

# Acculturation and dietary patterns among residents of Surinamese origin in the Netherlands: the HELIUS dietary pattern study

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## Abstract

**Objective:** Insight into the role of acculturation in dietary patterns is important to inform the development of nutrition programmes that target ethnic minority groups. Therefore, the present study aimed to investigate how the adherence to dietary patterns within an ethnic minority population in the Netherlands varies by acculturation level compared with the host population.

**Design:** Cross-sectional study using data of the HELIUS study. Dietary patterns were assessed with an ethnic-specific FFQ. Acculturation was operationalized using unidimensional proxies (residence duration, age at migration and generation status) as well as on the basis of the bidimensional perspective, defined by four distinct acculturation strategies: assimilation, integration, separation and marginalization.

**Setting:** Amsterdam, the Netherlands.

**Subjects:** Participants of Dutch (*n* 1370) and Surinamese (*n* 1727) origin.

**Results:** Three dietary patterns were identified: (i) 'noodle/rice dishes and white meat' (traditional Surinamese pattern); (ii) 'red meat, snacks and sweets'; and (iii) 'vegetables, fruit and nuts'. Surinamese-origin respondents adhered more to the traditional Surinamese pattern than the other dietary patterns. Neither the unidimensional proxies nor the bidimensional acculturation strategies demonstrated consistent associations with dietary patterns.

**Conclusions:** The lack of consistent association between acculturation and dietary patterns in the present study indicates that dietary patterns are quite robust. Understanding the continued adherence to traditional dietary patterns when developing dietary interventions in ethnic minority groups is warranted.

**Keywords**  
Acculturation  
Dietary patterns  
Ethnic minority groups  
Migrant  
Surinamese-origin residents

Many Western countries have encountered shifts in dietary patterns over the last few decades, including an increase in the consumption of added sugar and animal food products and a decrease in the intake of fibre<sup>(1–4)</sup>. This so-called Western diet has negative consequences for public health<sup>(5,6)</sup>, which is also of concern to the growing ethnic minority and migrant-origin groups in many Western countries when they adopt parts of the Western diet<sup>(5,7)</sup>.

Migration can play a role in dietary patterns by bringing about cultural changes affecting attitudes, orientations or behaviours<sup>(5,7–9)</sup>, a process that is defined as acculturation<sup>(10,11)</sup>. Age at the time of migration to the host country, length of residence in the new environment and generation status are often used in the literature as proxies of acculturation<sup>(12)</sup>. These proxies are quick and convenient; however, many authors have criticized their use. They do not directly measure elements of culture such as culturally

determined attitudes, behaviours or cultural orientation<sup>(12–17)</sup>. Furthermore, they assume that the process of adaptation to the host culture is accompanied by the loss of the original culture and results in an exclusive orientation to the host culture, which is also conceptualized as the unidimensional perspective<sup>(11,18,19)</sup>. Thus, it can be argued that unidimensional proxies do not capture the bidimensional changes that occur when individuals from different cultural and social backgrounds interact<sup>(15,20)</sup>.

The bidimensional perspective, in contrast, assumes that both cultural orientations are relatively independent of one another. Individuals may adapt to the host culture without losing their attachment to the culture of origin<sup>(19)</sup>. These two dimensions allow individuals the option of maintaining or rejecting their culture of origin while adopting values, attitudes and behaviours of the host culture<sup>(17)</sup>.

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Studies on the relationship between acculturation and diet have generally used a unidimensional operationalization of acculturation<sup>(21–31)</sup>. As shown in reviews by Satia-Abouta *et al.* and Ayala *et al.* on acculturation and diet, most studies have found no consistent association between level of acculturation and intake of specific food groups. The methods used to measure acculturation and incomplete assessment of predictors of dietary intake may explain these inconsistent results<sup>(7,31)</sup>. The bidimensional perspective may be more informative in this regard because of its more nuanced characterization of cultural orientation and, presumably, its association with diet.

The current study aimed to investigate the role of acculturation in the dietary patterns of residents of Surinamese origin in the Netherlands using both the unidimensional and the bidimensional perspectives. The dietary patterns of Dutch- and Surinamese-origin participants were compared to explore differences on the basis of the acculturation status of the Surinamese. In addition, we explored differences within the Surinamese group. Comparison of Dutch and Surinamese respondents makes it possible to explore the robustness of dietary patterns.

## Methods

### *Study design and sample*

A quantitative cross-sectional study design was used and baseline measurements of the HELIUS study were taken. The HELIUS study is a prospective cohort study among the largest ethnic minority and migrant-origin groups living in Amsterdam, the Netherlands and data collection started in January 2011. The overall aim of the HELIUS study is to examine the health disparities across different ethnic groups and its causes. For the current study, data collected between January 2011 and December 2013 were used. The population, aged 18–70 years, was randomly sampled, stratified by ethnicity, from the Amsterdam city register. More details on the HELIUS study design have been published elsewhere<sup>(32)</sup>. The current study is a sub-study of HELIUS and included Dutch and Surinamese participants of African and South Asian origin. Surinamese-origin migrants are one of the largest ethnic minority groups in the Netherlands<sup>(33)</sup>. Approximately 80 % are of either African origin or South Asian origin<sup>(34,35)</sup>. These groups differ considerably in terms of culture, migration history, geographical origin and socio-economic position; African-origin Surinamese share a common ancestry with the African-descent populations in the West, while South Asian-origin Surinamese share a common ancestry with the South Asian populations<sup>(32)</sup>. Each participant's ethnicity was defined according to the country of birth of the participant as well as that of both his/her parents. Specifically, a participant was considered as of non-Dutch (i.e. Surinamese origin) if he/she fulfilled either of the following criteria: (i) he/she was born in Suriname and

had at least one parent born in Suriname or (ii) he/she was born in the Netherlands but both his/her parents were born in Suriname<sup>(34)</sup>. Registry data, upon which the sampling was made, are based on the country of birth; thus further distinction of the Surinamese group into South Asian or African origin was based on participants' self-report.

During the informed consent procedure of the HELIUS study, the participant's permission was asked to approach him/her for future additional studies. Participants of the HELIUS study who consented to take part in additional studies were asked to fill in an FFQ; this sub-study is described in more detail by Dekker *et al.*<sup>(36)</sup>. The response rates of the Dutch-origin, African Surinamese-origin and South Asian Surinamese-origin respondents who completed the FFQ were 73 %, 53 % and 49 %, respectively.

### *Assessment of dietary patterns*

Diet was measured using ethnic-specific FFQ that were specifically designed for the HELIUS study population, described by Beukers *et al.*<sup>(37)</sup>. Although the Surinamese group in HELIUS consists of two distinct ethnic groups (African origin and South Asian origin), similarities in the foods commonly eaten (such as specific vegetables and roti) allowed the design of a single questionnaire<sup>(36)</sup>. The FFQ with approximately 200 food items was used to collect information about the frequency and the amount of intake of the respective food items in the previous 4 weeks. Food items on the basis of similarity in nutrient profile, culinary use or ethnic origin were combined to obtain forty-nine food groups. Dietary patterns were derived on the basis of principal component analysis, which assesses the correlations between food groups to identify underlying patterns in the data. In order to describe differences in dietary patterns between the Dutch group and the Surinamese group, principal component analysis was performed for the whole sample. The number of components retained was based on the following criteria: components with an eigenvalue >1, a scree plot test and the interpretability of the components. Food items were considered to load on a component if they had an absolute factor loading  $\geq 0.3$ . A larger factor loading indicates a higher correlation of the food group to the respective component. The scree plot test clearly identified three major components. The components (hereafter called 'dietary patterns') were labelled on the basis of those food groups that loaded highest in the respective dietary pattern: (i) 'noodle/rice dishes and white meat' pattern; (ii) 'red meat, snacks and sweets' pattern; and (iii) 'vegetables, fruit and nuts' pattern. The dietary patterns were derived on the basis of the unadjusted consumption (g/d) of specific food groups. A factor score was calculated by summing the standardized intake of foods, weighted by the factor loadings of the foods groups for each dietary pattern; each participant received a factor score for each dietary pattern that emerged from the data. These scores

rank individuals according to the degree to which they conformed or adhered to each of the derived dietary patterns.

### Assessment of acculturation

The unidimensional perspective and the bidimensional perspective of acculturation were assessed with different indicators among the Surinamese-origin participants. The unidimensional indicators included residence duration, age at migration and generation status and are hereafter referred to as 'acculturation proxies'. Residence duration and age at migration in Surinamese-origin participants were assessed with the question: 'Since which year have you been living in the Netherlands?' The date of birth and date of completion of the questionnaire were checked to calculate residence duration and age at migration. Residence duration was classified into three categories ( $\leq 25$  years; 26–37 years;  $\geq 38$  years) and age at migration was classified into four categories ( $\leq 11$  years old; 12–17 years old; 18–34 years old;  $\geq 35$  years old) based on literature regarding life stages and migration<sup>(38)</sup>. Finally, generation status was defined on the basis of birthplace. Those born outside the Netherlands and having at least one parent born outside the Netherlands were considered first-generation Surinamese; those born in the Netherlands and having one or both parents born in Suriname were considered second-generation Surinamese<sup>(34)</sup>.

The bidimensional perspective was measured with twenty-six items regarding ethnic identity, social contacts and psychological attachment. The items applied to both the Dutch and the Surinamese culture; the Dutch scale and the Surinamese scale contained thirteen items each. Factor analysis indicated high internal consistency, Cronbach's  $\alpha = 0.88$  and  $0.89$  for the Dutch and Surinamese scale, respectively. Examples of questions were: 'I feel proud to be part of the Dutch culture'/'I feel proud to be part of the Surinamese culture' or 'I have a lot in common with Surinamese people'/'I have a lot in common with Dutch people'. The items were rated on a five-point Likert scale and the range of total scores was 13–65 per scale. Mean individual scores on the two scales were calculated, ranging from 1 to 5. On each scale, participants with a mean score of  $\geq 3$  were classified as 'highly orientated to the related culture', participants with a mean score of  $< 3$  were classified as 'low orientated to the related culture'. This cut-off point was based on literature regarding assessment of acculturation<sup>(39–41)</sup>. Based on the combination of their scores on each of the two scales, participants were categorized in one of the four acculturation strategies of Berry's acculturation framework<sup>(11)</sup>, shown in Fig. 1. That is, participants with a mean score of  $\geq 3$  on both the Surinamese and the Dutch scale indicate adaptation towards the host culture without losing attachment to the original culture, which is defined as 'integration'. A mean score of  $< 3$  on the Suriname scale and  $\geq 3$  on the Dutch scale implies cultural adaptation towards the

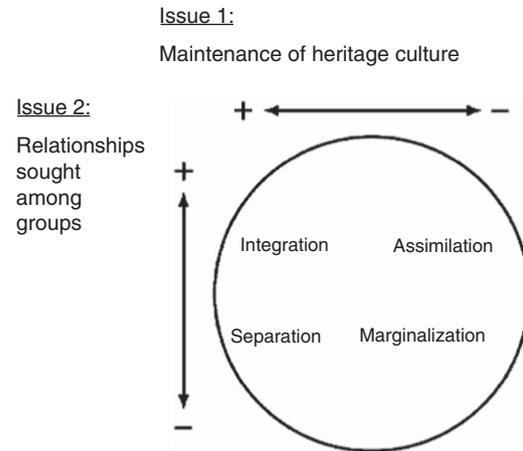


Fig. 1 The four acculturation strategies of Berry<sup>(10)</sup>

host culture accompanied by loss of the original culture, conceptualized as 'assimilation'. Further, participants with a mean score of  $\geq 3$  on the Surinamese scale and  $< 3$  on the Dutch scale were classified as having a 'separation' acculturation strategy; rejection of the host culture and orientation towards the original culture. Finally, a mean score of  $< 3$  on both the Surinamese and the Dutch scale indicates rejection of both the host culture and the culture of origin, defined by Berry as 'marginalization'<sup>(11)</sup>. In discussing the results this classification is referred to as the 'acculturation strategy'.

### Assessment of sociodemographic variables

The variables age, sex, education level and marital status were evaluated using a comprehensive self-completed questionnaire or, if participants were not able to fill in this questionnaire by themselves, an interview. Marital status was defined as living together with a partner (married/registered partnership or living together) or not (unmarried/never married, divorced/separated or widow/widower). Education level was indicated by the highest education attained (either in the Netherlands or in the country of origin). Four categories were used: 'never been to school or elementary schooling only', 'lower vocational schooling or lower secondary schooling', 'intermediate vocational schooling or intermediate/higher secondary schooling (general)' and 'higher vocational schooling or university'.

### Statistical analysis

Means, standard deviations and percentages of the baseline characteristics were calculated. Linear regression analysis was performed to investigate the association between dietary patterns and ethnicity (i.e. Dutch origin and Surinamese origin), to examine the differences in dietary pattern scores between the Dutch group and the acculturation status of the Surinamese group, and to examine the differences within the Surinamese group, adjusted for age, educational level and marital status<sup>(22–24,27,29)</sup>. *Post hoc* analysis was applied to test the interaction between acculturation and ethnicity.

As no substantial differences were found between the South Asian Surinamese origin and the African Surinamese origin, the data of the two groups were combined. It has been observed that dietary patterns and acculturation vary on the basis of sex<sup>(42,43)</sup>. Therefore, we also tested for interaction between acculturation and sex and found this to be present, thus analysis was stratified on the basis of sex. Data analyses were conducted with the statistical software package IBM SPSS Statistics version 20.0.

## Results

### **Baseline characteristics**

Participants with missing data on the acculturation variables or covariates were excluded from the analyses (131 participants). In total, 1370 Dutch-origin and 1727 Surinamese-origin participants remained. Table 1 summarizes the participants' characteristics by ethnicity and sex. In our study sample, the average age ranged from 47 to 49 years between the subgroups and there were substantially more women than men in all ethnic groups. The majority of the men and women of Surinamese origin, 85 % and 86 %, respectively, were first-generation residents. The distribution of the categories of residence duration differed between men and women. For example, 44 % of the Surinamese-origin men had residence duration of 38 years or more *v.* 30 % of the Surinamese-origin women. The majority of the men and women of Surinamese origin (51 % and 53 %, respectively) were between 18 and 34 years old at the time of migration. With regard to acculturation strategy, 74 % of the Surinamese-origin men and 83 % of the women were classified as integrated, indicating high orientation to both the Dutch and the Surinamese culture.

### **Dietary patterns and ethnicity**

The food groups with factor loadings  $\geq 0.30$  in at least one of the ethnic groups are presented in Supplemental Table 1 (see online supplementary material). The 'noodle/rice dishes and white meat' pattern was characterized by higher intakes of noodle and rice dishes, chicken, savoury sauces, sugar-sweetened beverages, roti, fish and organ meat. The 'red meat, snacks and sweets' pattern consisted of higher intakes of red meat, snacks, pasta, cheese, (fried) potato dishes and pancakes. The 'vegetables, fruit and nuts' pattern was characterized by a higher consumption of vegetables, fruit, olive oil, legumes, nuts and seeds and fish. Average dietary pattern scores differed significantly between ethnic groups, as shown in Table 2. The results suggest that participants of Surinamese origin adhere more closely to the 'noodle/rice dishes and white meat' pattern while Dutch-origin participants adhere more to the 'red meat, snacks and sweets' and the 'vegetables, fruit and nuts' patterns.

### **Differences in adherence to dietary patterns by acculturation**

Table 3 presents the differences in dietary pattern scores between respondents of Dutch and Surinamese origin differentiated by residence duration, age at migration, generation status and acculturation strategy of the Surinamese. In all acculturation strategies, Surinamese had significantly higher scores on the 'noodle/rice dishes and white meat' pattern than Dutch, with unstandardized beta coefficients ranging from 0.77 to 1.74. With regard to the acculturation proxies, higher 'noodle/rice dishes and white meat' pattern scores compared with Dutch were observed among Surinamese with shorter residence duration, a higher age at migration and among Surinamese of the first generation. Table 3 also shows that the different acculturation strategies scored significantly lower on the 'red meat, snacks and sweets' pattern than Dutch-origin participants (differences vary between  $-1.26$  and  $-0.69$ ). Similar results were found between Dutch and the Surinamese with regard to the acculturation proxies. Within the 'vegetables, fruit and nuts' pattern, Surinamese-origin participants had significantly lower scores than Dutch-origin participants, ranging from  $-0.68$  to  $-0.06$ , independent of their acculturation level or acculturation strategy, except for the marginalized Surinamese. In all dietary patterns, the differences compared with Dutch were greater in men than in women.

When focusing on differences within the Surinamese group, a more nuanced picture was observed as presented in Table 4. With regard to residence duration, Surinamese-origin men who lived in the Netherlands for a longer period of time scored significantly lower on the 'noodles/rice dishes and white meat' pattern. This trend was also seen in women, but was not statistically significant. Residence duration was not significantly associated with the other dietary patterns, except for Surinamese women who lived in the Netherlands for 38 years or longer. Men who migrated at an older age scored significantly higher on the 'noodles/rice dishes and white meat' pattern. Women who were older at the time of migration scored significantly lower on the 'red meat, snacks and sweets' pattern. First-generation Surinamese-origin women scored significantly higher than the second-generation women on the 'noodle/rice dishes and white meat' pattern. The first generation did not differ significantly from the second generation on the 'red meat, snacks and sweets' and 'vegetables, fruit and nuts' patterns. Overall, the observed differences in dietary patterns between the acculturation levels or acculturation strategies were small.

## Discussion

The results indicate that dietary patterns in Surinamese-origin people living in the Netherlands differ from those of their Dutch-origin peers and that they do not vary

**Table 1** General characteristics of the study sample: Dutch-origin (*n* 1370) and Surinamese-origin (*n* 1727) participants, Amsterdam, the Netherlands, January 2011–December 2013 (HELIUS dietary pattern study)

Characteristic	Surinamese						Dutch					
	Men			Women			Men			Women		
	<i>n</i> or mean	%, SD or range	<i>n</i> or mean	%, SD or range	<i>n</i> or mean	%, SD or range	<i>n</i> or mean	%, SD or range	<i>n</i> or mean	%, SD or range	<i>n</i> or mean	%, SD or range
<i>n</i> and %	641 48.9	37 12.1	1086 47.9	63 11.5	627 49.0	46 13.1	743 47.2	54 13.8				
Age (years), mean and SD												
Marital status												
Married/registered partnership/living together	346	54.0	348	32.0	410	65.4	406	54.6				
Unmarried/divorced/separated/widow(er)	295	46.0	738	68.0	217	34.6	337	45.4				
Educational level												
Never been to school or elementary schooling only	60	9.4	98	9.0	16	2.6	14	1.9				
Lower vocational schooling or lower secondary schooling	224	35.2	325	30.0	93	14.8	115	15.6				
Intermediate vocational schooling or intermediate/higher secondary schooling	183	28.7	358	33.1	141	22.5	158	21.4				
Higher vocational schooling or university	170	26.7	302	27.9	377	60.1	452	61.2				
Generation												
First	543	85	931	86								
Second	98	15	155	14								
Residence years												
≤25 years	138	25	324	35								
26–37 years	167	31	326	35								
≥38 years	237	44	278	30								
Age at migration												
≤11 years old	123	23	189	20								
12–17 years old	99	18	164	18								
18–34 years old	278	51	490	53								
≥35 years old	43	8	87	9								
Acculturation strategy												
Assimilated	42	7	69	6								
Integrated	529	83	806	74								
Separated	54	8	166	15								
Marginalized	16	3	45	4								
Dietary pattern score, mean and range (min, max)	0.72	–1.22, 10.28	0.38	–1.64, 7.86	–0.61	–2.10, 2.92	–0.75	–1.96, 1.75				
Noodle/rice dishes and white meat	–0.10	–2.00, 5.87	–0.54	–2.21, 5.58	0.91	–1.79, 5.59	0.20	–1.59, 4.18				
Red meat, snacks and sweets	–0.42	–2.38, 7.23	–0.05	–2.18, 5.35	0.17	–1.77, 4.92	0.32	–1.66, 4.50				
Vegetables, fruit and nuts												

Data are presented as number and percentage unless indicated otherwise.

**Table 2** Differences in dietary pattern scores according to ethnicity, displayed as unstandardized regression coefficients\*, among Dutch-origin (*n* 1370) and Surinamese-origin (*n* 1727) participants, Amsterdam, the Netherlands, January 2011–December 2013 (HELIUS dietary pattern study)

	Men ( <i>n</i> 1268)		Women ( <i>n</i> 1829)	
	Beta	95 % CI	Beta	95 % CI
Noodle/rice dishes and white meat				
Dutch	Ref.		Ref.	
Surinamese	1.23†	1.13, 1.33	1.06†	0.98, 1.13
Red meat, snacks and sweets				
Dutch	Ref.		Ref.	
Surinamese	-1.13†	-1.24, -1.02	-0.73†	-0.81, -0.65
Vegetables, fruit and nuts				
Dutch	Ref.		Ref.	
Surinamese	-0.50†	-0.61, -0.39	-0.27†	-0.36, -0.17

Ref., reference category.

\*Adjusted for age, education level and marital status.

†Differences were statistically significant compared with Dutch ( $P < 0.001$ ).

by acculturation. With few exceptions we found that regardless of residence duration, age at migration, generation status or acculturation strategy (assimilation, integration, marginalization or separation), Surinamese-origin participants adhered more to a dietary pattern that is characterized by traditional Surinamese foods than the other dietary patterns.

The findings of the current study show inconsistencies with the literature<sup>(5,7,21–24,26,28–31,44,45)</sup>. For example, while residence duration was associated with lower scores on the more traditional dietary pattern ('noodle/rice dishes and white meat') in Surinamese-origin men, the opposite was observed among residents of Asian Indian origin in the USA<sup>(26)</sup>, while others were not able to find an association between length of residence and diet<sup>(21–23)</sup>. Sanou *et al.* found that Haitian immigrants easily undergo dietary transitions from their healthier traditional diet to a more Western diet with increasing time since migration<sup>(46)</sup>.

Nevertheless, a comparison with the literature is difficult because of several methodological considerations. First, most studies examined the link between acculturation and individual foods, instead of dietary patterns. Studying an overall dietary pattern presents a broader picture of what is consumed by taking into account the correlation between foods. It therefore describes dietary behaviour better than individual foods. Second, other studies have not included a reference group from the host population, as was performed in the present study. The comparison has provided insight into the robustness of the adherence to the dietary patterns, independent of level of acculturation or acculturation strategy. Third, contextual differences are likely to influence diet in other settings; Amsterdam is a multicultural city with a large Surinamese population, thus traditional Surinamese foods and ingredients are easily available<sup>(8,47)</sup>. The association between acculturation and dietary patterns might differ in settings where traditional foods and ingredients are less available.

Potential explanations for our observation that Surinamese-origin respondents maintained a traditional dietary pattern without adapting to a Westernized dietary pattern are twofold. First, it may just be that the traditional dietary pattern in this group is very robust. This idea is supported by a recent analysis in the same study population which found that a socio-economic gradient in adherence to this traditional dietary pattern was not present among Surinamese-origin residents (LH Dekker, unpublished results). The robustness of the adherence to a traditional diet is further underscored by a study of Sharma and Cruickshank<sup>(48)</sup> which reported that African-Caribbean adults in Britain, despite their low incomes, spent more on traditional foods like yams than on potatoes, thereby maintaining cultural food preferences. A second potential explanation is that the reality may be more complex than we have managed to capture in this analysis. For example, sociodemographic variables may influence dietary patterns. A migrant who migrated to the host country at a young age may still not adopt dietary patterns of the host country because he or she lives with parents or grandparents who prefer a traditional diet<sup>(47,49)</sup>. Additionally, migrants may be likely to change breakfast and lunch patterns towards those observed in the host population but the preferences for dinner together with the family may promote the consumption of traditional foods<sup>(50)</sup>. Other factors, such as the value assigned to traditional foods and taste preference as described in the dietary acculturation model of Satia-Abouta *et al.*<sup>(7)</sup>, may also influence dietary patterns. This model presumes that there is a complex and dynamic relationship of socio-economic, demographic and cultural factors with exposure to the host culture which may better predict to what extent new migrants change their attitudes about food, taste preferences and food preparation. Such factors may all be relevant for the degree of adaptation to the dietary patterns of the host culture<sup>(7)</sup>.

Moreover, there might not be a single best acculturation model<sup>(51)</sup>. Flannery *et al.* compared the unidimensional

**Table 3** Differences in dietary pattern scores between ethnic Dutch and Surinamese residents with respect to their acculturation strategy, residence duration, age of migration and generation status, displayed as unstandardized regression coefficients\*, Amsterdam, the Netherlands, January 2011–December 2013 (HELIUS dietary pattern study)

	Noodle/rice dishes and white meat						Red meat, snacks and sweets						Vegetables, fruit and nuts					
	Men (n 1268)			Women (n 1829)			Men (n 1268)			Women (n 1829)			Men (n 1268)			Women (n 1829)		
	Beta	95 % CI		Beta	95 % CI		Beta	95 % CI		Beta	95 % CI		Beta	95 % CI		Beta	95 % CI	
<b>Residence duration</b>																		
Dutch Surinamese	Ref.	1.38, 1.67		Ref.	1.04, 1.24		Ref.	-1.29, -0.94		Ref.	-0.83, -0.63		Ref.	-0.71, -0.36		Ref.	-0.33†	
≤25 years	1.52†	1.10, 1.37	1.14†	0.96, 1.16	1.06†	0.96, 1.16	-1.18†	-1.34, -1.02	-1.11†	-0.78†	-0.88, -0.67	-0.73†	-0.52†	-0.69, -0.35	-0.54†	-0.22†	-0.46, -0.21	
26–37 years	1.08†	0.96, 1.20	1.01†	0.99, 1.11	1.01†	0.99, 1.11	-1.15†	-1.30, -1.01	-1.15†	-0.81†	-0.92, -0.70	-0.37†	-0.52, -0.22	-0.37†	-0.06	-0.19, 0.09		
≥38 years																		
<b>Age at migration</b>																		
Dutch Surinamese	Ref.	0.98, 1.29		Ref.	0.97, 1.21		Ref.	-1.03, -0.67		Ref.	-0.65, -0.41		Ref.	-0.78, -0.40		Ref.	-0.39, -0.08	
≤11 years old	1.14†	1.09, 1.42	0.99†	0.86, 1.12	0.99†	0.86, 1.12	-1.13†	-1.32, -0.93	-0.85†	-0.84†	-0.97, -0.71	-0.53†	-0.25†	-0.46, -0.05	-0.59†	-0.18†	-0.35, -0.02	
12–17 years old	1.25†	1.15, 1.39	1.08†	0.99, 1.17	1.08†	0.99, 1.17	-1.31†	-1.45, -1.18	-1.13†	-0.85†	-0.94, -0.75	-0.84†	-0.45†	-0.59, -0.30	-0.25†	-0.20†	-0.32, -0.08	
18–34 years old	1.27†	1.15, 1.64	1.15†	0.98, 1.32	1.15†	0.98, 1.32	-1.21†	-1.49, -0.93	-1.31†	-0.85†	-1.02, -0.68	-0.85†	-0.59†	-0.88, -0.30	-0.45†	-0.20†	-0.60, -0.17	
≥35 years old	1.39†																	
<b>Generation status</b>																		
Dutch Surinamese	Ref.	1.13, 1.34		Ref.	1.00, 1.15		Ref.	-1.13, -1.04		Ref.	-0.88, -0.73		Ref.	-0.58, -0.35		Ref.	-0.32, -0.12	
First generation	1.24†	1.01, 1.39	0.95†	0.81, 1.09	0.95†	0.81, 1.09	-1.15†	-1.21, -0.79	-1.15†	-0.80†	-0.46, -0.20	-0.33†	-0.68†	0.90, -0.47	-0.46†	-0.22†	-0.69, -0.33	
Second generation	1.20†																	
<b>Acculturation strategy</b>																		
Dutch Surinamese	Ref.	0.73, 1.25		Ref.	0.58, 0.95		Ref.	-1.36, -0.79		Ref.	-0.95, -0.57		Ref.	-0.72, -0.14		Ref.	-0.60, -0.13	
Assimilated	0.99†	1.12, 1.32	1.06†	0.99, 1.14	1.06†	0.99, 1.14	-1.12†	-1.24, -1.01	-1.07†	-0.73†	-0.81, -0.65	-0.76†	-0.51†	-0.62, -0.39	-0.43†	-0.24†	-0.34, -0.14	
Integrated	1.11†	1.17, 1.64	1.17†	1.04, 1.30	1.17†	1.04, 1.30	-1.26†	-1.53, -1.00	-1.12†	-0.69†	-0.82, -0.55	-0.73†	-0.55†	-0.82, -0.29	-0.51†	-0.40†	-0.56, -0.23	
Separated	1.41†																	
Marginalized	1.74†	1.33, 2.15	0.96†	0.73, 1.19	0.96†	0.73, 1.19	-0.99†	-1.45, -0.53	-0.99†	-0.87†	-1.11, -0.64	-0.87†	-0.23	-0.69, 0.24	-0.23	-0.09	-0.39, 0.20	

Ref., reference category.

\*Adjusted for age, educational level and marital status.

†Differences were statistically significant compared with Dutch ( $P < 0.05$ ).

**Table 4** Differences in dietary pattern scores among Surinamese residents with respect to their acculturation strategy, residence duration, age of migration and generation status, displayed as unstandardized regression coefficients\*, Amsterdam, the Netherlands, January 2011–December 2013 (HELIUS dietary pattern study)

	Noodle/rice dishes and white meat						Red meat, snacks and sweets						Vegetables, fruit and nuts					
	Men (n 641)			Women (n 1086)			Men (n 641)			Women (n 1086)			Men (n 641)			Women (n 1086)		
	Beta	95 % CI		Beta	95 % CI		Beta	95 % CI		Beta	95 % CI		Beta	95 % CI		Beta	95 % CI	
Residence duration																		
≤25 years	Ref.			Ref.			Ref.			Ref.			Ref.			Ref.		
26–37 years	-0.98†	-0.52, -0.06		-0.07	-0.21, 0.08		0.01	-0.18, 0.19		0.02	-0.10, 0.13		-0.01	-0.23, 0.21		0.07	-0.08, 0.23	
≥38 years	-0.43†	-0.66, -0.20		-0.11	-0.27, 0.04		0.09	-0.10, 0.27		0.01	-0.11, 0.14		0.12	-0.10, 0.34		0.22†	0.05, 0.39	
Age at migration																		
≤11 years old	Ref.			Ref.			Ref.			Ref.			Ref.			Ref.		
12–17 years old	0.24	-0.04, 0.53		-0.06	-0.26, 0.13		-0.19	-0.42, 0.04		-0.26†	-0.41, -0.10		0.27	-0.01, 0.54		-0.03	-0.25, 0.18	
18–34 years old	0.33†	0.07, 0.59		0.05	-0.12, 0.22		-0.34†	-0.55, -0.13		-0.23†	-0.37, -0.10		0.04	-0.21, 0.29		-0.11	-0.29, 0.08	
≥35 years old	0.49†	0.10, 0.88		0.15	-0.11, 0.41		-0.23	-0.54, 0.09		-0.20	-0.41, 0.01		-0.12	-0.49, 0.25		-0.37†	-0.65, -0.09	
Generation status																		
First generation	Ref.			Ref.			Ref.			Ref.			Ref.			Ref.		
Second generation	-0.18	-0.47, 0.11		-0.21†	-0.40, -0.01		-0.08	-0.32, 0.16		0.08	-0.08, 0.25		-0.08	-0.35, 0.18		-0.07	-0.28, 0.15	
Acculturation strategy																		
Assimilated	Ref.			Ref.			Ref.			Ref.			Ref.			Ref.		
Integrated	0.24	-0.09, 0.56		0.30†	0.08, 0.52		-0.02	-0.29, 0.25		0.05	-0.13, 0.24		-0.10	-0.40, 0.20		0.08	-0.16, 0.33	
Separated	0.42†	0.00, 0.84		0.41†	0.16, 0.66		-0.15	-0.50, 0.21		0.09	-0.12, 0.30		-0.16	-0.55, 0.22		-0.06	-0.34, 0.21	
Marginalized	0.74†	0.14, 1.34		0.21	-0.13, 0.54		0.12	-0.38, 0.62		-0.08	-0.36, 0.20		0.19	-0.36, 0.73		0.21	-0.16, 0.59	

Ref., reference category.  
 \*Adjusted for age, educational level and marital status.  
 †Differences were statistically significant compared with the first acculturation status of the Surinamese ( $P < 0.05$ ).

and bidimensional models of acculturation in a sample of 291 Asian Americans. Both models performed equally well, predicting many criteria with excellent validity. They concluded that the use of a specific acculturation model is dependent on the research topic and the research population<sup>(51)</sup>. The unidimensional model requires fewer items, takes less time to administer and is easier to interpret. The bidimensional model may produce larger findings with e.g. cultural preferences, cultural knowledge and ethnic identification<sup>(51)</sup>.

The strength of the present study includes the large sample size of more than 1300 participants of Dutch origin and more than 1700 participants of Surinamese origin in which a dietary pattern analysis was performed. Dietary patterns can give a broader picture of what is consumed than individual foods and nutrients<sup>(52)</sup>. Additionally, the dietary patterns obtained have been previously observed in a selection of this study sample (LH Dekker, unpublished results). This underscores the reproducibility of these dietary patterns in research. However, the limitations merit consideration. First, social desirability may have influenced the responses of the Surinamese-origin participants on the questions regarding cultural orientation. They might have over-reported their feeling of belonging to the Dutch culture, which may explain that the assimilated and integrated Surinamese do not adhere significantly more to the 'red meat, snacks and sweets' pattern than the separated and marginalized respondents. Second, the HELIUS study was designed to address ethnic differences in health and may have appealed to a segment of the Surinamese population that is particularly interested in the health of their own ethnic group. Consequently, the dietary patterns of this group may be particularly traditional. In that case, this would be noticed in a higher proportion of respondents preferring separation or marginalization rather than integration. With this in mind it is important to mention that more than 70 % of the Surinamese-origin residents in the study were 'integrated'. Although this is a representation of the target population, the power to detect differences in dietary patterns could therefore be limited. There might be different outcomes when the analysis used in the current study is repeated in another sample with a better distribution over the acculturation strategies. Third, the age of Surinamese participants could be strongly correlated to residence duration. Thus, adjusting for age in the analysis may have weakened the association between residence duration and dietary patterns. Finally, and perhaps most importantly, our analysis is cross-sectional while we are attempting to understand a determinant of dietary change. Prospective analysis of acculturation and diet may shed more light on this issue.

The results of the current study imply that it is important to take the traditional dietary habits of Surinamese-origin residents into account in the development of dietary interventions or nutrition programmes in order to meet the specific needs of this ethnic minority group. Counselling

on dietary change should take into account the foods eaten by ethnic minority groups. For example, this group could be encouraged to maintain the healthful aspects of a Surinamese dietary pattern, which is rich in fish and chicken (in preference to red meat). Additionally, in this predominantly older, first-generation group, it seems that no distinction needs to be made on the basis of acculturation status when promoting the consumption of vegetables and fruit and when discouraging the consumption of red meat and snacks.

The present study findings may not apply to other ethnic minority groups. Although our results indicate that the operationalization of acculturation does not make a difference to the association with dietary patterns, it is worth investigating this issue further in groups with different migration histories, geographical locations and culture. Furthermore, the analysis was based on individual-level factors, including a broader range of sociodemographic, socio-cultural and environmental factors, which may help to better understand the process of acculturation and its role as a determinant of dietary behaviour.

To conclude, the findings suggest that there is no difference in the use of unidimensional or bidimensional indicators for acculturation when assessing variation in dietary patterns. However, assessing the role of acculturation as a determinant of diet may require more comprehensive analyses, including food availability and taste preference. Nevertheless, the lack of association between acculturation (operationalized unidimensionally as well as bidimensionally) and dietary patterns in the present study indicates that traditional dietary patterns might be quite robust. Consequently, they need to be accounted for when developing dietary interventions for ethnic minority and migrant-origin populations.

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### Supplementary material

To view supplementary material for this article, please visit <http://dx.doi.org/10.1017/S1368980015001391>

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