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Dietary acculturation among the South-Asian Surinamese population in the Netherlands: the HELIUS study

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Abstract

Objective: To test Koctürk's model of dietary change among South-Asian Surinamese in the Netherlands. The model categorizes foods into staple, complementary and accessory foods and postulates that dietary change after migration begins with accessory foods while foods associated with ethnic identity (staple foods) change at a slower rate.

Design: Cross-sectional data from the HELIUS study. Dietary intake was assessed with an FFQ. Acculturation was based on social contacts and sense of belonging and was translated into four strategies of acculturation: assimilation, integration, separation and marginalization. Other indicators of acculturation included residence duration, age at migration and migration generation status.

Setting: Amsterdam, the Netherlands.

Subjects: Participants of Dutch (*n* 1456) and South-Asian Surinamese origin (*n* 968).

Results: Across all acculturation strategies, South-Asian Surinamese participants reported significantly higher intakes of rice (staple food) and chicken (complementary food) and significantly lower intakes of red meat and vegetables (complementary foods) and cookies and sweets (accessory food) than Dutch participants. Men, second-generation and assimilated South-Asian Surinamese were inclined towards Dutch foods such as potato, pasta and red meat. Accessory foods like fruits showed variation across acculturation strategies.

Conclusions: Consistent with the Koctürk model, the intake of staple foods was stable among South-Asian Surinamese irrespective of acculturation strategy while the intake of accessory foods like fruit varied. Contrary to expectations, South-Asian Surinamese showed consistently high intakes of complementary foods like chicken and fish irrespective of acculturation strategy. Public health practitioners should take into consideration the complex and dynamic nature of dietary acculturation.

Keywords
South-Asian Surinamese
Dietary acculturation
Migration
Koctürk's model
HELIUS study

In many Western countries, diet has shifted towards increased consumption of fat, added sugar and animal foods with a decrease in the intake of fibre[1]. This has been linked to higher chronic disease risk among the local population of Western countries[2] and its adoption may also presumably have negative consequences for a growing non-Western migrant population residing in Western countries[3,4]. South Asians living in Western countries have shown higher levels of CVD risk and diabetes compared with host populations[5,6].

After migration, immigrants come in contact with the dominant culture of the host country, thereby starting a process of gradual cultural change which is termed acculturation[7]. Acculturation is considered a major determinant of dietary change in migrants and has been extensively studied[8,9]. It is generally assumed that with acculturation, migrants will gradually abandon their, presumably healthy, traditional diet and adopt a less favourable, Western diet. However, studies of the association between acculturation and diet have shown mixed results. For example, studies that measured fat-related dietary patterns among immigrants in the USA showed no association between acculturation and fat intake[10,11]; and studies on length of time of residence and fat intake in North America found a positive association[7,12,13]. Similarly, results for fruits and vegetables were inconsistent[14,15]. The lack of consistent findings may, in part, be due to an insufficient understanding of the process of dietary change. A model of dietary change, developed by Koctürk[16,17], is meant to enhance the understanding of food combination patterns in different

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cultures and the process of adaptation to new dietary patterns. This model categorizes food into staple, complementary and accessory foods along an axis where identity and taste form the two extreme poles. The model postulates that migrants will continue to consume foods that are strongly tied with their cultural identity. Dietary change is more likely to involve foods that play a less central role for identity. This model has been used to structure a qualitative study[18] but it has not been tested quantitatively to our knowledge.

The aim of the present paper is to test Koctürk's model of dietary change using quantitative data. To this end, this model is applied to the South-Asian Surinamese population in the Netherlands. South-Asian Surinamese have migrated twice: first from India to Suriname around 1873 as indentured labourers, mostly from the modern-day states of Uttar Pradesh, Bihar and adjoining areas; and then after the independence of Suriname in 1875, many South-Asian Surinamese migrated from Suriname to the Netherlands. South-Asian Surinamese constitute approximately 1% of the total population of the Netherlands. According to the most recent data published on Surinamese in 2008 by Statistics Netherlands, there are 10% Surinamese living in Amsterdam out of which 40% are of South Asian origin[19].

Previous studies have shown ethnic differences regarding disease and diet among minorities living in Western countries[20]. South Asians have higher prevalence of CVD as compared with other ethnic groups living in Western countries[21]. A previous study in South-Asian Surinamese living in the Netherlands explored the association between educational level, residence duration, age at migration and level of social contacts with Dutch-origin peers and several aspects of the diet, and found inconsistent associations[22]. A more recent study has indicated that Surinamese maintain their traditional dietary pattern irrespective of their acculturation status[23]. However, although these studies have considered dietary patterns rather than individual foods or food groups, they have not taken into consideration the significance of specific foods within the diet. Koctürk's model might provide more insight into how the diet of South-Asian Surinamese living in the Netherlands is situated along the spectrum of this model.

We hypothesize that the intake of staple foods characterizing the traditional diet of South-Asian Surinamese will be quite high among South-Asian Surinamese as compared with the Dutch across the different acculturation strategies, while the intake of complementary and accessory foods is more likely to vary on the basis of acculturation.

Methods

Study design and sample

Cross-sectional baseline data of the HELIUS (Healthy Life in an Urban Setting) study were used. The HELIUS study is a cohort study among the six largest ethnic groups living in Amsterdam, the Netherlands. The overall aim of the HELIUS study is to examine the health disparities and their causes across different ethnic groups. Details on the design of the HELIUS study are described elsewhere[24]. In brief, participants aged 18–70 years were randomly sampled from the Amsterdam municipality register, stratified by ethnicity. Participants filled in a questionnaire and underwent a physical examination. Participants of the HELIUS study who were included between January 2011 and December 2013 and consented to take part in additional studies were invited to also complete an FFQ. For the current study, we studied 1456 Dutch and 968 South-Asian Surinamese HELIUS participants, who also had dietary intake data available.

Ethnicity

Participant's ethnicity was defined according to the country of birth of the participant as well as that of his/her parents. Specifically, a participant was considered as of Surinamese origin if he/she fulfilled either of the following criteria: (i) he or she was born in Suriname and had at least one parent born in Suriname (first generation); or (ii) he or she was born in the Netherlands but both his/her parents were born in Suriname (second generation)[25]. Suriname's population is made up of several ethnic groups including African Surinamese, South-Asian Surinamese, Javanese, Amerindian and Chinese. Hence, self-identification (by questionnaire) was also used to further distinguish Surinamese of South-Asian, African, Javanese and other origins.

Ethical approval

The HELIUS study has been approved by the Academic Medical Center Ethical Review Board. All participants provided written informed consent[24].

Measurement of diet

Food intake was measured using ethnic-specific FFQ that were designed for the HELIUS study by Beukers *et al.* and were also validated for the respective populations[26]. The FFQ with approximately 200 food items were used to collect information about the frequency and the amount of intake of the respective food items in the previous 4 weeks. In the current study we used information about the frequency of intake of relevant foods, as described below.

Use of Koctürk's model

Koctürk's model categorizes foods into staple, complementary and accessory foods. The staple is usually one or more carbohydrate-rich foods with a neutral taste, which gives the dish its identity. Bread (*roti*) and white rice are staple foods in the South-Asian Surinamese diet. In the Netherlands the traditional staples are bread and potatoes, the last decades including rice and pasta.

The staples are complemented with other foods, for example legumes, meat, fish, eggs, vegetables or milk/cheese, in order to make a particular dish. The staples and complementary foods are what people first think about when asked what they eat. Accessory foods include items such as sweets, nuts, fruits and drinks. Their main culinary role is to enhance the taste and presentation of basic foods[17]. The model postulates that dietary pattern is likely to be characterized by the intake of staple foods due to strong cultural identification, while the consumption of accessory and complementary foods may be more variable.

Food groups

For the present study we placed food items into different food categories as described by Koctürk. Thus the staple foods category included rice/fried rice, fried noodles, potatoes, bread, pasta and *roti*. The complementary foods category included legumes, chicken, red meat, fish, eggs, milk and vegetables. The accessory foods category included nuts, fruits, sugar-sweetened beverages (fruit juices and soft drinks), traditional Hindustani sweets, and cookies and sweets.

Certain variables were combined to form a new variable. For example, rice, fried rice and fried noodles were combined to form a single variable (rice and noodles); fried potatoes (eaten as a snack or as a meal), other potatoes and pasta to form a variable (potatoes and pasta). Among the complementary foods, organ meat, minced meat, beef, pork, lamb, sheep and other meat were combined to form a variable (red meat). Similarly, cooked and raw vegetables were combined to form a variable (vegetables); shellfish and fish were combined to form a variable (fish). Among accessory foods, fruit juices and soft drinks were combined to form a variable (sugar-sweetened beverages) and small cakes, cake, cookies, candy bars, little chocolates and sweets were combined to form a variable (cookies and sweets) excluding the traditional South-Asian Surinamese sweets.

Assessment of acculturation

The assessment of acculturation among South-Asian Surinamese participants has been described in a previous study[22]. Briefly, we used two methods to operationalize acculturation.

First, we applied a bidimensional model of acculturation based on Berry's acculturation framework[27]. In this approach, acculturation was measured with twenty-six items regarding ethnic identity (two items), social contacts (four items) and cultural orientation (twenty items). The items applied to both the Dutch culture (thirteen items) and the Surinamese culture (thirteen items). The items included questions, for example, about feeling proud to be part of the Dutch culture or commonalities with the Surinamese culture. Mean individual scores on the two scales were calculated. Based on the combination of the mean scores on each of the two scales, participants were categorized into one of the four acculturation groups of Berry's acculturation framework, namely assimilation, integration, separation and marginalization[27], that hereafter are referred to as acculturation strategies. Assimilation refers to cultural adaptation towards the host culture accompanied by loss of the original culture after migration. Integration refers to cultural adaptation towards the host culture without losing attachment to the original culture after migration. Separation refers to rejection of the host culture and orientation towards the original culture after migration. Finally, marginalization refers to rejection of both the host culture and the culture of origin after migration. Second, we measured one-dimensional proxies of acculturation, namely residence duration, age at migration and generation status, that hereafter are referred to as acculturation proxies. Residence duration was classified into two categories (≤35 years; >35 years) and age at migration was classified into three categories (≤18 years old; 19–35 years old; ≥35 years old) based on an earlier paper describing the assessment of acculturation among South-Asian Surinamese participants[22]; although in our paper we combined some categories due to small numbers of participants in each category.

Educational level

For educational level, participants were categorized as: (i) those who have never been to school or have elementary schooling only; (ii) those with lower vocational schooling or lower secondary schooling; (iii) those with intermediate vocational schooling or intermediate/higher secondary education schooling; and (iv) those with higher vocational schooling or university.

Statistical analysis

Descriptive statistics were used to calculate means, medians, standard deviations and percentages of the baseline characteristics. Frequency of intake of combined food variables was calculated in terms of mean number of days per week. We tested for statistical differences between Dutch and South-Asian Surinamese in the intake of combined food variables using the *t* test. We compared the intake of each food category within each acculturation strategy and acculturation proxy among the South-Asian Surinamese against the intake among the Dutch. For the sake of simplifying the number of variables presented in the paper, only the combined food variables which showed significant statistical differences in terms of frequency of intake between the two ethnic groups were retained for further analysis (rice and noodles, bread, potatoes and pasta, red meat, fish, vegetables, sugar-sweetened beverages, cookies and sweets, fruit) and other food variables were excluded (*roti*, legumes, milk, eggs, traditional Hindustani sweets and nuts).

Multiple regression analysis was used to determine the differences in food intakes of South-Asian Surinamese with

different acculturation strategies compared with Dutch participants by adjusting for age and educational level. We made dummy variables for acculturation strategy, including assimilation, integration, separation and marginalization, with Dutch as the reference group, which were used in multiple regression models. We stratified by gender to look at gender differences regarding the intakes of food items among the South-Asian Surinamese compared with the intakes among the Dutch. Data analyses were conducted with the statistical software package IBM SPSS Statistics Version 21.0.

Results

Baseline characteristics of the study population

Table 1 shows the participants' characteristics by ethnicity and gender. In our study sample, the average age ranged from 46 to 49 years and there were substantially more women than men in both ethnic groups. The mean residence duration for Surinamese men was 34·2 years and for Surinamese women was 31·5 years. The majority of the Surinamese men and women were younger than 35 years when they migrated; similarly most of them were first-generation migrants. In terms of acculturation strategy, 77·3 % of the Surinamese men and 69·1 % of the Surinamese women were classified as integrated, indicating high orientation to both the Dutch and the Surinamese culture. Educational level was higher among the Dutch men and women as compared with the South-Asian Surinamese men and women.

Differences between South-Asian Surinamese and Dutch participants' intake of staple, complementary and accessory foods

There were clear ethnic differences in the frequency of intake of staple, complementary and accessory foods among men and women (Table 2). For example, among staple foods, Surinamese men and women showed significantly more frequent intake of rice and noodles (Surinamese men 4·20 d/week *v.* Dutch men 2·72 d/week) and significantly lower intakes of potato and pasta (Surinamese women 2·34 d/week *v.* Dutch women 4·11 d/week) and bread as compared with Dutch men and women. With respect to complementary foods, Surinamese men and women showed significantly higher intakes of chicken (Surinamese men 2·65 d/week *v.* Dutch men 1·23 d/week) and fish, and significantly lower intakes of red meat (Surinamese men 1·76 d/week *v.* Dutch men 2·80 d/week) and vegetables (Surinamese women 6·39 d/week *v.* Dutch women 7·90 d/week) as compared with Dutch men and women. For accessory foods, Dutch men and women showed significantly higher intake of cookies and sweets (Surinamese men 3·49 d/week *v.* Dutch men 5·96 d/week) as compared with Surinamese men and women, while Dutch women showed significantly higher intake of fruit (Surinamese women 4·68 d/week *v.* Dutch women 5·06 d/week) as compared with Surinamese women.

Table 1 Characteristics of Dutch and South-Asian Surinamese participants, stratified by gender; HELIUS (Healthy Life in an Urban Setting) study, Amsterdam, the Netherlands, January 2011–December 2013

	South-Asian Surinamese				Dutch			
	Men (*n* 410; 42·4 %)		Women (*n* 558; 57·6 %)		Men (*n* 654; 44·9 %)		Women (*n* 796; 55·1 %)	
	Mean or *n*	SD or %	Mean or *n*	SD or %	Mean or *n*	SD or %	Mean or *n*	SD or %
Age (years), mean and SD	46·9	12·6	46·9	12·1	49·6	13·0	47·0	13·7
Educational status, *n* and %								
Never been to school or elementary schooling	155	13·5	243	17·6	31	3·1	33	2·8
Lower vocational schooling or lower secondary schooling	390	33·9	467	33·7	144	14·4	176	14·9
Intermediate vocational schooling or intermediate/higher secondary education schooling	351	30·5	387	28·0	239	23·8	251	21·3
Higher vocational schooling or university	255	22·2	287	20·7	589	58·7	718	61·0
Residence years, *n* and %								
≤35 years	141	42·7	261	56·9	–		–	
>35 years	190	57·3	194	42·3	–		–	
Age of migration, *n* and %								
≤18 years old	136	41·2	223	48·6	–		–	
19–35 years old	137	41·5	213	46·5	–		–	
≥35 years old	10	3·0	22	4·7	–		–	
Acculturation category, *n* and %								
Assimilated	38	9·6	53	10·1	–		–	
Integrated	307	77·3	364	69·1	–		–	
Separated	38	9·6	79	15·0	–		–	
Marginalized	14	3·5	31	5·9	–		–	
Migration generation status, *n* and %								
First generation	333	81·2	469	84·1	–		–	
Second generation	77	18·8	89	15·9	–		–	

Table 2 Differences in the frequency of intake of staple, complementary and accessory foods (d/week) among South-Asian Surinamese men and women and Dutch men and women; HELIUS (Healthy Life in an Urban Setting) study, Amsterdam, the Netherlands, January 2011–December 2013

	South-Asian Surinamese men		Dutch men		South-Asian Surinamese women		Dutch women	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Staple foods								
Rice and noodles	4·20	2·10	2·72**	2·37	4·46	2·26	1·35**	1·13
Bread	4·75	2·37	5·65**	2·04	4·57	2·49	5·32**	2·23
Potatoes and pasta	2·40	1·85	4·66**	1·91	2·34	1·91	4·11**	1·82
Roti	0·60	0·82	–		0·58	0·83	–	
Complementary foods								
Chicken	2·65	1·68	1·23**	1·07	2·50	1·65	1·17**	1·02
Red meat	1·76	1·94	2·80**	2·20	1·46	1·62	2·71**	1·78
Fish	2·27	1·99	1·63**	1·54	2·38	2·08	1·38**	1·22
Vegetables	4·91	2·91	6·89**	2·79	6·39	2·94	7·90**	2·81
Legumes	1·04	1·11	0·70	0·81	0·96	1·04	0·73	0·88
Eggs	1·25	1·35	1·50	1·31	1·25	1·16	1·57	1·26
Milk	3·18	3·23	3·60	3·24	2·97	3·32	3·01	3·12
Accessory foods								
Cookies and sweets	3·49	3·87	5·96**	4·67	3·47	3·78	7·00**	5·03
Fruits	3·85	2·32	4·08*	2·47	4·68	2·33	5·06*	2·19
Sugar-sweetened beverages (fruit juices and soft drinks)	4·22	3·42	3·91	3·20	3·12	3·05	3·14	2·95
Traditional Hindustani sweets	0·24	0·47	0·00		0·24	0·53	0·00	
Nuts	1·07	1·40	1·20	1·53	1·19	1·53	1·33	1·62

Mean value was significantly different from that of Surinamese: *$P < 0·05$, **$P < 0·01$.

Differences in food intake between South-Asian Surinamese and Dutch across acculturation strategies and acculturation proxies

There were consistent differences in terms of food intake of South-Asian Surinamese as compared with Dutch participants across all acculturation strategies and proxies (Table 3). Within the Surinamese group we observed differences between different acculturation strategies. Compared with the other acculturation strategies, 'assimilated' Surinamese men and women showed more inclination towards foods that are generally consumed more frequently by the Dutch such as potato, pasta, red meat and vegetables, while Surinamese participants who were classified as 'separate' within the acculturation strategies reported higher intake of rice compared with other acculturation strategies. The food intake among 'integrated' Surinamese participants was moderately placed between that of 'assimilated' and 'separated' Surinamese participants; food intake among 'marginalized' Surinamese participants was different from that of all other acculturation strategies and also different from the Dutch except for fruit intake. For the acculturation proxies, Surinamese men and women living in the Netherlands for longer than 35 years and who migrated at a younger age (≤18 years old) had lower intakes of rice, chicken and fish, and higher intakes of potato, pasta and red meat, as compared with participants living in the Netherlands for less than 35 years and participants who migrated when they were 19 years or older. Second-generation Surinamese men and women had lower intakes of rice, fish, vegetables and fruits but higher intakes of bread, potato, pasta, chicken, red meat, and cookies and sweets as compared with first-generation Surinamese men and women.

In addition, South-Asian Surinamese men showed more inclination towards foods which have a high consumption among the Dutch; for example, they had higher intakes of potato and pasta, bread, red meat, and cookies and sweets compared with women, indicating a higher level of dietary change.

Intake of food items among South-Asian Surinamese as compared with Dutch with respect to acculturation strategy adjusted for age and educational level

After adjusting for age and educational level (Table 4), South-Asian Surinamese men and women still showed the same consistent differences in terms of food intake as compared with Dutch men and women, i.e. significantly higher intakes of rice and chicken and lower intakes of potato and pasta, red meat, vegetables, and cookies and sweets as compared with the Dutch across all acculturation strategies.

Discussion

This is the first study which has quantitatively investigated dietary acculturation based on Koctürk's dietary change model[16,17]. The results of our study show that the intake of staple foods like rice, fried rice and noodles is consistently higher among South-Asian Surinamese as compared with Dutch-origin participants, irrespective of acculturation strategy, residence duration or migration generation, which is in line with Koctürk's model. In addition, accessory foods like fruits vary across

Table 3 Frequency of intake of staple, complementary and accessory foods (d/week) among South-Asian Surinamese men and women with respect to integration, residence years, age of migration and generation status, as compared with Dutch men and women; HELIUS (Healthy Life in an Urban Setting) study, Amsterdam, the Netherlands, January 2011–December 2013

	Staple foods												Complementary foods												Accessory foods							
	Rice and noodles				Bread				Potatoes and pasta				Chicken				Red meat				Fish				Vegetables				Cookies and sweets				Fruit			
	Men		Women		Men		Women		Men		Women		Men		Women		Men		Women		Men		Women		Men		Women		Men		Women	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Acculturation strategy																																
Dutch (men, *n* 410; women, *n* 558)	2·72	2·37	1·35	1·13	5·65	2·04	5·32	2·23	4·66	1·91	4·11	1·82	1·23	1·07	1·17	1·02	2·80	2·20	2·71	1·78	1·63	1·54	1·38	1·22	6·89	2·79	7·90	2·81	5·96	4·67	7·00	5·03	4·08	2·47	5·06	2·19
Assimilated (men, *n* 38; women, *n* 53)	4·63**	2·20	3·92**	2·91	5·37	1·96	4·84	2·31	2·75**	1·97	2·69**	2·16	2·47**	1·78	2·21**	1·36	1·82**	1·93	1·89**	1·99	1·94	1·78	2·18*	2·10	5·55*	3·29	6·01*	3·14	3·07**	3·04	3·46**	3·26	4·05	2·51	4·54	2·45
Integrated (men, *n* 307; women, *n* 364)	4·82**	2·21	4·44**	2·24	4·66**	2·45	4·40**	2·58	2·39**	1·79	2·31**	1·91	2·69**	1·66	2·59**	1·68	1·76**	1·96	1·44**	1·57	2·19**	1·94	2·41**	2·07	4·90**	2·73	6·49**	3·00	3·55**	3·71	3·53**	3·91	3·77**	2·30	4·71	2·30
Separated (men, *n* 38; women, *n* 79)	5·53**	2·09	4·89**	2·15	5·22	2·13	4·92	2·22	2·31**	2·31	2·23**	1·79	2·61**	1·60	2·53**	1·66	1·71**	1·87	1·58**	1·80	1·67	1·72	2·46**	1·93	4·00**	2·98	5·84**	2·58	3·05**	3·30	4·20**	4·21	4·05	2·48	4·56*	2·29
Marginalized (men, *n* 14; women, *n* 31)	5·40**	2·62	4·53**	2·59	4·42*	2·06	5·34	2·26	1·91**	1·39	2·11**	1·94	3·11**	2·20	2·06**	1·72	1·06**	1·13	0·89**	1·26	2·14*	1·34	2·08	2·18	4·70*	3·65	7·00	2·34	4·97*	8·97	2·22**	2·67	4·66	2·12	4·36	2·53
Residence years																																
≤35 years (men, *n* 141; women, *n* 261)	5·21**	2·29	4·76**	2·24	4·83**	2·33	4·53**	2·48	2·09**	1·64	2·00**	1·73	2·96**	1·80	2·49**	1·61	1·57**	1·55	1·28**	1·47	2·26**	2·05	2·40**	2·08	4·66**	2·98	6·36**	2·84	3·22**	4·17	3·14**	3·86	3·76	2·40	4·94	2·18
>35 years (men, *n* 190; women, *n* 194)	4·76**	2·19	4·21**	2·26	4·63**	2·42	4·70**	2·54	2·34**	1·76	2·50**	1·89	2·34**	1·52	2·40**	1·63	1·73**	1·77	1·48**	1·60	2·13**	1·89	2·69**	2·07	5·26**	2·91	7·00**	2·91	3·33**	3·66	3·21**	3·22	4·28	2·27	4·94	2·30
Age at migratiion																																
≤18 years old (men, *n* 136; women, *n* 223)	4·60**	2·26	4·34**	2·23	4·69**	2·33	4·45**	2·21	2·48**	1·75	2·56**	1·91	2·58**	1·63	2·76**	1·55	1·79**	1·65	1·72**	1·73	2·02**	1·81	2·40**	2·00	4·86**	2·98	6·56**	3·01	3·64**	4·26	3·42**	3·17	3·68*	2·35	4·58**	2·33
19–35 years old (men, *n* 137; women, *n* 213)	5·37**	2·09	4·61**	2·22	4·68**	2·46	4·69**	2·51	1·91**	1·66	1·86**	1·64	2·64**	1·75	2·14**	1·64	1·49**	1·73	1·00**	1·19	2·32**	2·08	2·51**	2·01	5·15**	2·84	6·72**	2·80	2·70**	3·27	2·91**	4·09	4·53*	2·26	5·28	2·09
≥35 years old (men, *n* 10; women, *n* 22)	5·57**	2·91	5·67**	2·71	5·42	2·30	5·23	2·44	2·12**	0·92	2·05**	1·87	2·66**	1·47	2·42**	1·55	1·66**	1·37	1·32**	1·46	3·27**	2·58	3·86**	3·03	5·55	3·95	7·00	2·63	4·78	3·51	3·08**	2·29	4·50	2·17	5·31	1·96
Generation status																																
First generation (men, *n* 333; women, *n* 469)	4·94**	2·94	4·54**	2·28	4·70**	2·38	4·61**	2·51	2·25**	1·74	2·19**	1·81	2·61**	1·66	2·45**	1·62	1·68**	1·71	1·36**	1·53	2·18**	1·95	2·49**	2·07	4·99**	2·95	6·63**	2·91	3·27**	3·87	3·19**	3·61	4·05	2·34	4·92	2·24
Second generation (men, *n* 77; women, *n* 89)	4·60**	2·22	4·00	2·09	4·94**	2·32	4·39**	2·37	3·08**	2·17	3·14**	2·25	2·79**	1·75	2·79**	1·73	2·12**	2·72	2·00**	1·99	1·90**	1·67	1·80	1·80	4·56**	2·72	5·12**	2·78	4·44**	3·79	4·99**	4·26	2·99**	2·05	3·43**	2·44

Mean value was significantly different from that of Dutch: *$P < 0·05$, **$P < 0·01$.

Table 4 Differences in intake of staple, complementary and accessory foods (d/week) across acculturation strategies among South-Asian Surinamese men and women, as compared with Dutch men and women, adjusted for age and educational level (Dutch are taken as reference); HELIUS (Healthy Life in an Urban Setting) study, Amsterdam, the Netherlands, January 2011–December 2013

	Staple foods											
	Rice and noodles				Bread				Potatoes and pasta			
	Men		Women		Men		Women		Men		Women	
	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI
Acculturation strategy												
Assimilated (men, *n* 38; women, *n* 53)	3·18**	2·62, 3·74	2·47**	1·98, 2·95	−0·29	−1·01, 0·42	−0·39	−1·04, 0·25	−1·90**	−2·53, 1·27	−1·38**	−1·96, 0·86
Integrated (men, *n* 307; women, *n* 364)	3·37**	3·14, 3·60	2·95**	2·74, 3·15	−0·97**	−1·27, 0·67	−0·89**	−1·18, 0·60	−2·24**	−2·51, 1·98	−1·72**	−1·95, 1·49
Separated (men, *n* 38; women, *n* 79)	4·16**	3·59, 4·72	3·36**	2·96, 3·74	−0·39	−1·12, 0·33	−0·31**	−0·85, 0·22	−2·23**	−2·87, 1·60	−1·79**	−2·23, 1·36
Marginalized (men, *n* 14; women, *n* 31)	3·94**	3·05, 4·84	2·99**	2·36, 3·61	−1·15*	−2·31, 0·00	0·05	−0·78, 0·89	−2·75**	−3·77, 1·74	−1·89**	2·57, 1·22

	Complementary foods															
	Chicken				Red meat				Fish				Vegetables			
	Men		Women		Men		Women		Men		Women		Men		Women	
	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI
Acculturation strategy																
Assimilated (men, *n* 38; women, *n* 53)	1·13**	0·70, 1·57	0·98**	0·61, 1·35	−1·63**	−2·31, 0·95	−0·74**	−1·23, 0·26	0·62*	0·12, 1·12	0·80**	0·34, 1·25	−1·34**	−2·26, 0·41	−1·73**	−2·53, 0·94
Integrated (men, *n* 307; women, *n* 364)	1·38**	1·20, 1·56	1·36**	1·20, 1·53	−1·69**	−1·97, 1·41	−1·20**	−1·42, 0·99	0·87**	0·66, 1·07	0·98**	0·78, 1·18	−1·95**	−2·33, 1·56	−1·40**	−1·76, 1·05
Separated (men, *n* 38; women, *n* 79)	1·41**	0·96, 1·85	1·27**	0·97, 1·58	−1·68**	−2·37, 1·00	−1·05**	−1·46, 0·65	0·34	−0·15, 0·84	1·04**	0·66, 1·42	−2·65**	−3·59, 1·71	−2·03**	−2·69, 1·37
Marginalized (men, *n* 14; women, *n* 31)	1·77**	1·06, 2·47	0·82**	0·34, 1·30	−2·41	−3·50, 1·32	−1·74**	−2·37, 1·12	0·85*	0·06 –1·65	0·63*	0·05, 1·22	−1·96**	−3·45, 0·47	−0·94**	−1·97, 0·08

	Accessory foods							
	Cookies and sweets				Fruit			
	Men		Women		Men		Women	
	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI
Acculturation strategy								
Assimilated (men, *n* 38; women, *n* 53)	−2·81**	−4·26, 1·36	−3·43**	−4·72, 2·15	0·04	−0·74, 0·82	−0·38*	−1·00, 0·23
Integrated (men, *n* 307; women, *n* 364)	−2·32**	−2·93, 1·72	−3·32**	−3·89, 2·75	−0·23	−0·56, 0·09	−0·39*	−0·67, 0·12
Separated (men, *n* 38; women, *n* 79)	−2·76**	−4·23, 1·29	−2·65**	−3·72, 1·58	−0·01	−0·78, 0·80	−0·52*	−1·04, 0·01
Marginalized (men, *n* 14; women, *n* 31)	−0·82**	−3·15, 1·51	−4·59**	−6·26, 2·93	0·80	−0·46, 2·06	−0·85*	−1·65, 0·04

Mean value was significantly different from that of Dutch: *$P < 0·05$, **$P < 0·01$.

acculturation strategies, which is also consistent with Koctürk's model. In contrast to our expectations, consumption of complementary foods like chicken and fish was also higher among South-Asian Surinamese than in Dutch participants, regardless of acculturation strategy.

A previous study in Oslo used Koctürk's model qualitatively to capture the change in diet of Pakistani women after migration from Pakistan to Oslo, Norway[18]. The study took the traditional eating habits in Pakistan and the new eating trends in Norway into account. The results of that study gave limited support to the hypothesis that changes occur predominantly among the accessory foods and least among the staple foods. Inconsistent with the Koctürk model, participants reported several changes concerning staple foods; for example, *chapatti*, *roti* or *paratha* were replaced by bread with spreads. In our study, we also saw that many South-Asian Surinamese reported the intake of bread but we do not know to what extent South-Asian Surinamese might have replaced rice with Dutch staples like bread, potato and pasta as ours is a cross-sectional study. Also, we do not know when the bread is being eaten: presumably at breakfast and lunch, so the hot meal with the family might still be 'traditional'.

In our study South-Asian Surinamese participants with shorter residence duration or who migrated at an older age or were first-generation migrants showed more inclination towards foods that are more typical of a Surinamese dietary pattern, like rice, chicken and fish. On the other hand, the assimilated and the second-generation Surinamese participants showed an inclination towards Dutch foods like potato, pasta, red meat, vegetables, and cookies and sweets. The results of our study are in contrast to an earlier study conducted in the Netherlands which found inconsistent associations between length of residence, age at migration and diet[22]. Previous studies focusing on dietary patterns among the Surinamese in the Netherlands found that they were more likely to have 'noodle/rice dishes and white meat' dietary pattern, while the Dutch displayed greater adherence to 'red meat, snacks and sweets' and 'vegetables, fruit and nuts' dietary patterns[23]. Our finding that second-generation Surinamese had higher intakes of red meat and cookies and sweets than first-generation migrants is in line with a review by Gilbert and Khokhar[3] and the study by Norman *et al.*[28], both of which concluded that younger generations consume more elements of a Westernized diet. The results of our study also showed variable intake of some food items across different acculturation strategies. These inconsistencies have been reported previously in the literature[29–35] and suggest that the mechanisms underlying dietary change are more complex and multidimensional than we have been able to capture. Interestingly, we observed that two typically South-Asian foods, *roti* (flat bread) and South-Asian sweets (e.g. *barfi*, *gulab jamun*, etc.), were consumed infrequently by our study population. With regard to Hindustani sweets, this might somehow be related to residence duration; as mentioned previously, our study population has lived in the Netherlands for an average of 33 years. Given that Koctürk's theory postulates that the intake of accessory foods is likely to change first, this finding is not surprising. However, this does not explain the infrequent consumption of *roti*, which is a staple food. The preparation of *roti* requires time and culinary skill, so this may go some way to explaining its infrequent consumption.

An interesting comparison here would be to look at how different ethnicities respond to the phenomenon of dietary acculturation in different countries as compared with the results of our study, where South-Asian Surinamese show strong adherence to traditional foods in the Netherlands. In a study from Oslo, Norway, South Asians including people from Sri Lanka and Pakistan reported increasing their consumption of meat, milk, butter, margarine, potatoes, oil and fish after migration[36]. A study among Chinese immigrant women living in Seattle, Washington, USA and Vancouver, British Columbia, Canada showed that participants with high scores on the Western acculturation scale reported higher-fat dietary behaviours but also increased fruit and vegetable intake as compared with women with low scores on Western acculturation[7]. Thus dietary acculturation seems like a context-specific phenomenon, where different ethnic groups respond differently to the change in food and sociocultural environment after migration.

Strengths and limitations

Our study tested Koctürk's model using quantitative data for the first time. We compared food categories between Dutch and Surinamese residents based on Koctürk's model with respect to the acculturation status of the Surinamese, which might add to the current knowledge. One of the strengths of our present study includes the large sample size of almost 1000 participants of South-Asian Surinamese origin. The results of our study could possibly be generalized to non-Western ethnic minority groups residing in countries where language is not a barrier, for example Latin-American residents in Spain[37] as is the case among Surinamese in the Netherlands, where language is not a major barrier. Our study also has some limitations. The most important limitation is that Koctürk's model is a model of dietary change due to migration while our analysis is cross-sectional. A prospective analysis of acculturation and diet may shed more light on this issue. As the HELIUS study focused on health disparities, selection bias is possible; people who were already ill and wanted a health check or particularly healthy persons could have participated in our study. This might have affected the true representation of the dietary patterns of Surinamese participants.

Implications

Our study has shown that foods that are theoretically associated with identity remain consistently consumed despite acculturation on the basis of Berry's strategies and

other proxies. For example, the results of our study imply that South-Asian Surinamese residents of the Netherlands should be encouraged to maintain the healthful aspects of a Surinamese dietary pattern which is rich in fish and chicken (in preference to red meat) and avoid unsaturated fats and refined grains like white rice. Our study showed that second-generation South-Asian Surinamese migrants are more likely to use red meat and sweets as compared with first-generation migrants. In addition, South-Asian Surinamese men had a higher level of dietary acculturation than South-Asian Surinamese women. A study among Latinos in the USA has shown lower consumption of vegetables and higher consumption of saturated fats among Latino men as compared with Latino women, which was related to the degree of acculturation[38]. This points towards the fact that there are gender and generation differences in terms of dietary acculturation and that further studies regarding public health interventions should take these gender and generation differences into account. The insights provided by the present study can be used to develop interventions targeting both dietary behaviours and the dietary environment of South-Asian Surinamese.

Conclusion

The results of our study partly confirm Koctürk's model. South-Asian Surinamese showed consistent use of staple foods like rice irrespective of length of residence, acculturation strategy and generation level, while there were variations for intake of accessory foods like fruits across acculturation strategy. Contrary to Koctürk's model, the intake of complementary foods like chicken and fish was consistently high across acculturation strategies and through generations. Men, assimilated and second-generation Surinamese more frequently consumed 'Dutch foods'. Public health practitioners should take the complicated and dynamic nature of dietary acculturation into account while developing dietary interventions.

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