited from each country.

2.3 | Online survey procedure

Three identical web surveys were designed using Qualtrics to investigate consumption and purchase behavior of different kinds of yoghurt (sugar-sweetened, sugar-reduced, artificially sweetened, and naturally sweetened) among consumers in three different countries: New Zealand, Singapore, and France. The surveys were translated into the local languages of each country: English (New Zealand and Singapore) and French (France). The instructions page explained the general objectives of the current research along with the ethical considerations (confidentiality, anonymity, and voluntarily of the participation).

Participants from New Zealand and France indicated their consent for participation in the study by typing their name before answering the online survey questions. Participants from Singapore clicked on the option of “begin the questionnaire” to confirm their consent for the study. After being informed about the objectives, participants provided information on sociodemographic characteristics, such as gender, age, nationality, qualification, annual income, region of residence, and eating habits. The information about the frequency of yoghurt consumption was asked again to confirm the eligibility criteria. The consumption and purchase behavior of participants participating from three different countries were evaluated using eight constructs: attitude, behavioral control, subjective norms, behavioral intentions, sugar-consciousness, substitution of sugar with sweeteners, perceived flavor, and product labels and claims. The questions for each of these constructs have been summarized in Table 1. The data from individual

TABLE 1 Questions for the different constructs used to evaluate the consumption and purchase behaviors of participants for different kinds of yoghurt (sugar-sweetened, sugar-reduced, artificially sweetened, and naturally sweetened).

Constructs	Questions	Scale
Perceived behavioral control	How difficult/easy would it be for you to limit your intake of sugar sweetened yoghurt, if you wanted to, even if sugar-sweetened yoghurt was much expensive than yoghurt sweetened with sweeteners? (PBC1)	1 = <i>Very difficult</i> to 5 = <i>Very easy</i>
Subjective norms	For most people whose opinions you value, how would they feel about you eating less than recommended portion size of sugar-sweetened yoghurt every day? (SBN1)	1 = <i>Strongly disapprove</i> to 5 = <i>Strongly approve</i>
Attitude	For you, eating less than the recommended portion size of sugar-sweetened yoghurt everyday would be enjoyable? (ATT1)	1 = <i>Extremely unlikely</i> to 5 = <i>Extremely likely</i>
	For you, eating less than the recommended portion size of sugar-sweetened yoghurt everyday would be beneficial? (ATT2)	1 = <i>Extremely unlikely</i> to 5 = <i>Extremely likely</i>
Behavioral intentions	How many days per week do you intend to limit your intake of sugar-sweetened yoghurts? (BVN1)	1 = 0-1 day, 2 = 2-3 days, 3 = 4-5 days, 4 = 6-7 days
	I want to feel that I am capable of avoiding the intake of sugar-sweetened yoghurt regularly in future. (BVN2)	1 = <i>Strongly disagree</i> to 5 = <i>Strongly agree</i>
Substitution of sugar with sweeteners	I pay special attention to types of sweeteners (artificial or natural) when making the most of my food selection. (SSN1)	1 = <i>Strongly disagree</i> to 5 = <i>Strongly agree</i>
	How often does the presence of natural sweetener in the yoghurt influence your consumption/purchase decision? (SSN2)	1 = <i>Never</i> to 5 = <i>Always</i>
	How often does the presence of artificial sweetener in the yoghurt influence your consumption/purchase decision? (SSN3)	1 = <i>Never</i> to 5 = <i>Always</i>
Sugar-consciousness	How often do you pay attention to the amount of sugar in the yoghurt that you consume? (SCC1)	1 = <i>Never</i> to 5 = <i>Always</i>
	How often do you consume yoghurt without sugar or low sugar? (SCC2)	1 = <i>Never</i> to 5 = <i>Always</i>
Product labels and claims	In your opinion, yoghurts labeled with "no added sugar" are: Unnatural to natural (PLC1)	1 = <i>Unnatural</i> to 5 = <i>Natural</i>
	Distrustful to trustworthy (PLC2)	1 = <i>Distrustful</i> to 5 = <i>Trustworthy</i>
	Unhealthy to healthy (PLC3)	1 = <i>Unhealthy</i> to 5 = <i>Healthy</i>
	Cheap to expensive (PLC4)	1 = <i>Cheap</i> to 5 = <i>Expensive</i>
	Low to high caloric value (PLC5)	1 = <i>Low caloric value</i> to 5 = <i>High caloric value</i>
	In your opinion, yoghurts labeled with "naturally sweetened" are Distrustful to trustworthy (PLC6)	1 = <i>Distrustful</i> to 5 = <i>Trustworthy</i>
	Unhealthy to healthy (PLC7)	1 = <i>Unhealthy</i> to 5 = <i>Healthy</i>
	Cheap to expensive (PLC8)	1 = <i>Cheap</i> to 5 = <i>Expensive</i>
	Low to high caloric value (PLC9)	1 = <i>Low caloric value</i> to 5 = <i>High caloric value</i>
	In your opinion, the sugar content should be clearly visible on a packaging label of yoghurts that are high in sugar. (PLC10)	1 = <i>Strongly disagree</i> to 5 = <i>Strongly agree</i>
	In your opinion, the government should impose a sugar tax on yoghurts that are high in sugar. (PLC11)	1 = <i>Strongly disagree</i> to 5 = <i>Strongly agree</i>
	How often does the information on the nutritional table/list of ingredients influence your consumption/purchase decision? (PLC12)	1 = <i>Never</i> to 5 = <i>Always</i>
Perceived flavor	In your opinion, yoghurts labeled with "no added sugar" are less tasty than their regular counterpart? (PCF1)	1 = <i>Strongly disagree</i> to 5 = <i>Strongly agree</i>
	In your opinion, yoghurts labeled with "naturally sweetened" are less tasty than their regular counterpart? (PCF2)	1 = <i>Strongly disagree</i> to 5 = <i>Strongly agree</i>

web surveys was automatically saved on the Qualtrics website and was extracted on the completion of data collection.

2.4 | Data analysis

2.4.1 | Partial least squares–confirmatory factor analysis (PLS–CFA)

Partial least squares–confirmatory factor analysis (PLS–CFA) was used to obtain the conceptual framework model in current research. PLS–CFA was specifically used because it requires a saturated model that links all the latent variables allowing all the constructs to be freely correlated (Barcelos et al., 2022). In this research, the relationship between all the eight latent variables (attitude, subjective norms, perceived behavioral control, behavioral intentions, sugar consciousness, influence of substitution of sugar with sweeteners, perceived flavor, and product labels and claims) was studied. The latent variables that showed significant relationship ($p < .05$) were filtered out and used to construct a conceptual framework model, which was later analyzed using partial least squares–path modeling (PLS–PM). Three separate PLS–CFA were carried out for results obtained from France, New Zealand, and Singapore using R studio version 2023.06.0+421. The measurement model of PLS–CFA showed that all the loading indicators were above .708, indicating satisfactory item reliability.

2.4.2 | Partial least squares–path modeling (PLS–PM)

PLS–PM can be defined as correlational structural modeling, which allows the estimation of complex cause and effect modeling by using latent and manifest variables (Malavalli et al., 2021). The current study used PLS–PM because it has been reported to be robust to multicollinearity and generates latent models with non-normality (Kantono et al., 2019). PLS–PM is a two-step algorithm that separately estimates individual latent construct of the measurement model and then, in a second step, estimates the path model coefficients using ordinary least squares regression (Chin, 1998).

The conceptual framework models obtained using PLS–CFA were then validated and measured using PLS–PM to understand the correlation between the constructs of the TPB (attitude, subjective norms, perceived behavioral control, and behavioral intentions) and consumer perception and acceptance constructs (sugar consciousness, influence of substitution of sugar with sweeteners, perceived taste/flavor, and packaging labels) among the participants from the three different countries. Three separate PLS–PM analyses were performed using the PLS–PM module of the XLSTAT version 2023.1.1 (Lumivero) using conceptual models obtained for participants from France, New Zealand, and Singapore. The reliability of the model was estimated using the goodness of fit (GoF) statistics and Dillon–Goldstein's rho, which were obtained for each manifest variable. A value greater than .7 for Dillon–Goldstein's rho suggests the sample reliability of the model (Nunnally, 1994).

2.4.3 | Partial least squares–multigroup analysis (PLS–MGA)

The partial least squares–multigroup analysis (PLS–MGA) uses a non-parametric test to evaluate the differences in the hypothetical relationship among different groups (Wang et al., 2019). The ability to detect meaningful patterns across group-specific behavior can be significantly improved with this analysis (Usman et al., 2023). PLS–MGA has been successfully applied to evaluate group differences in a variety of fields, such as marketing (Calvo-Porrall et al., 2017), tourism (Prayag & Lee, 2019), and technology (Chen & Yan, 2019). The present research employed PLS–MGA (XLSTAT version 2023.1.1 (Lumivero, Denver, Colorado)) to understand how the consumption and purchase behaviors of participants from New Zealand, Singapore, and France were influenced with different sweetened yoghurt samples (sugar-sweetened, sugar-reduced, artificially sweetened, and naturally sweetened). The conceptual framework model used in this study is shown in Figure 1. PLS–MGA was further used to examine the differences in consumption and purchase behavior between participants from the different countries.

3 | RESULTS

3.1 | Sociodemographic characteristics

The sociodemographic characteristics of participants from New Zealand, Singapore, and France are summarized in Table 2. The demographic factors evaluated included gender, age, qualification, annual income, ethnicity, eating habits, frequency of yoghurt consumption, and the preferred method for sweetening yoghurt. Most participants were females (78.4% New Zealanders, 85.8% French, and 53.1% Singaporeans). In addition, most participants were omnivorous (86.3% New Zealanders, 95.1% French, and 86.4% Singaporeans). Most of the participants from New Zealand and France were Europeans (47.5% and 99%, respectively) and consumed yoghurt daily (46.1% and 86.3%, respectively). On the other hand, most participants from Singapore were Chinese (84.3%) and consumed yoghurt on a weekly basis (64%). The preferred method to sweeten the yoghurt varied with participants from different countries. Fruit addition was the preferred method of sweetening yoghurt for New Zealand (65.2%) and Singapore (56.8%) participants, whereas sugar addition was the preferred method for participants in France (60.3%).

3.2 | Analysis of TPB and consumer perception and acceptance constructs in the conceptual model

Table 3 shows the survey statistics for TPB and consumer's perception and acceptance constructs, comparing the consumption and purchase behavior of yoghurt among the participants from New Zealand, France, and Singapore. Participants from New Zealand (68.63%) and Singapore (60.78%) found it easier to limit their intake of sugar-sweetened

TABLE 2 Sociodemographic characteristics of participants from New Zealand, France, and Singapore.

Variable	New Zealand (n = 204)			France (n = 204)			Singapore (n = 204)		
	Category	Number	Percentage	Category	Number	Percentage	Category	Number	Percentage
Gender	Male	43	21.1	Masculin	29	14.2	Male	176	46.9
	Female	160	78.4	Feminin	175	85.8	Female	199	53.1
	Non-binary/third gender	1	0.49	Non binaire	0	0.00	Non-binary/third gender	0	0.00
	Prefer not to say	0	0.00	Préfère ne pas répondre	0	0.00	Prefer not to say	0	0.00
Age	18–25	48	23.5	18–25 ans	37	18.1	21–25	85	22.7
	26–35	69	33.8	26–35 ans	54	26.5	26–35	100	26.7
	36–45	45	22.1	36–45 ans	70	34.3	36–45	100	26.7
	46–55	33	16.2	46–55 ans	31	15.2	46–55	61	16.3
	56–65	9	4.41	56–65 ans	12	5.88	56–65	29	7.73
Qualification	No former education	1	0.49	Aucune qualification	25	12.3	No former education	1	0.27
	High school	20	9.80	Baccalauréat	70	34.3	Secondary school (e.g., GCE's)	19	5.07
	Diploma or certification	36	17.7	Bac +2	46	22.6	A level	19	5.07
	Bachelor's degree	83	40.7	License	36	17.7	Diploma or certification	90	24.0
	Master's degree or higher	64	31.4	Master ou niveau supérieur	27	13.2	Bachelor's degree	201	53.6
							Master's degree or higher	45	12.0
Annual income	<\$20,000	37	18.1	<12,000€	40	19.7	<\$20,000	39	10.4
	\$20,000–\$30,000	15	7.35	12,000€–18,000€	31	15.2	\$20,000–\$30,000	38	10.1
	\$30,000–\$50,000	25	12.3	18,000€–30,000€	66	32.4	\$30,000–\$50,000	92	24.5
	\$50,000–\$70,000	42	20.6	30,000€–42,000€	45	22.1	\$50,000–\$70,000	72	19.2
	\$70,000–\$90,000	33	16.2	42,000€–54,000€	12	5.88	\$70,000–\$90,000	46	12.3
	\$90,000–\$120,000	52	25.5	54,000€–74,000€	10	4.90	\$90,000–\$120,000	88	23.5

(Continues)

TABLE 2 (Continued)

Variable	New Zealand (n = 204)			France (n = 204)			Singapore (n = 204)		
	Category	Number	Percentage	Category	Number	Percentage	Category	Number	Percentage
Ethnicity	European	97	52.3	Européen	202	99.0	Chinese	316	84.3
	Māori	8	3.92	Māori	0	0.00	Malay	38	10.1
	Pacific	8	3.92	Polynésien	0	0.00	Indian	14	3.73
	Asian	64	26.6	Asiatique	0	0.00	Others	7	1.87
	MELAA (Middle Eastern/Latin American/ African)	9	4.41	MELAA (Moyen-Orient/Amérique latine/Afrique)	2	0.98			
Others	18	8.82	Autre	0	0.00				
Eating habits	Omnivorous	176	86.3	Omnivore	194	95.1	Omnivorous	324	86.4
	Vegetarian	21	10.3	Végétarien	3	1.47	Vegetarian	25	6.67
	Vegan	2	0.98	Végan	2	0.98	Vegan	10	2.67
	Pescatarian	5	2.45	Pescatarien	5	2.45	Pescatarian	16	4.27
	Daily	94	46.1	Quotidiennement	176	86.3	Daily	135	36.0
Frequency of consumption of yoghurt	Weekly	92	45.1	Hebdomadairement	24	11.8	Weekly	240	64.0
	Fortnightly	19	9.31	Bi-Mensuellement	4	1.96	Fortnightly	0	0.00
	Monthly	0	0.00	Mensuellement	0	0.00	Monthly	0	0.00
	Never	0	0.00	Jamais	0	0.00	Never	0	0.00
	Sugar	21	10.3	Sucre	123	60.3	Sugar	18	4.80
Preferred method for sweetening the yoghurt	Fruit	133	65.2	Fruit	32	15.7	Fruit	213	56.8
	Fruit jam	4	1.92	Confiture de fruit	25	12.3	Fruit jam	19	5.07
	Honey	33	16.2	Miel	17	8.33	Honey	54	14.4
	Sweetener (Natural or Artificial)	13	6.37	Édulcorant (naturel ou artificiel)	7	3.43	Sweetener (Natural or Artificial)	36	9.60
	Not applicable						Not applicable	35	9.33

TABLE 3 Distribution of the participants responses for each question under theory of planned behavior (TPB) and consumer perception and acceptance constructs to understand the consumption purchase behavior of participants from New Zealand, France, and Singapore for different kinds of yoghurt (sugar-sweetened, sugar-reduced, artificially sweetened, and naturally sweetened).

Constructs	Question ^a	Distribution 1–2 score (%)			Distribution 3 score (%)			Distribution 4–5 score (%)			Scale used
		New Zealand	France	Singapore	New Zealand	France	Singapore	New Zealand	France	Singapore	
Perceived behavioral control	PBC1	11.27	34.31	14.71	19.61	24.51	24.51	68.63	41.18	60.78	1 = Very difficult to 5 = Very easy
	SBN1	6.86	7.35	10.29	51.47	65.69	37.25	41.18	26.96	52.45	1 = Strongly disapprove to 5 = Strongly approve
Attitude	ATT1	30.88	47.55	16.67	27.45	45.99	25.98	40.69	6.86	57.35	1 = Strongly disagree to 5 = Strongly agree
	ATT2	25.49	19.12	11.76	22.55	48.04	27.94	51.47	32.84	60.29	1 = Strongly disagree to 5 = Strongly agree
Behavioral intentions ^b	BVN2	4.41	25.98	7.84	18.63	25.98	22.55	76.96	48.04	69.61	1 = Strongly disagree to 5 = Strongly agree
Substitution of sugar with sweeteners	SSN1	23.42	27.95	14.71	17.07	18.14	18.63	59.51	53.92	66.67	1 = Strongly disagree to 5 = Strongly agree
	SSN2	28.78	40.20	19.12	52.68	52.94	43.63	18.54	6.86	37.25	1 = Never, 2 = Sometimes, 3 = About half the time, 4 = Most of the time, 5 = Always
	SSN3	46.34	39.71	37.25	16.59	28.92	24.51	37.07	31.37	38.24	1 = Never, 2 = Sometimes, 3 = About half the time, 4 = Most of the time, 5 = Always
Sugar consciousness	SCC1	41.95	31.38	55.88	12.20	23.04	11.76	45.85	45.56	32.35	1 = Never, 2 = Sometimes, 3 = About half the time, 4 = Most of the time, 5 = Always
	SCC2	40.49	36.76	44.12	11.22	28.92	12.75	48.29	34.31	43.14	1 = Never, 2 = Sometimes, 3 = About half the time, 4 = Most of the time, 5 = Always

(Continues)

TABLE 3 (Continued)

Constructs	Question ^a	Distribution 1–2 score (%)			Distribution 3 score (%)			Distribution 4–5 score (%)			Scale used
		New Zealand	France	Singapore	New Zealand	France	Singapore	New Zealand	France	Singapore	
Products labels and claims	PLC1	15.12	17.15	11.27	11.71	13.24	17.16	73.16	69.61	71.57	1 = Unnatural to 5 = Natural
	PLC2	17.15	15.68	10.78	22.06	17.16	18.14	60.79	67.16	71.08	1 = Distrustful to 5 = Trustworthy
	PLC3	8.33	13.72	9.80	12.75	11.27	13.73	78.92	75.00	76.47	1 = Unhealthy to 5 = Healthy
	PLC4	8.30	21.18	14.22	27.80	35.96	37.75	63.90	42.86	48.04	1 = Cheap to 7 = Expensive
	PLC5	49.02	54.19	37.25	26.96	23.65	28.43	24.02	22.17	34.31	1 = Low caloric value to 5 = High caloric value
	PLC6	19.11	11.76	13.24	18.63	17.65	19.12	62.25	70.59	67.65	1 = Distrustful to 5 = Trustworthy
	PLC7	15.12	10.78	10.29	20.49	17.16	19.61	64.39	72.07	70.10	1 = Unhealthy to 5 = Healthy
	PLC8	9.76	22.06	13.73	35.12	28.92	37.75	55.12	49.02	48.53	1 = Cheap to 5 = Expensive
	PLC9	30.39	34.31	24.51	36.76	31.37	23.04	32.84	34.31	52.45	1 = Low caloric value to 5 = High caloric value
	PLC10	5.36	3.43	2.94	4.88	7.35	12.25	89.76	89.22	84.80	1 = Strongly disagree to 5 = Strongly agree
	PLC11	28.79	51.96	18.63	19.02	20.59	29.41	52.20	27.46	51.96	1 = Strongly disagree to 5 = Strongly agree
	PLC12	30.24	34.32	33.33	15.12	30.39	25.00	54.63	35.29	41.67	1 = Never, 2 = Sometimes, 3 = About half the time, 4 = Most of the time, 5 = Always
Perceived flavor	PCF1	44.87	32.35	36.27	21.95	25.49	24.02	33.17	42.16	39.71	1 = Strongly disagree to 5 = Strongly agree
	PCF2	57.08	59.32	45.10	22.93	27.45	23.04	20.00	13.23	31.86	1 = Strongly disagree to 5 = Strongly agree

^aFor the abbreviations used for questions, please see the full questions in Table 1 for each construct.

^bPlease note that question BVN1 “How many days per week do you intend to limit your intake of sugar-sweetened yoghurts” is not displayed in the table because this question was not evaluated using a scale. Participants were given four options: 0–1, 2–3, 4–5, 6–7 days.

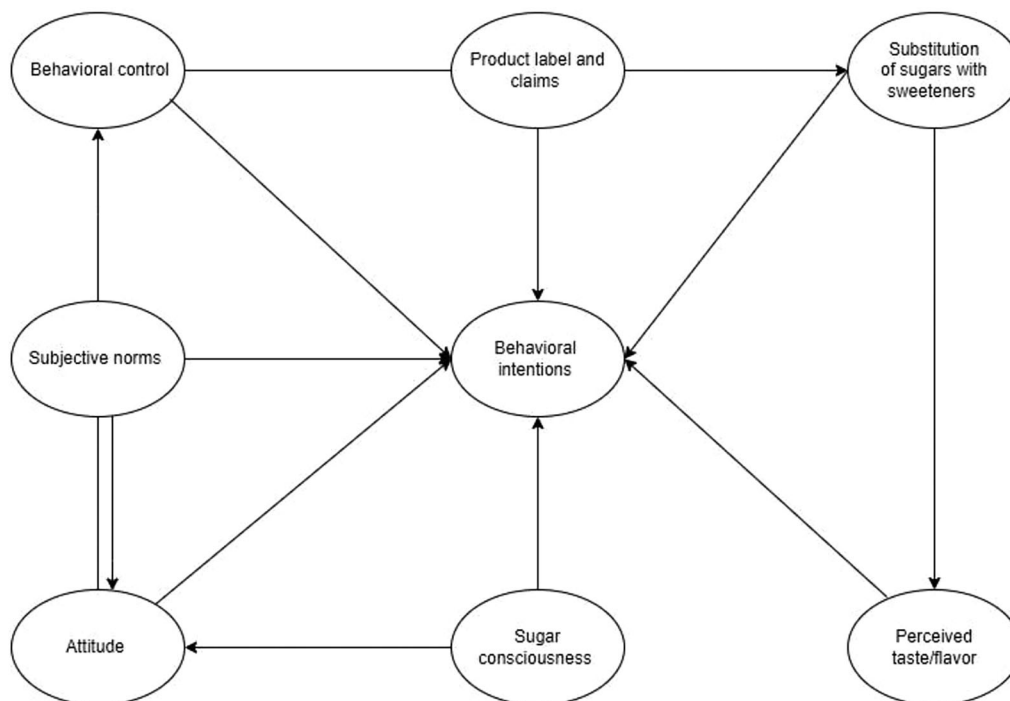


FIGURE 1 Conceptual framework model designed for the multigroup partial least squares-path modeling (PLS-PM) analysis to examine differences between the consumption and purchase behavior of participants from New Zealand, Singapore, and France.

yoghurt, even if it was more expensive than yoghurt sweetened with other sweeteners (PBC1). In contrast, only 41.18% of participants from France reported the same. Eating less than the recommended portion size of sugar-sweetened yoghurt every day was strongly approved by people whose opinions were valued by more participants from Singapore (52.45%) compared to New Zealand (41.18%) and France (26.96%) participants (SBN1).

The attitude of participants toward consumption of sugar-sweetened yoghurt varied with different countries. More participants from Singapore and New Zealand agreed that eating less than the recommended portion size of sugar-sweetened yoghurt everyday was enjoyable (57.35% and 40.69%, respectively) (ATT1) and beneficial (60.29% and 51.47%, respectively) (ATT2) compared to participants from France (6.86% and 32.84%, respectively).

Participants from Singapore were more likely to limit their intake of sugar-sweetened yoghurts to between 2 and 3 days (46.08%). However, participants from New Zealand (37.25%) or France (49.51%) were more likely to limit their intake of sugar-sweetened yoghurts to between 0 and 1 day (BVN1). Participants from all three countries expressed a strong belief in their ability to avoid sugar-sweetened yoghurt in the future (BVN2). In New Zealand, 76.96% of participants strongly agreed with this statement, followed by 69.61% of Singaporean participants and 48.04% of French participants.

Participants from all three countries agreed that they pay special attention to the type of sweeteners when making food selections (SSN1). In Singapore, 66.67% of participants agreed or strongly agreed with this statement, followed by 59.51% of participants from New Zealand and 53.92% of participants from France. In addition, most

New Zealand (52.68%), French (52.94%), and Singapore (43.63%) participants said that the presence of natural sweetener would influence their decision to consume or purchase yoghurt about “half of the time” (SSN2). This means that in approximately 50% of instances, the inclusion of a natural sweetener would sway their decision to consume or purchase that specific yoghurt product. Interestingly, participants from Singapore and France were more divided in their opinions on how often the presence of artificial sweetener influences their consumption or purchase decision (SSN3). Participants in Singapore and France (38.24% and 31.7%, respectively) said that artificial sweetener influences their decision most of the time or always. However, 37.25% and 39.71% of participants from Singapore and France, respectively, said that artificial sweetener never or sometimes influences their decision. In contrast, most participants from New Zealand (46.34%) said that artificial sweetener does not influence their decision much.

Participants from France and Singapore had contrasting opinions on how often they pay attention to the amount of sugar in yoghurt (SCC1). In France, 45.56% of participants said that they pay attention to the amount of sugar most of the time or always, whereas 55.88% of participants from Singapore said that they never or sometimes pay attention to the amount of sugar. In New Zealand, the opinions were more divided, with 41.95% of participants saying that they never or sometimes pay attention to the amount of sugar and 45.85% saying that they always or most of the time pay attention to the amount of sugar. Participants from all three countries were divided on how often they consume yoghurt without sugar or low sugar (SCC2). Participants in New Zealand, France, and Singapore (48.29%, 34.31%, and 43.14%, respectively) said that they consume it most of the time or always.

However, 40.49% of participants from New Zealand, 36.76% from France, and 44.12% from Singapore selected “never” or “sometimes” as their answer.

The effect of product labels and claims (“no added sugar,” “naturally sweetened,” “sugar content of high-sugar products,” “label for the imposition of sugar-tax on high-sugar yoghurts,” and “nutritional table/list of ingredients”) on the consumption/purchase decision of participants was investigated. It was revealed that most participants from all three countries perceived yoghurts labeled with “no added sugar” as more natural (PLC1), trustworthy (PLC2), healthier (PLC3), and expensive (PLC4). There was a divided opinion among participants from Singapore about the caloric value of yoghurt labeled with “no added sugar” (PLC5). Overall, 37.25% of participants perceived them as low-calorie, whereas 34.31% perceived them to be high calorie. In contrast, most participants from New Zealand (49.02%) and France (54.19%) perceived them to be low-calorie.

Most participants from New Zealand, France, and Singapore perceived the yoghurts labeled “naturally sweetened” as more trustworthy (PLC6), healthier (PLC7), and expensive (PLC8). However, opinions of participants from New Zealand and France on the caloric value of yoghurts labeled as “naturally sweetened” were split (PLC9). One-third (30.39% and 34.31%, respectively) perceived them as low-calorie; another one-third (36.76% and 31.37%, respectively) perceived them as neither high nor low-calorie, and the remaining one-third (32.84% and 34.31%, respectively) perceived them as high-calorie. In contrast, most respondents from Singapore (52.45%) found them to be high calorie.

The majority of participants from all three countries (89.76%, 89.22%, and 84.80% in New Zealand, France, and Singapore, respectively) agreed that sugar content should be clearly visible on the packaging label of yoghurts that are high in sugar (PLC10). Moreover, most participants from New Zealand (52.20%) and Singapore (51.96%) expressed a higher level of agreement with the imposition of a sugar-tax on high-sugar yoghurts, compared to participants from France participants, where a larger proportion (51.96%) expressed disagreement with the idea of a sugar tax (PLC11). Participants from Singapore had a divided opinion on the influence of nutritional table/list of ingredients on their consumption/purchase decision (PLC12). Overall, 33.33% of participants indicated that their decision will “never” be influenced or will only be influenced “sometimes,” whereas 41.67% of participants indicated that they will be influenced “most of the time” or “always.” In contrast, most New Zealand participants (54.63%) indicated that their consumption/purchase decision will be influenced “most of the time” or “always.” Interestingly, results from French participants showed a more split opinion, with one-third selecting “never” or “sometimes,” another one-third selecting “about half the time,” and the remaining one-third selecting “most of the time” or “always” as their response.

The effect of labels (“no added sugar” and “naturally sweetened”) on the perceived flavor was also evaluated. It was found that participants from New Zealand and France had contrasting opinions. Most New Zealand participants (44.87%) disagreed with the notion that yoghurts labeled with “no added sugar” are less tasty compared to their regular

counterparts, whereas most French participants (42.16%) agreed with the notion. Participants from Singapore were divided in their opinions, 39.71% agreeing and 36.27% disagreeing with the statement (PCF1). With regards to the label “naturally sweetened” (PCF2), most participants from New Zealand, France, and Singapore disagreed with the statement that yoghurts labeled with the claim “naturally sweetened” are less tasty compared to their regular counterparts (57.08%, 59.32%, and 45.10%, respectively).

3.3 | The relationships between TPB and consumer perception and acceptance constructs using PLS-PM

The important constructs for developing the conceptual framework model required for the application of PLS-PM were identified using PLS-CFA. PLS-CFA was used because it employs a saturated model that allows the linking of all the latent variables (Barcelos et al., 2022), thus allowing the evaluation of all the possible significant relationships. Using PLS-CFA, the relationships between all eight latent variables in this study (attitude, subjective norms, perceived behavioral control, behavioral intentions, sugar consciousness, influence of substitution of sugar with sweeteners, perceived flavor, and product labels and claims) specific to data obtained from New Zealand, France, and Singapore were examined. Three separate PLS-CFA were performed as a precursor to PLS-PM to obtain the conceptual framework unique to each country. This novel approach allowed the customization of the conceptual framework based on unique characteristics of each country. This approach can also be described as explorative to directive, as the significance of the relationships between latent variables was explored first, followed by positive and negative correlations of those latent variables. By using this approach, we aimed to enhance the accuracy and applicability of PLS-PM for multicultural studies, by capturing the specific behavior that shapes the correlations of different latent constructs.

3.3.1 | New Zealand study

The PLS-CFA results for New Zealand revealed that behavioral intention showed a significant and positive relationship with sugar consciousness, behavioral control, substitution of sugar with sweeteners, and significant and negative relationship with perceived flavor (Appendix Table 1). Sugar consciousness had significantly positive relationships with behavioral control and substitution of sugar with sweeteners and significantly negative relationship with perceived flavor. Moreover, both behavioral control and subjective norms showed significant and positive relationship with attitude. Finally, product labels and claims showed a significant and negative relationship with perceived flavor.

Based on these results, a conceptual framework for New Zealand was developed and analyzed using PLS-PM. Dillon–Goldstein’s ratio for each of the manifest variables in the conceptual framework analyzed using PLS-PM showed a value of greater than .7, indicating overall reliability of the associated models. The GoF value of the model (.237)

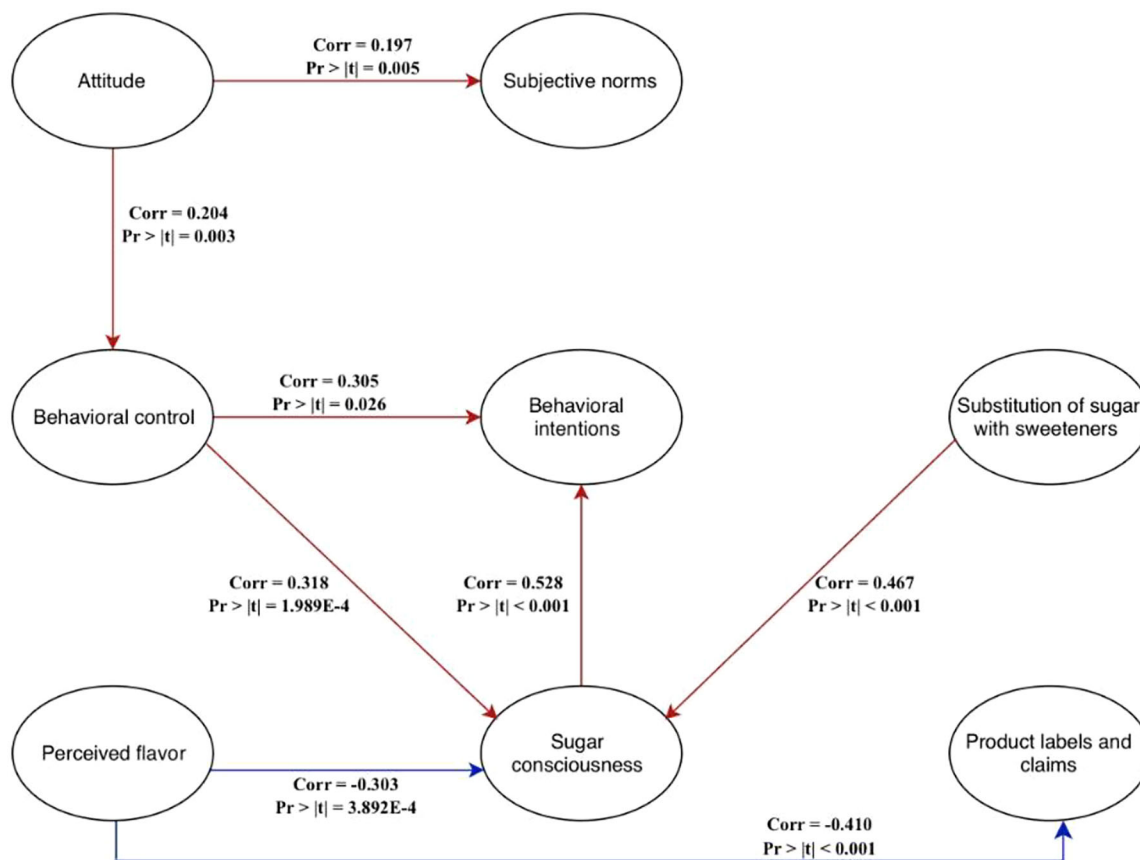


FIGURE 2 Partial least squares-path modeling (PLS-PM) results showing the significant correlations between different variables that evaluate the consumption and purchase behavior of yoghurts among consumers from New Zealand. The significant correlations are indicated by the arrows. Absence of arrows between latent variables indicates no significant correlation. Red arrows indicate positive correlations ($p < .05$), and blue arrows indicate negative correlations ($p < .05$).

was similar to the GoF value of the bootstrapped model (.252) for the PLS-PM analysis carried out.

Figure 2 shows the PLS-PM results that depict the relationships between the TPB constructs and consumer perception and acceptance constructs, which help explain the overall consumption and purchase behavior of yoghurt among New Zealand's participants. Attitude had a significant positive correlation with subjective norms ($\text{corr} = .197, p < .01$) and behavioral control ($\text{corr} = .204, p < .01$). Sugar-consciousness ($\text{corr} = .528, p < .001$) and behavioral control ($\text{corr} = .305, p < .05$) had significant positive correlations with behavioral intention. Expectedly, sugar-consciousness was positively correlated to substitution of sugar with sweeteners ($\text{corr} = .467, p < .001$). On the other hand, perceived flavor showed a negative correlation with product labels and claims ($\text{corr} = -.410, p < .001$) and sugar-consciousness ($\text{corr} = -.303, p < .001$).

The weight contributions of each question within a construct are summarized in Appendix Table 2 for New Zealand participants (full questions for the abbreviations of each question can be found in Table 1). For attitude, question ATT1 had a higher weight than ATT2. For behavioral intentions, BVN2 had a higher weight than BVN1. In terms of substitution of sugar with sweeteners, SSN1 and SSN3 had higher weights than SSN2. Additionally, both SCC1 and SCC2 ques-

tions contributed almost equal weight for sugar-consciousness. For product labels and claims, PLC3, PLC6, and PLC10 had higher weights compared to other questions. In terms of perceived flavor, PCF2 had a higher weight than PLCF1 (Appendix Table 2).

3.3.2 | France study

The PLS-CFA results for France revealed that behavioral intention showed a significant and positive relationship with sugar consciousness, behavioral control, subjective norms, attitude, substitution of sugar with sweeteners, and product labels and claims (Appendix Table 1). Sugar-consciousness showed a significantly positive relationship with behavioral control, subjective norms, attitude, product labels and claims, and substitution of sugar with sweeteners and significantly negative relationship with perceived flavor. Moreover, attitude showed a significant and positive relationship with substitution of sugar with sweeteners and significant and negative relationship with perceived flavor. Product labels and claims had significantly negative relationship with perceived flavor. The substitute of sugar with sweeteners showed a significant and negative relationship with perceived flavor.

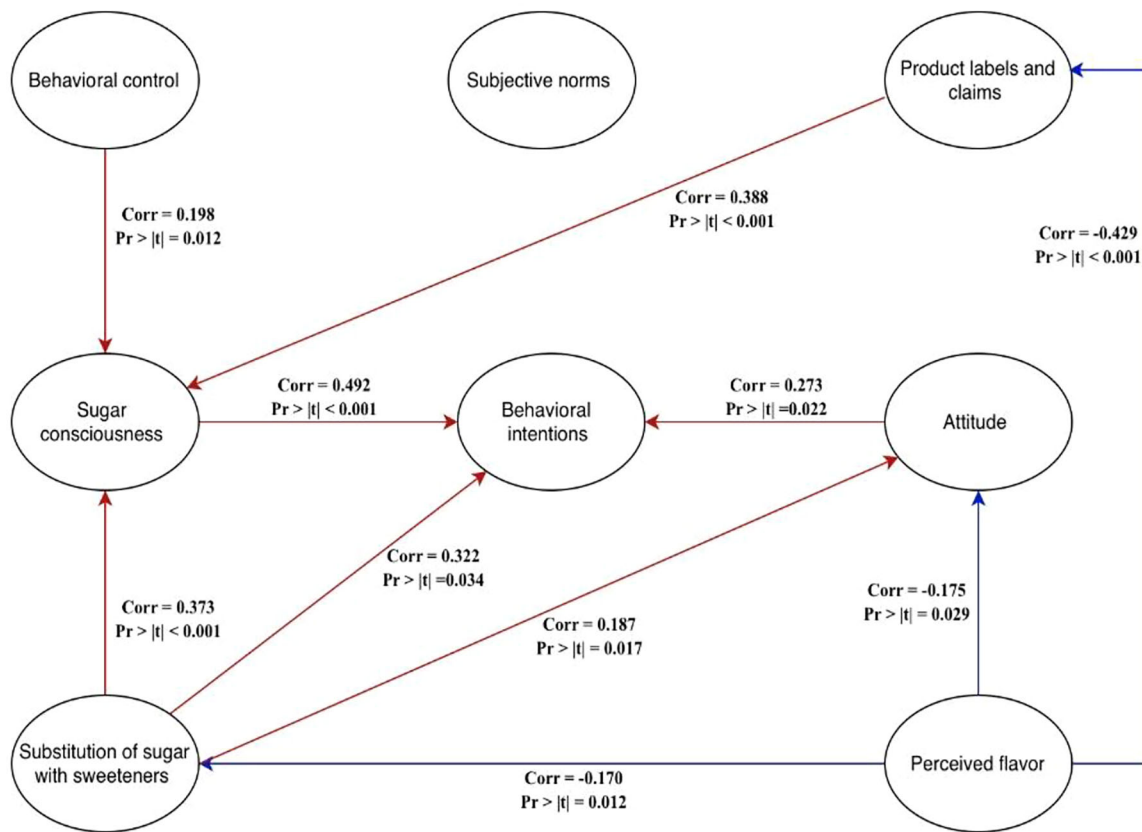


FIGURE 3 Partial least squares-path modeling (PLS-PM) results showing the significant correlations between different variables that evaluate the consumption and purchase behavior of yoghurts among consumers from France. The significant correlations are indicated by the arrows added. Absence of arrows between latent variables indicates no significant correlation. Red arrows indicate positive correlations ($p < .05$), and blue arrows indicate negative correlations ($p < .05$).

Based on these results, a conceptual framework for France was developed, which was then analyzed using PLS-PM. Dillon–Goldstein’s ratio for each of the manifest variables in the conceptual framework analyzed using PLS-PM showed a value of greater than .7, indicating the overall reliability of the associated models. The GoF value of the model (.243) was similar to the GoF value of the bootstrapped model (.255) for the PLS-PM analysis carried out.

Figure 3 shows the PLS-PM results that depict the relationships between the TPB constructs and consumer perception and acceptance constructs, which help explain the overall consumption and purchase behavior of yoghurt among French participants. Sugar-consciousness ($\text{corr} = .492$, $p < .001$), attitude ($\text{corr} = .273$, $p < .05$), and substitution of sugar with sweeteners ($\text{corr} = .322$, $p < .05$) had significant positive correlations with behavioral intention. Product information labels ($\text{corr} = .388$, $p < .001$), substitution of sugar with sweeteners ($\text{corr} = .373$, $p < .001$), and behavioral control ($\text{corr} = .198$, $p < .05$) were positively correlated to sugar-consciousness. Substitution of sugar with sweeteners showed a significant positive correlation with attitude ($\text{corr} = .187$, $p < .05$). Additionally, perceived taste/flavor was negatively correlated with product labels and claims ($\text{corr} = -.429$, $p < .0001$) and attitude ($\text{corr} = -.175$, $p < .05$).

The weight contributions of each question within a construct are summarized in Appendix Table 2 for French participants (full questions for the abbreviations of each question can be found in Table 1). For attitude, both ATT1 and ATT2 questions contributed almost equal weight to this variable. For behavioral intentions, BVN2 had a higher weight than BVN1. In terms of substitution of sugar with sweeteners, SSN1 and SSN3 had higher weights than SSN2. Additionally, both SCC1 and SCC2 questions contributed almost equal weight for sugar-consciousness. For product labels and claims, PLC11 and PLC12 had higher weights compared to other questions. In terms of perceived flavor, PCF1 had a higher weight than PLCF2 (Appendix Table 2).

3.3.3 | Singapore study

The PLS-CFA results for Singapore revealed that behavioral intention showed a significant and positive relationship with sugar consciousness, behavioral control, attitude, substitution of sugar with sweeteners, and product labels and claims (Appendix Table 1). Sugar-consciousness showed a significant and positive relationship with

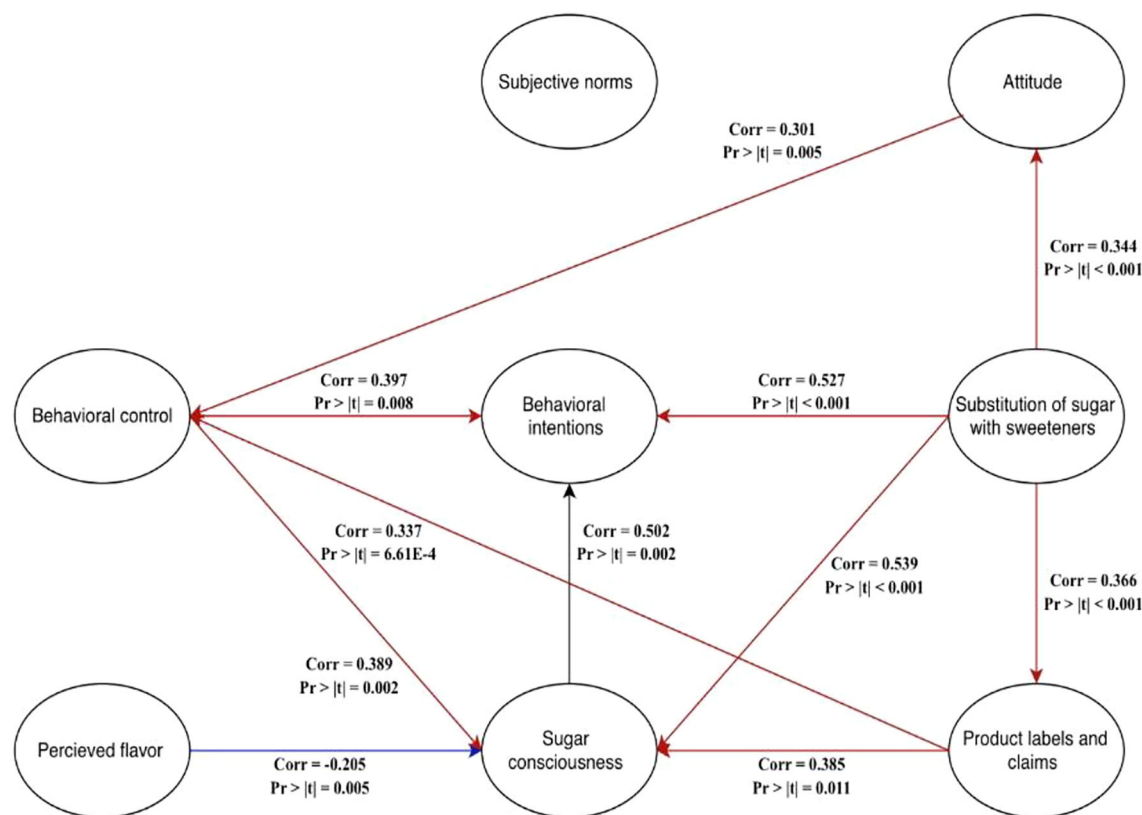


FIGURE 4 Partial least squares-path modeling (PLS-PM) results showing the significant correlations between different variables that evaluate the consumption and purchase behavior of yoghurts among consumers from Singapore. The significant correlations are indicated by the arrows added. Absence of arrows between latent variables indicates no significant correlation. Red arrows indicate positive correlations ($p < .05$), and blue arrows indicate negative correlations ($p < .05$).

behavioral control, attitude, product labels and claims, substitution of sugar with sweeteners, and significant and negative relationship with perceived flavor. Behavioral control showed a significant and positive relationship with attitude, product labels and claims, and substitution of sugar with sweeteners. Subjective norms had a significant and positive relationship with attitude. Attitude showed significant and positive relationships with product labels and claims, substitution of sugar with sweeteners, and perceived flavor. Product labels and claims only had a significant and positive relationship with substitution of sugar with sweeteners.

Based on these results, a conceptual framework for Singapore was developed, which was then analyzed using PLS-PM. Dillon-Goldstein's ratio for each of the manifest variables in the conceptual work analyzed using PLS-PM showed a value of greater than .7, indicating the overall reliability of the associated models. The GoF value of the model (.306) was similar to the GoF value of the bootstrapped model (.317) for the PLS-PM analysis carried out.

PLS-PM detailing the relationship between the TPB and consumer's perception and acceptance constructs, thus representing the overall consumption and purchase behavior of yoghurt among participants participating from Singapore has been shown in Figure 4. Please note that significant positive correlations of a value above .3 have been shown and discussed for the simplification of the model. Substitution

of sugar with sweeteners ($\text{corr} = .527, p < .001$) followed by sugar consciousness ($\text{corr} = .502, p < .01$) and behavioral control ($\text{corr} = .397, p < .01$) showed a significant and positive impact on the behavioral intentions. Behavioral control ($\text{corr} = .389, p < .01$), product labels and claims ($\text{corr} = .385, p < .05$), and substitution of sugar with sweeteners ($\text{corr} = .539, p < .001$) showed a positive effect, whereas perceived taste/flavor ($\text{corr} = -.205, p < .01$) showed a negative impact on sugar consciousness. Moreover, behavioral control was significantly and positively impacted by attitude ($\text{corr} = .301, p < .01$) and product labels and claims ($\text{corr} = .337, p < .001$). Substitution of sugar with sweeteners showed a significant and positive effect on both attitude ($\text{corr} = .344, p < .001$) and product labels and claims ($\text{corr} = .366, p < .001$).

The weight contributions of each question within a construct are summarized in Appendix Table 2 for Singapore participants (full questions for the abbreviations of each question can be found in Table 1). For attitude, both ATT1 and ATT2 questions contributed almost equal weight to this variable. For behavioral intentions, BVN2 had a higher weight than BVN1. In terms of substitution of sugar with sweeteners, SSN1 had a higher weight than SSN2 and SSN3. Additionally, SCC1 had a higher weight than SCC2 for sugar-consciousness. For product labels and claims, PLC11 had the highest weight compared to other questions. In terms of perceived flavor, PCF1 had a higher weight than PCF2 (Appendix Table 2).

3.4 | Relationships between TPB constructs, and consumer perception and acceptance constructs between New Zealand, France, and Singapore using partial least squares-multigroup analysis (PLS-MGA)

The results of PLS-MGA demonstrated a statistically significant difference in the impact of subjective norms on attitude between French versus Singaporeans and Singaporeans versus New Zealanders ($p < .05$). This finding indicates that the strength and consistency of the relationship between subjective norms and attitudes vary significantly across the two cultural contexts. Table 4 also shows a statistically significant difference in the impact of behavioral control on the influence of sweeteners on the consumption and purchasing behavior between Singaporeans and French participants ($p < .05$). This finding indicates that the strength of the relationship between behavioral control and substitution behavior varies significantly across the two nationalities. PLS-MGA results also revealed a statistically significant difference in the impact of influence of substitution of sugar with sweeteners on the behavioral intention of reducing the intake of sugar-sweetened yoghurts between Singapore and New Zealand participants ($p < .05$). This suggests that individual's intentions to reduce sugar intake by adopting sugar substitutes varies among different cultures.

4 | DISCUSSION

4.1 | Understanding the relationship between TPB constructs and consumer perception and acceptance constructs in a cross-cultural study using multiple conceptual models

PLS-PM is a statistical technique used for structural equation modeling, which allows researchers to analyze complex relationships between latent variables (Malavalli et al., 2021). However, in a multicultural study, it is important to ensure that the conceptual model used is unique for each country. A preliminary analysis of the same conceptual framework model using PLS-PM on data obtained from studies carried out in France, Singapore, and New Zealand yielded a low number of significant correlations. When carrying out multicultural studies, it is important to develop unique conceptual models because different cultures have different values, beliefs, and norms. Hence, in this study, a unique conceptual model was customized for each country using PLS-CFA to yield a broader spectrum of significant relationships between TPB constructs and consumer perception and acceptance constructs. This approach recognized the diversity of factors that can influence sugar consumption behavior of participants from different countries and ensured that the models are better suited to each specific country.

The findings in this study suggest that the use of a preliminary step such as PLS-CFA to obtain the customized conceptual model for each country was instrumental in finding all the possible relationships. This reiterates the value of considering cultural and contextual variables in multicultural consumer behavior studies. Takemi and Woo (2017) used the TPB to understand the variables that influenced sweetness prefer-

ence among children from Korea and Japan. However, their study used a single conceptual model that assumed that behavioral intention was influenced by affective attitude, cognitive attitude, normative belief, motivation to comply, perceived behavioral control, parenting practice, accessibility, and reward. A single conceptual framework does not adequately capture the cultural nuances that influence children's behavior and intentions related to sweetness preference as factors like parenting practices and sweet food accessibility of sweet foods can vary between Japan and Korea. This supports the need to develop unique conceptual models for each country.

Constructs used to measure behavioral intention in a study may have different connotations or importance in different countries, leading to measurement bias and potentially misrepresenting the actual intentions of consumers. For example, a study by Forde and Solomon-Moore (2019) on sugar consumption among low-socioeconomic individuals in the United Kingdom used a single conceptual model to characterize sugar-intake behavior and to understand consumer attitude toward the health effects of sugar consumption. They found that consumption behavior was mainly influenced by personal (food insecurity), psychological (mental health), and social (food access and familial behavior) factors. However, the findings of this study may not be generalizable to all individuals within the low-socioeconomic status group or to all those who are food insecure across the United Kingdom, as the study only interviewed clients from different food banks. Each food bank might serve communities with varying degrees of food insecurity, cultural norms, and resource availability. Hence, it is important to use different conceptual models for cross-cultural studies. This will allow researchers to capture the relevant constructs in different cultures to obtain a more accurate understanding of consumer behavioral intentions.

4.2 | Perceived behavioral control, sugar consciousness, and substitution of sugar with sweeteners had a significant and positive effect on the behavioral intentions aimed at the reduction of the sugar-intake

Behavioral control showed a positive correlation with the behavioral intentions of reducing the intake of sugar-sweetened yoghurt among participants from New Zealand (Figure 2) and Singapore (Figure 4). Behavioral control in the current research was assessed by asking the participants to indicate their ease or difficulty for limiting their intake of sugar-sweetened yoghurt. Participants from both New Zealand and Singapore found it easier to limit their intake of sugar-sweetened yoghurt, even if it was more expensive than yoghurt sweetened with other sweeteners (PBC1). A study conducted in United States and Australia using convenience sampling to examine the usefulness of self-regulation theory in predicting the consumption behavior of SSB found that self-control (assessed using the item "I am good at resisting temptation") had a significant effect on the intention of avoiding the intake of sugary drinks (McAlpine & Mullan, 2022). Additionally, a study in Singapore evaluated parents' intention to control the sugar consumption

TABLE 4 Results of partial least squares-multigroup analysis (PLS-MGA) analysis comparing the consumption and purchase behavior of different kinds of yoghurts (sugar-sweetened, sugar-reduced, artificially sweetened, and naturally sweetened) of consumers from New Zealand, France, and Singapore.

Latent variables	Path coefficients showing the impact of latent variables on one another for each country			PLS-MGA <i>p</i> -value obtained by comparing the impact of latent variable on one another between two different countries		
	New Zealand	France	Singapore	France vs. New Zealand	France vs. Singapore	Singapore vs. New Zealand
Sugar consciousness → Attitude	.172*	.200**	.107	.832	.347	.594
Subjective norms → Attitude	.180**	.073	.487***	.446	.010	.040
Attitude → Behavioral control	.215**	.176*	.303***	.703	.178	.406
Behavioral control → Substitution of sugar with sweetener	.068	.051	.300***	.871	.010	.050
Substitution of sugar with sweeteners → Perceived taste/flavor	-.138	-.152*	-.133	.970	.832	.960
Sugar consciousness → Behavioral intentions	.329***	.342***	.196**	.911	.188	.257
Subjective norms → Behavioral intentions	.014	.037	.127	.772	.327	.238

(Continues)

TABLE 4 (Continued)

Latent variables	Path coefficients showing the impact of latent variables on one another for each country			PLS-MGA <i>p</i> -value obtained by comparing the impact of latent variable on one another between two different countries		
	New Zealand	France	Singapore	France vs. New Zealand	France vs. Singapore	Singapore vs. New Zealand
Attitude → Behavioral intentions	-.010	.131*	.107	.109	.792	.228
Behavioral control → Behavioral intentions	.145*	.095	.119	.505	.772	.752
Product labels and claims → Behavioral intentions	.181*	.212**	.103	.713	.198	.416
Substitution of sugar with sweeteners → Behavioral intentions	.048	.090	.260***	.554	.099	.030
Perceived taste/flavor → Behavioral intentions	-.066	.028	-.117*	.257	.099	.545

Note: Significance level of correlation-coefficient: **p* < .05, ***p* < .01, *** *p* < .001. Bold font: Significant correlation coefficients and PLS-MGA *p*-values below 5%.

by asking them how willing they were to reduce the amount of sugar their child consumes (Chan et al., 2021). The authors found that parents who established strict control over sugar consumption were successful in limiting the frequency of SSB intake, which in turn reduced the intake of SSBs among children. However, the authors explained that not all parents were able to establish strict control over sugar consumption as children are also cared for by grandparents and domestic helpers who influence dietary choices. Additionally, parents indicated that outside the home, they possess limited influence over their child's dietary choices during their time at childcare centers or in preschool environments.

Substitution of sugar with sweeteners was positively correlated with the behavioral intentions of reducing the intake of sugar-sweetened yoghurts among the participants from France (Figure 3) and Singapore (Figure 4). In this study, the latent variable "substitution of sugar with sweeteners" was evaluated using three questions: (1) attention paid to the type of sweetener (SSN1), (2) presence of natural sweetener in yoghurt (SSN2), and (3) willingness to try yogurts sweetened with artificial sweeteners (SSN3). SSN1 and SSN2 questions contributed equal weight to the substitution of sugar with sweeteners construct for participants from France. However, for participants from Singapore, SSN3 contributed more weight (see Appendix Table 2 for details). In addition, most participants from both France and Singapore agreed that they paid special attention to the type of sweetener, or the presence of natural sweetener in yoghurt that in turn influenced their consumption/purchase decisions about half the time (Table 3). The positive correlation of substitution of sugar with sweeteners on the behavioral intentions of reducing sugar intake was consistent with other studies. A study conducted with participants from United Kingdom and USA studied the impact of diet drinks (drinks sweetened with noncaloric artificial sweeteners) on the consumption behavior of participants who regularly consumed SSBs using an implementation intention-based intervention (Judah et al., 2020). The authors found that there was a significantly large reduction in the consumption of SSBs for the participants who consumed diet drink over 2 months. This suggests that substituting SSBs with sweeteners can be an effective strategy for reducing SSB consumption. Additionally, in Chile, a recent growth in the reformulation of products by replacing sucrose with noncaloric sweeteners has been observed. This is due to the increased intention of the Chileans to reduce their sugar intake after the mandatory introduction of warning labels on the front of food packages for high sugar content in 2016 (Reyes et al., 2020). On the other hand, the acceptance of an intervention that involved substituting sugar with artificial sweeteners to reduce sugar intake was least accepted by French-speaking residents in Switzerland (Hagmann et al., 2018). This was the case when the intervention was framed as a way to reduce sugar in breakfast cereals and yogurt. The authors suggested that this was due to consumers' perception of artificial sweeteners as being unhealthy or as a health risk.

There was a significant and positive correlation between sugar consciousness and behavioral intentions to reduce the intake of sugar-sweetened yoghurt across participants from New Zealand (Figure 2), France (Figure 3), and Singapore (Figure 4). In the present study,

sugar consciousness was evaluated using two questions: (1) the frequency of attention paid to the amount of sugar in yoghurt (SCC1) and (2) the frequency of consumption of yoghurt without sugar or low sugar (SCC2). For participants from New Zealand, France, and Singapore both these questions contributed equal weight to the sugar-consciousness construct (see Appendix Table 2 for details). Participants from New Zealand had somewhat divided opinions on SCC1, as half indicated that they never or sometimes pay attention to sugar and other half said that they always or most of the time pay attention to the amount of sugar when consuming yoghurt (Table 3). However, most Singapore participants indicated that they never or sometimes pay attention to sugar when consuming yoghurt compared to participants from France which indicated that they pay attention to the amount of sugar most of the time or always (Table 3). In terms of SCC2, participants from all three countries expressed divided opinions. Approximately half of the participants reported consuming "without sugar" or "low sugar" yoghurt most of the time or always, whereas the other half indicated that they "never" or only "sometimes" consume it (Table 3). The positive correlation of sugar-consciousness with behavioral intentions is consistent with other studies. A study by Hagmann et al. (2018) found that sugar consciousness as measured by the question "How much attention do you pay to the sugar content in your diet?", was one of the strongest factors that influenced acceptance of government interventions to reduce sugar intake in French-speaking regions of Switzerland. Similarly, another study conducted in Portugal reported that sugar-consciousness; as assessed using the same question showed a positive correlation with the acceptance of interventions aimed at reducing the sugar-intake (Prada et al., 2020). This suggests that individuals who are more aware of their sugar intake are likely to be more motivated to reduce their sugar consumption, thereby displaying greater support for interventions aimed at the same goal.

4.3 | Product labels and claims was negatively correlated to perceived flavor among New Zealand and France's participants

Product labels and claims showed a negative correlation with the perceived flavor of yoghurt among the participants from New Zealand (Figure 2) and France (Figure 3). In the present study, product labels and claims were evaluated using different labels, such as "no added sugar" (PLC1-PLC5), "naturally sweetened" (PLC6-PLC9), "sugar content of high-sugar products" (PLC10), "label for the imposition of sugar-tax on high-sugar yoghurts" (PLC11), and "nutritional table/list of ingredients" (PLC12). For participants from New Zealand, healthiness of "no added sugar" label (PLC3), trustworthiness of "naturally sweetened" label (PLC6), and the labeling of "sugar content" in high-sugar yoghurts (PLC10) contributed the most weight to the product labels and claims construct (see Appendix Table 2 for details). Most participants from New Zealand perceived yoghurts labeled with "no added sugar" as healthier and yoghurts labeled with "naturally sweetened" label as more trustworthy (Table 3). In addition, most New Zealand participants agreed that "sugar content" should be clearly visible on the

packaging label of yoghurts that are high in sugar (Table 3). For participants from France, label of “sugar content” in high-sugar products (PLC10) and label of “sugar-tax” on high-sugar products (PLC11) contributed the most weight to the product labels and claims construct (see Appendix Table 2 for details). Majority of participants from France agreed with the statement that sugar content should be clearly visible on the packaging of high-sugar yoghurts but disagreed with the idea of imposition of sugar-tax label (Table 3).

The negative correlation of product labels and claims with perceived flavor has also been observed in past studies. This negative relationship between product labels and claims and perceived flavor can be explained by the “health-pleasure” trade-off effect, which suggests that the presence of nutritional claims may lead to the expectation of more negative hedonic attributes (e.g., less tasty or inferior taste) (Fenko et al., 2016; Loebnitz & Grunert, 2018). Benson et al. (2019) conducted a study with participants from Ireland to investigate the effects of different nutritional and health claims like “no added sugar,” “good chocolate,” “gluten and nut free,” “with live cultures,” and “63 calories per bar” on the consumers’ perception of chocolate. The authors found that consumers were more likely to perceive products labeled with nutritional and health claims as being bland or poor in taste. In addition, Bollard et al. (2016) found that SSB labeled with text or pictorial warning label (i.e., *WARNING: High sugar content*) was associated with consumers’ perception of the beverage tasting worse compared to SSBs with no warning label. Recently, a study conducted in Portugal also found a negative correlation between perceived taste/flavor and product information labels. Yoghurts labeled with sugar-related claims (0% sugar, sugar-free, no added sugar, or low-sugar) were perceived as being of inferior taste (Prada et al., 2021).

4.4 | Partial least squares-multigroup analysis (PLS-MGA) revealed significant differences between two countries during the evaluation of impact of one latent variable on another

The impact of “subjective norms” on “attitude” was significant between participants in France and Singapore, as well as Singapore and New Zealand (Table 4). Subjective norm in the current study was assessed using one question, SBN1 (Table 1). It was found that majority of participants from Singapore indicated that eating less than recommend portion size of sugar-sweetened yoghurt will be strongly approved by people whose opinions they value (Table 3). In contrast, majority of participants from New Zealand and France had a neutral stance toward the approval of people whose opinions they value (Table 3). In terms of attitude, participants from New Zealand and Singapore were also more likely to agree that eating less than the recommended portion size of sugar-sweetened yoghurt everyday would be enjoyable (ATT1) and beneficial (ATT2). In contrast, most participants from France were either neutral or disagreed with these statements (Table 3). The difference in the participants’ response can be explained by cultural differences. In the present study, majority of the Singapore’s participants (84%) were Chinese, and most of the France and New Zealand

participants (99% and 52%, respectively) were Europeans (Table 2). Chinese cultures, in general, are more collectivist, emphasizing group harmony and conformity to social norms (An et al., 2023) compared to European cultures that are more individualistic, emphasizing personal autonomy and individual decision-making. In collectivist societies, the influence of family, peers, and community members can have a more substantial impact on influencing attitudes and behaviors (Zhang et al., 2023). The culture of New Zealand is a mix of collectivism and individualism. Tassell et al. (2010) found that although most of New Zealand’s population has European settler ancestry and holds individualistic values, the indigenous Māori culture of New Zealand, which prioritizes community, collaboration, and inclusivity, aligns with horizontal collectivist values.

The impact of “perceived behavioral control” and “substitution of sugar with sweeteners” was significant between participants in France and Singapore (Table 4). The perceived behavioral control in the current study was assessed using one question (PBC1) (Table 1). Participants from Singapore (60.78%) found it easier to limit their intake of sugar-sweetened yoghurt, even if it was more expensive than yoghurt sweetened with sweeteners compared to only 41.18% of participants from France reporting the same. In terms of substitution of sugar with sweeteners, most participants from France and Singapore agreed that they pay special attention to types of sweeteners (artificial or natural) when making food selection. Cultural norms and values of participants in Singapore may emphasize self-control and discipline, leading to a higher perceived behavioral control (Li et al., 2018), in terms of limiting their intake of sugar-sweetened yogurt, even if it is more expensive. On the other hand, participants from France may have different cultural norms and attitudes toward food and indulgence (Vosgerau et al., 2020), which could result in a lower perceived behavioral control in this context. Moreover, economic factors may also contribute to this difference. The cost of food products can influence individuals’ perceived behavioral control, as higher prices may act as a deterrent and make it more difficult for individuals to limit their intake. It is possible that the participants from Singapore, who reported higher perceived behavioral control, may have a higher willingness or ability to pay for healthier alternatives, such as yogurt sweetened with other sweeteners, compared to participants from France. While it remains inconclusive to definitively determine the strength of the relationship between the consumption of naturally and/or artificially sweetened foods and beverages and cardiometabolic health over prolonged periods, particularly in comparison to sugar, there is a consensus that substituting free sugars with sugar substitutes can result in a reduction in total dietary energy intake (Sørensen et al., 2014). This consensus has manifested in the growth of sugar substitutes in Singapore in recent years, as evidenced by increased usage in various products. According to research conducted across 12 store locations in Singapore, spanning the four major retail supermarkets (NTUC FairPrice, Cold Storage, Sheng Siong, and Giant), and two major convenience stores (Cheers and 7-Eleven), there has been a notable increase in the incorporation of sugar substitutes. The categories displaying growth include energy drinks (80), carbonates (45), milk-based iced-coffees (33), RTD vinegars (31), and flavored drinks (27) (Tan et al., 2021).

Additionally, in April 2016, the Singapore Ministry of Health declared War on Diabetes to reduce diabetes burden. Larger F&B retailers and establishments were less affected, as they had resources to offer a variety of F&B options, including high/low sugar content and/or artificially/naturally sweetened options, catering to consumers willing to pay higher prices (Ow Yong & Koe, 2021).

The impact of “substitution of sugar with sweeteners” on “behavioral intentions” aimed toward limiting or avoiding the intake of sugar-sweetened yoghurt was significant between Singapore and New Zealand (Table 4). The “substitution of sugar with sweeteners” construct had higher weights for SSN1 and SSN3 (Table 1) for participants in Singapore and New Zealand. In terms of substitution of sugar with sweeteners, most participants from Singapore and New Zealand agreed that they pay special attention to types of sweeteners (artificial or natural) when making food selection (SSN1). Moreover, participants from Singapore had mixed opinions regarding SSN3. Half of the participants indicated that the presence of artificial sweetener influenced their consumption/purchase decision “most of the time” or “always,” whereas the other half indicated that it “never” or “sometimes” influenced their decision. In contrast, most of the participants from New Zealand indicated that the presence of artificial sweetener “never” or only “sometimes” influences their decision (SSN3, Table 3). A study by Dunford et al. (2018) found that New Zealand had significantly lower percentages of products containing nonnutritive sweeteners compared to Mexico (11%) and the United States (4%). This suggests that New Zealanders may be less familiar with artificial sweeteners and therefore less likely to consider them when making food choices. In Singapore where there might be a higher prevalence of products containing artificial sweetener, people may be more accustomed to their presence and thus more likely to be influenced by their presence.

5 | CONCLUSION

This study examined the consumer consumption and purchase behavior of sugar-sweetened, sugar-reduced, artificially sweetened, and naturally sweetened yoghurts in New Zealand, France, and Singapore. Using the TPB framework and consumer perception and acceptance constructs, the findings revealed the significance of various factors influencing sugar consumption behaviors. These included perceived behavioral control, the substitution of sugar with sweeteners, and the impact of product labeling and claims on perceived flavor. The study emphasized the need for customized conceptual models that consider cultural diversity in shaping consumer behavior. The PLS-CFA was used as a precursor to PLS-PM to identify the potential relationships between constructs that influence sugar consumption in different countries. The study highlights the importance of developing customized conceptual models that account for cultural diversity in shaping consumer behavior. The analysis also highlighted the notable differences between countries, and the necessity of considering cultural variations when assessing the impact of specific constructs. This insight is crucial for policymakers and food manufacturers seeking to

design effective interventions for promoting sugar-reduction behavior. Overall, this research contributes to a deeper understanding of the complex dynamics and cultural influences that shape consumer food choices in a globalized world.

6 | LIMITATIONS AND FUTURE STUDIES

While this study provides valuable insights, it is important to acknowledge its limitations. The use of convenience sampling from specific countries (France, Singapore, and New Zealand) may limit the generalizability of the findings due to potential sampling bias and cross-cultural variability. Subcultures and individual variations within each country might not have been adequately represented in the study. Another limitation is the reliance on self-reported data that can introduce biases as participants might respond what they perceive as socially desirable or acceptable.

To address these limitations, future studies could consider incorporating a combination of qualitative and quantitative analyses. This approach would provide a comprehensive understanding of underlying cultural, social, and psychological factors that shape consumer behaviors. It would also be valuable to evaluate additional constructs such as media exposure, societal norms, and generational influences to gain a more holistic understanding of cross-cultural differences. Collectively, these approaches would advance future research in a culturally sensitive and comprehensive manner.

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SUPPORTING INFORMATION

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