HUMAN BIOLOGY AND PUBLIC HEALTH JOURNAL OF THE AUXOLOGICAL SOCIETY

ISSN 2748-9957 | Vol. 2 2024 | pp. 1–13

Transcending borders: anthropometric insights and body image among Turkish immigrants in Germany and the Netherlands

Kübra Baran[1] · Başak Koca Özer[2] · Michael Hermanussen[3] · Detlef Groth[4] · Christiane Scheffler[5]

[1]Ankara University, Graduate School of Social Sciences, Department of Anthropology, 06100 Sıhhiye, Ankara, Turkey
[2]Ankara University, Faculty of Languages, History and Geography, Department of Anthropology, Sub-department of Physical Anthropology, 06100 Sıhhiye, Ankara, Turkey
[3]Aschauhof, 24340 Eckernförde-Altenhof, Germany
[4]University of Potsdam, Institute of Biochemistry and Biology,14476 Potsdam- Golm, Germany
[5]University of Potsdam, Institute of Biochemistry and Biology, Human Biology, Am Neuen Palais 10, 14467 Potsdam, Germany

Citation:

Baran, K./Özer, B./Hermanussen, M. et al. (2024). Transcending borders: anthropometric insights and body image among Turkish immigrants in Germany and the Netherlands, Human Biology and Public Health 2. https://doi.org/10.52905/hbph2024.2.87.

Received: 2024-08-13
Accepted: 2024-10-10
Published: 2024-12-20

Conflict of Interest:

There are not conflicts of interest.

Correspondence to:

Kübra Baran
email: kbaran@ankara.edu.tr

Keywords

anthropometry, body image, Turkish immigrants, Germany, the Netherlands

Abstract

Background The phenomenon of human migration is multi-dimensional, involving economic, political, cultural and environmental factors; it operates with 'push-pull' dynamics and structures the immigrant population in terms of behaviour, social dynamics, dietary patterns, growth trajectories, reproductive strategies and overall well-being. Since the 1960s, Turkish immigrants have settled mainly in Germany and the Netherlands.

Objectives The study aims to understand the changes in anthropometric variables that have occurred among adult Turkish immigrants due to migration, as well as to identify the factors affecting their body image and height.
Sample: The cross-sectional study included a random sample (aged 18-65 years) of 190 Turkish immigrants (73 males, 117 females) living in Germany and the Netherlands, and 278 non-migrant individuals (120 males, 158 females) living in Turkey.

Methods Anthropometric data on height, weight, circumferences, and skinfold thickness were collected, and a body image survey was administered. In addition to descriptive statistics, a principal component analysis (PCA) and a linear regression model were conducted.

Results No statistical difference was found between the height of Turkish immigrants in Germany and the Netherlands, and those living in Turkey for males. Overweight was more prevalent in Turkish immigrant groups than in those living in Turkey. Comparison of Turkish immigrants and non-immigrants showed that both male and female living in Europe had higher body image scores.

Conclusion The height differences between Turkish immigrants and those still living in Turkey may result from the insufficient integration of immigrants into the new society. It was found that educational level positively affects the height of both sexes in both Turkish immigrants and non-immigrants.

Take home message for students Physiological and morphological changes occur in immigrants during adaptation to a new environment. BMI and weight values for Turkish immigrants are higher than those for individuals living in Turkey; however, no difference in height was found.

Abbreviations

PCA principal component analysis
BMI body mass index
EDU´ education level
LM linear regression models
B Linear regression estimates
STD standard error of the mean

Introduction

Human migration, an enduring phenomenon since the ancient era of our ancestors in Africa, has been influenced by multifaceted factors. It is uncommon for human populations to sustain isolation, with migration typically driven by a complex interplay of "Push-Pull" dynamics rooted in economic, political, cultural, and environmental contexts (Ravenstein 1885). Relocation exposes individuals to diverse environmental conditions, thereby impacting their behaviour, social dynamics, dietary patterns, growth trajectories, reproductive strategies, and overall well-being. Importantly, migration contributes to the introduction of novel genetic, physiological, and morphological traits within populations (Hermanussen 2013; Mascie-Taylor and Little 2004).
Morphological differences among individuals from the same ethnic group but with diverse geographical, social, and occupational backgrounds have been documented by many researchers. Resettlement in new destinations is considered a significant factor contributing to physical changes in homogeneous populations, a phenomenon known as the migration effect. This phenomenon demonstrates the phenotypic plasticity of body measurements, as Boas (1912) showed in Japanese immigrants in the USA. Height, especially in immigrant groups relocating to new geographical and social settings, shows a strong dependency on Social-Economic-Political-Emotional (SEPE) factors. Bogin's studies in the 1990s revealed that Mayan immigrant children moving from Guatemala to the USA grew on average 11cm taller than their peers in their country of origin. Similarly, historical data from Dutch colonists' children in Brastagi, Indonesia (1926–1928) showed they were 15cm taller than their counterparts in the Netherlands. The positive secular trend in the height of immigrants across generations is primarily due to the relationship between better SEPE environments and higher average height (Boas 1912; Bogin et al. 2018; Bogin 2021; Scheffler et al. 2021; Bogin 2023). Immigrants tend to be taller than the native population of their home country. However, as they adapt, changes in diet, reduced physical activity, and migration-related stress can lead to increased obesity rates, as supported by numerous studies (Murphy et al. 2017).
Immigrants often maintain strong affiliations with their home countries and cultures, fostering transnational bonds with their respective societies. Moreover, they frequently perpetuate traditional values, cultural norms, ethnic-religious affiliations, legal frameworks, and political ideologies, alongside customary lifestyles and dietary practices (Bogin et al. 2018). When examining the migration patterns of the Turkish population, it is evident that this movement began predominantly in the early 1960s, primarily toward Germany and several other European countries. Immigrants often depart with the desire to return to their home country. However, this desire transforms into a state of permanent migration for individuals who do not return, constituting a challenging process where maintaining ties with the homeland becomes a coping strategy (Özbay 2001; Bogin et al. 2018; Akkayan 2003). This situation holds for Turkish immigrants. It has been over 60 years since the first gen-

eration of Turkish immigrants arrived, the majority of whom have chosen to settle permanently in their new countries rather than return to Turkey. Presently, second and third-generation Turkish immigrants reside in Germany and the Netherlands (Çınar 2017; Ekşi et al. 2015).

According to the 2020 report by the Federal Statistical Office of Germany (Destatis 2022), Germany's total population is approximately 83 million, with around 12 million individuals being immigrants. Among them, 1.5 million Turkish immigrants constitute the largest immigrant group. The age range with the highest concentration of Turkish citizens in Germany is between 20 and 45 years old (Destatis 2022; Diyih 2019; Ministry of Labor and Social Security 2018). In 2021, the Dutch population is approximately 17.5 million, with approximately 4 million being immigrants of which the 425 thousand Turkish immigrants are the largest group. The age range with the highest concentration of Turkish citizens in the Netherlands falls between 20 and 40 years old (Diyih 2019; Ministry of Labor and Social Security 2018; Statistics Netherlands 2022).

Long-term migration across national borders represents one of the primary avenues through which the demographic structure of various countries transforms. Migrating populations acquire new phenotypic characteristics. Numerous studies have been conducted to comprehend the changes in human growth patterns accompanying migration. Classic examples of studies on the growth of immigrant children include Boas' (Boas 1912) research on European immigrants in the United States (Shapiro 1939), study on Japanese immigrants in Hawaii (Goldstein 1943), studies on Mexican immigrants to the United States, and studies by Greulich (Greulich 1976) on Japanese-American born children(Boas 1912; Hermanussen 2013).

Migration continues to be one of the most crucial and highly socio-political issues of our time (Danso 2006; Kobyliansky and Arensburg 1977). The aim of this study is to comprehend the changes brought about by migration, given the limitations of studies on the anthropometric variables of adult Turkish immigrants.

Body size is perceived as a sign of social dominance. Taller males are often perceived as more competent and authoritative, and taller individuals tend to view themselves as more self-confident (Hermanussen et al. 2022). Body image pertains to an individual's perceptions, feelings, and thoughts about their own body (Grogan 2006). The scientific exploration of body image has a rich history and continues to be a rapidly growing field. Experiences shaping one's body profoundly influence various aspects of psychosocial functioning and quality of life (Cash and Pruzinsky 2002; Grogan 2016). The formation of body image is acknowledged to be complex and multidimensional, shaped by factors such as sex, ethnicity, cultural context, age, and the state of both body and mind (Cash and Smolak 2012). Behavioural scientists, physicians, and philosophers have developed theories regarding the nature and significance of body image from diverse perspectives. Clinical practitioners have sought remedies that alter both the body and mind to aid individuals experiencing a diminished quality of life due to body image experiences. Other applied researchers have developed interventions aimed at preventing body image issues among youth (Cash and Smolak 2012).

We are interested in understanding how Turkish immigrants in Germany and the Netherlands define their bodies and how their personal views on integration into the host society and belonging to their Turkish origin community vary. We aim to explore the factors influencing individuals' body image and height.

In this context, three hypotheses have been formulated for this study:

1. Turkish immigrants are taller than non-immigrants living in Turkey.
2. Turkish immigrants are heavier and have higher BMI values than non-immigrants living in Turkey.
3. There is a positive relationship between body image, educational level, and height for both Turkish immigrants and non-immigrants living in Turkey.

Subjects and methods

A cross-sectional study was conducted using a random sampling method, involving 190 Turkish immigrants aged between 18 and 65 years residing in Germany (20 males, 45 females) and the Netherlands (53 males, 72 females), as well as 278 non-immigrant individuals (120 males, 158 females) living in Turkey. Data from the second generation Turkish immigrants were collected in 2023 from individuals residing in Amsterdam, the Netherlands; Munich, Germany, and Duisburg, Germany.

Height measurements were obtained using a Martin-type anthropometer, while knee and elbow width was measured using a small diameter calliper. Circumference measurements were taken using a tape measure, and skinfold thickness (SFT) measurements were performed using a Holtain-type skinfold calliper. Weight and body composition components were determined using the TANITA SC-330. Anthropometric measurements were obtained following the techniques outlined in the Anthropometric Standardization Reference Manual (ASRM) and the protocols established by the International Biological Programme (IBP) (Weiner and Louri 1969).

The "Body Image Questionnaire" adapted by Gökdoğan (Gökdoğan 1988) based on Berscheid, Walster, and Bohrnstedt's (Berscheid et al. 1973) measure of body image satisfaction was utilized in this study. Under the category of overall body appearance, seven items were included (athletic ability, body proportions, height, muscle strength, posture, skin colour, and weight). Additionally, under the category of facial features, nine items were included for females (chin, ears, eyes, facial beauty, hair, mouth, nose, teeth, voice), and males, an additional item regarding facial hair was included, a total of ten items. Under the category of body parts, four items were included (shoulders, arms, hands, feet), and under the torso category, four items were included (abdomen, hips, legs, and ankles). Furthermore, items related to breast and chest areas, as well as genitalia, were included. There were 25 items for females and 26 items for males. Each item was rated on a scale from 1 (not satisfied at all) to 5 (very satisfied). Total scores and section scores were obtained by dividing the total sum of scores for items by the number of items. In terms of reliability, the correlation coefficient between total scores from the first and second administrations was found to be 0.88, calculated using the Pearson product-moment correlation coefficient. The Cronbach's alpha coefficient for this study was determined to be 0.92, indicating high internal consistency reliability (Gökdoğan 1988).

Statistical analysis

Means, standard deviations, t-test (Independent Samples t-test), and Kruskal-Wallis test were employed to obtain the measurements' means within the scope of the research. Principal component analysis

(PCA) was utilized to assess the relationship between anthropometric measurements and the Body Image Questionnaire. PCA is one of the multivariate statistical analysis methods used to determine the relationship between variables. It is employed to understand the variance structure within a dataset and for dimensionality reduction purposes. Essentially, PCA aims to identify relationships between variables in a dataset and creates a new set of variables that represent these relationships with fewer dimensions (Jolliffe 1990).

Linear regression models are used to predict a dependent variable using one or more independent variables. Linear regression model results show how the dependent variable (height) is associated with the independent variables (Body Image, education level, BMI). The effect of each independent variable in the model is expressed with coefficients. Linear regression models are estimated using an optimization technique such as the least squares method. This method tries to minimize the total squared errors between the observed values and the values predicted by the model.

For males: lm (formula = height ~ BMI + chin + abdomen + sport + edu)

For females: lm (formula = height ~ BMI + facial beauty + hips + sport + edu)

Statistical analysis was conducted using the statistical package from the Data Theory Scaling System Group (DTSS) and the practical interface of R Studio version 4.3.1 (RStudio 2023.06.16).

Ethical considerations

This study was conducted with the approval of the Ankara University Ethics Committee under protocol number 85434274-050.04.04, granted on February 6, 2023. Following the receipt of ethical approval, anthropometric measurements were initiated.

Results

Age-dependent data on height, weight, and BMI values for Turkish immigrants living in Germany and the Netherlands, compared to non-immigrant individuals living in Turkey, are presented in Table 1. There is no statistically significant difference in height between individuals living in Turkey and the pooled Turkish immigrant group for both sexes (males $p=0.288$, females $p=0.252$). There are no differences in height of males ($p=0.329$) and females ($p=0.137$) living in Turkey and Turkish immigrants in Germany, as well as in the heights of males living in Turkey compared to males living in the Netherlands ($p=0.077$). But non-immigrant females in Turkey were around 2cm taller compared to females living in the Netherlands ($p=0.008$), whereas female Turkish immigrants in Germany are taller around 4cm ($p=0.002$) than in the Netherlands.

Turkish immigrant females living in Germany and the Netherlands are more overweight ($p<0.0001$) than in Turkey. However, no difference in weight was observed for Turkish males living in Turkey and Germany or the Netherlands ($p=0.488$ respectively $p=0.315$). The weight of Turkish immigrants in Germany and the Netherlands do not differ (males: $p=0.822$, females: $p=0.997$).

Turkish immigrant females in Germany and the Netherlands have a higher BMI than females living in Turkey ($p=0.002$ respectively $p=2.779$); however, no difference was found in males ($p=0.209$). Also, Turkish immigrant males in the Netherlands have a higher BMI compared to

males living in Turkey (p=0.05), Turkish immigrants between Germany and the Netherlands do not differ in BMI (males: p=0.146, females: p=0.902).

PCA is a method used to reduce the size of multidimensional data sets and to represent them while preserving the variance contained in the data set. According to PCA analysis; all individuals included in the sample group were grouped as males and females, and by adding the body image survey questions and educational level of the individuals, which are thought to affect height, the 4 most significant variables out of 27 in total were determined (Table 2). Subsequently, variables affecting the height of Turkish immigrants living in Germany and the Netherlands and those living in Turkey were determined among the three groups. Significant variables may differ by sex and country.

With PCA, the data set was reduced and significant variables were determined. Then, the following linear regression model was used to determine the factors affecting height. BMI value was not calculated when performing PCA analysis, but it is included in the linear model because it was included in the data set and was determined to have a significant effect on height.

According to this linear regression model network, it has been stated that variables such as BMI, chin, abdomen, sports, and education level are effective variables on height for males. For females, it has been stated that variables such as BMI, facial beauty, hips, sports, and education level are effective variables on height. However, education level was found to be a variable that had a significant effect on height increase for both sexes (Table 3).

According to this linear regression model network, no results could be obtained due to the insufficient number of Turkish male immigrant individuals living in Germany included in the sample. Only Turkish immigrant female individuals could be calculated (Table 4). It has been stated that BMI, facial beauty, hips, sports, and education level are effective variables on height

Table 1 The distribution of age, height, weight, and BMI of Turkish individuals according to the country of residence (Turkish immigrants living in Germany, Turkish immigrants living in the Netherlands, Turkish immigrants-total sample of Turkish immigrants living in Germany and the Netherlands, Turkish origin residents living in Turkey)

	Germany		the Netherlands		Immigrants		Turkey	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Males								
N	20		53		73		120	
Age (years)	40.14	13.68	43.15	15.03	42.29	14.60	33.39	12.68
Height (cm)	173.50	7.38	173.10	7.08	173.60	7.12	175.20	7.22
Weight (kg)	84.33	14.46	84.35	12.92	82.34	13.29	82.14	13.44
BMI (kg/m^2)	27.93	4.14	28.06	4.06	28.02	4.04	26.77	3.91
Females								
N	45		72		117		158	
Age (years)	41.74	11.83	48.92	12.12	46.27	12.46	35.70	11.59
Height (cm)	162.20	6.49	158.10	6.89	159.60	7.01	160.60	6.40
Weight (kg)	74.38	14.33	74.96	12.72	74.75	13.29	64.85	14.48
BMI (kg/m^2)	28.43	5.86	30.04	5.62	29.40	5.74	25.33	5.81

Table 2 Principal component analysis (PCA) for all sample. Components (PC1, PC2, PC3, and PC4) represent the basic components. Each feature (chin, facial beauty, mouth, etc.) is represented by a component loading value for each principal component indicated bold.

	PC1	PC2	PC3	PC4
Males				
chin	**0.249**	0.085	0.227	0.149
facial beauty	0.245	0.040	0.072	-0.040
mouth	0.239	0.199	0.202	-0.100
ears	0.235	0.134	0.099	0.033
breasts and upper area	0.230	-0.198	-0.246	0.152
arms	0.225	0.207	-0.185	0.090
shoulders	0.222	0.068	-0.277	-0.057
feed	0.220	0.182	-0.136	0.056
hands	0.215	0.151	-0.164	0.111
hips	0.214	-0.258	-0.133	0.231
body posture	0.211	-0.237	-0.013	0.128
voice	0.202	0.140	0.140	-0.257
teeth	0.195	0.071	0.085	-0.398
eyes	0.195	0.175	0.081	0.145
skin color	0.193	0.087	-0.046	-0.195
body proportions	0.191	-0.310	0.157	0.186
muscle strength	0.188	0.061	-0.177	-0.310
legs and ankles	0.184	-0.068	-0.270	0.204
height	0.180	-0.053	0.045	-0.039
abdomen	0.173	**-0.388**	0.095	-0.005
nose	0.164	0.040	0.252	-0.108
weight	0.153	-0.396	0.239	-0.116
genital organ	0.130	0.067	-0.137	0.239
hairs	0.124	0.229	0.303	0.034
athletic	0.109	-0.125	-0.402	-0.364
edu	-0.106	0.255	**-0.267**	0.074
sport	0.035	0.230	0.137	**0.410**
Females				
facial beauty	**-0.245**	0.194	-0.072	0.192
legs and ankles	-0.240	-0.250	-0.018	-0.107
mouth	-0.238	0.221	0.000	0.042
breasts and upper area	-0.226	-0.130	0.014	-0.057
genital organ	-0.221	0.033	-0.040	-0.026
hands	-0.219	0.119	-0.105	-0.176
eyes	-0.216	0.199	-0.123	0.225
hips	-0.215	**-0.287**	0.009	-0.165
arms	-0.212	-0.076	-0.068	-0.356
shoulders	-0.208	0.012	-0.030	-0.421
nose	-0.206	0.181	0.023	0.262
body posture	-0.205	-0.281	0.031	0.060
voice	-0.200	0.147	-0.010	0.032
feed	-0.197	0.050	-0.012	-0.073
ears	-0.196	0.165	-0.041	0.173
abdomen	-0.193	-0.272	-0.152	0.0513
teeth	-0.191	0.194	0.195	0.013
chin	-0.185	0.266	0.112	-0.053
hairs	-0.167	-0.008	-0.238	0.180
body proportions	-0.166	-0.368	0.008	0.190
height	-0.1639	0.067	-0.234	-0.083
athletic	-0.161	-0.110	0.384	0.273
weight	-0.154	-0.340	-0.266	0.165
skin color	-0.153	0.251	-0.039	-0.043
muscle strength	-0.142	-0.008	0.408	-0.357
edu	0.090	0.049	**-0.503**	0.043
sport	0.073	0.115	-0.365	**-0.334**

for female individuals living in Germany. However, according to this model, none of the independent variables are statistically significant. This shows that the model is not successful in explaining the variables affecting height.

According to this linear regression model network, abdominal and educational level variables have a significant effect on the height of Turkish immigrant males living in the Netherlands. Accordingly, it was found that BMI and educational level variables had a significant effect on the height of Turkish immigrant females living in the Netherlands (Table 5).

According to this linear regression model network, BMI and education level were found to have a significant effect on height for male individuals living in Turkey. It was found that only education level had a significant effect on height for female individuals living in Turkey (Table 6).

Table 3 Linear Regression Analysis of height for all sample. Independent variables for males: body mass index (BMI), chin, abdomen, sport, education level; Independent variables for females: BMI, facial beauty, hips, sport, education level. Among all the factors of the model, education level (edu) is the variable that affects height. Linear regression estimates (β), Std. Error- standard error of the mean, t-value, p-value.

	β	Std. Error	t	p (>|t|)
Males				
(Intercept)	1545.6	77.76	19.87	<0,001
BMI	14.977	1.715	0.825	0.411
chin	0.4258	9.341	0.046	0.964
abdomen	10.026	6.816	1.471	0.145
sport	-3.050	16.514	-0.185	0.854
edu	**24.765**	**6.358**	**3.895**	**<0.0001*** **
Females				
(Intercept)	1591.96	56.078	28.389	<0,001
BMI	-1.510	1.028	-1.468	0.144
facial beauty	-6.092	5.876	-1.037	0.302
hips	-1.141	4.063	-0.281	0.779
sport	-7.909	10.691	-0.740	0.461
edu	**18.161**	**4.632**	**3.921**	**<0.0001*** **

*p<0.05 **p<0.001

Table 4 Linear regression analysis of height for Turkish female immigrants living in Germany. Independent variables: body mass index (BMI), facial beauty, hips, sports, education level (edu). No statistical significance was found among the independent variables. Linear regression estimates (β), Std. Error – standard error of the mean, t value, p-value.

	β	Std. Error	t	p (>|t|)
(Intercept)	1657.30	228.353	7.258	<0.001
BMI	-2.419	3.730	-0.648	0.526
facial beauty	1.509	14.239	0.106	0.917
hips	-8.087	13.284	-0.609	0.551
sport	-10.124	34.657	-0.292	0.774
edu	13.675	22.580	0.606	0.553

*p<0.05 **p<0.001

Discussion

Anthropometric characteristics exhibit significant variation across populations, influenced by factors such as nutrition, physical activity levels, and genetic diversity (Özer et al. 2007). Our study found that there are no statistically significant differences in height of adult Turkish immigrants in Germany and the Netherlands compared

Table 5 Linear regression analysis of height for Turkish immigrants living in the Netherlands. Independent variables for men: body mass index (BMI), chin, abdomen, sport, education level (edu). Independent variables for females: BMI, facial beauty, hips, sports, education level. Linear regression estimates (*β*), Std. Error – standard error of the mean, t value, p-value.

	β	Std.Error	t	p (>|t|)
Males				
(Intercept)	1623.71	112.051	14.491	<0.001
BMI	-3.074	2.362	-1.301	0.201
chin	-6.514	14.785	-0.441	0.662
abdomen	**22.132**	**8.713**	**2.540**	**0.015 ***
sport	22.975	21.790	1.054	0.298
edu	**23.278**	**9.606**	**2.423**	**0.020***
Females				
(Intercept)	1.725.528	75.699	22.795	<0.001
BMI	**-3.625**	**1.411**	**-2.568**	**0.013 ***
facial beauty	-11.562	8.969	-1.289	0.202
hips	-2.240	6.017	-0.372	0.711
sport	-11.028	14.631	-0.754	0.454
edu	8.570	6.396	1.340	0.185

*p<0.05 **p<0.001

Table 6 Linear regression analysis of height for males and females living in Turkey. Independent variables for males: body mass index (BMI), chin, abdomen, sport, education level; Independent variables for women: BMI, facial beauty, hips, sports, education level (edu). Linear regression estimates (*β*), Std. Error – standard error of the mean, t value, *p*-value.

	β	Std.Error	t	p (>|t|)
Males				
(Intercept)	1527.95	111.325	13.725	<0,001
BMI	**4.981**	**2.464**	**2.022**	**0.050***
chin	-1.345	11.511	-0.117	0.908
abdomen	1.373	10.385	0.132	0.896
sport	**-40.201**	**23.262**	**-1.728**	**0.091.**
edu	**26.851**	**10.776**	**2.492**	**0.017***
Females				
(Intercept)	1373.53	97.127	14.142	<0.001
BMI	1.215	1.677	0.725	0.471
facial beauty	0.8751	11.195	0.078	0.938
hips	4.066	6.366	0.639	0.525
sport	-11.074	18.675	-0.593	0.555
edu	**35.884**	**10.237**	**3.505**	**0.000*****

*p<0.05 **p<0.001

to non-immigrant populations in Turkey. This finding contradicted our initial hypothesis, which anticipated taller heights among immigrant groups. Interestingly, females in Germany and Turkey were found to be significantly taller than those in the Netherlands (p=0.008).

Migration studies on height consistently show that migrating populations often exhibit taller height than their non-migrating counterparts (Mjönes 1987; Bogin et al. 2002; Özer and Scheffler 2018; Scheffler et al. 2021). This disparity may be attributed to challenges faced by Turkish immigrants in integrating into their host countries. For instance, Porsch-Oezcueruemez et al. (Porsch-Oezçueruemez et al. 1999) reported an average height of 170cm for Turkish adult male immigrants and 158cm for females in Germany, with our study confirming similar findings for males while indicating taller heights for female immigrants.

In contrast, Özer and Scheffler (Özer and Scheffler 2018) reported a height of 180.0cm for Turkish immigrant males, differing from our findings of 173.6cm for males in Germany. We attribute this discrepancy to the younger average age (24.6 years) of our study participants compared to theirs, which likely influenced height outcomes. Similarly, Özer (Özer 2008) found no significant height differences between Turkish immigrant females and females in Turkey, consistent with our own results.

Dijkshoorn et al. (Dijkshoorn et al. 2011) reported slightly shorter heights among Turkish immigrant males and females in the Netherlands compared to our study's findings. This difference may reflect a positive secular trend in height among Turkish immigrants over time in the Netherlands.

Regarding BMI and obesity, our study aligns closely with previous research, showing higher BMI values among Turkish immigrant females compared to those in Turkey, supporting our second hypothesis. Studies by Brussaard et al. (Brussaard et al. 2001) and Labree et al. (Labree et al. 2015) reported similar BMI trends, while Gadd et al. (Gadd et al. 2005) noted increased obesity risks among Turkish immigrants in Sweden. These findings underscore the influence of diet, lifestyle, and socioeconomic factors on health outcomes within immigrant populations in Europe.

Our third hypothesis regarding variables influencing height—such as body image, abdominal obesity, sports ability, and educational level—was supported by our findings. Educational level emerged as the most significant factor across our sample group, correlating with greater height. This is consistent with Martin et al.'s (Martin et al. 2020) findings on parental education's direct impact on height, independent of nutritional status. Our study also highlighted variations across different locations: in Germany, few variables significantly affected height among Turkish immigrants, possibly due to sample size limitations, while in the Netherlands, body image and educational level were influential for males, and BMI for females. In Turkey, sports ability, BMI, and educational level impacted male heights, with only educational level affecting females.

The cultural context of immigration mediates social adjustment processes, self-image formation, and body perception (Siefen et al. 1996), influencing health outcomes and anthropometric characteristics. Turkish origin immigrants in Europe consistently showed higher body image scores among both sexes, reflecting complex socio-cultural dynamics.

Factors linked to parental education, including social and economic circumstances, self-confidence, and group behaviour, play a direct role in child growth (Martin et al. 2020). Immigrant children tend to be shorter than their host country peers but taller than those in their country of origin,

highlighting the critical role of socio-environmental factors in physical development (Aßmann and Hermanussen 2013).

In conclusion, while our study provides valuable insights into anthropometric patterns among Turkish immigrants in Europe, it acknowledges limitations such as sample size constraints and potential biases. Future research with larger, more diverse samples and longitudinal designs is needed to deepen our understanding of these complex relationships. Our findings contribute to filling gaps in the literature on anthropometric studies of adult Turkish immigrants and highlight the need for nuanced approaches to health and integration policies in host countries.

Acknowledgements

The manuscript is a result of the 6th International Summer School called "Human Growth Data Analysis and Statistics", held in Potsdam/Gülpe between 16–22 July 2023. The summer school was supported by KoUP funding of University of Potsdam, the Auxological Society (Gesellschaft für Auxologie) and the Society of Anthropology (Gesellschaft für Anthropologie)

References

Akkayan, T. (2003). Internal migrations and issues in Turkey. Antropoloji 15, 29–61.

Aßmann, C./Hermanussen, M. (2013). Modeling determinants of growth: evidence for a community-based target in height? Pediatric Research 74 (1), 88–95. https://doi.org/10.1038/pr.2013.50.

Berscheid, E./Walster, E./Bohrnstedt, G. (1973). The happy American body: a survey report. PsycEXTRA Dataset.

Boas, F. (1912). Changes in the bodily form of descendants of immigrants. American Anthropologist 14 (3), 530–562.

Bogin, B. (2021). Social-Economic-Political-Emotional (SEPE) factors regulate human growth. Human Biology and Public Health 1. https://doi.org/10.52905/hbph.v1.10.

Bogin, B. (2023). What makes people grow? Love and hope. Journal of Physiological Anthropology 42 (1), 13. https://doi.org/10.1186/s40101-023-00330-7.

Bogin, B./Hermanussen, M./Scheffler, C. (2018). As tall as my peers – similarity in body height between migrants and hosts. Anthropologischer Anzeiger 74 (5), 363–374. https://doi.org/10.1127/anthranz/2018/0828.

Bogin, B./Smith, P./Orden, A. B./Varela Silva, M. I./Loucky, J. (2002). Rapid change in height and body proportions of Maya American children. American Journal of Human Biology 14 (6), 753–761. https://doi.org/10.1002/ajhb.10092.

Brussaard, J. H./van Erp-Baart, M. A./Brants, H. A./Hulshof, K./Löwik, M. R. (2001). Nutrition and health among migrants in the Netherlands. Public Health Nutrition 4 (2b), 659–664. https://doi.org/10.1079/phn2001149.

Cash, Thomas F./Pruzinsky, Thomas (Eds.) (2002). Body image. A handbook of theory, research, and clinical practice. New York, NY, Guilford Press.

Cash, Thomas F./Smolak, Linda (Eds.) (2012). Body image. A handbook of science, practice, and prevention. 2nd ed. New York, NY, Guilford Press.

Çınar, Y. (2017). Türk Alman Ilişkilerinde Almanya'daki Türk Göçmenler (1961–2000). Turkish immigrants in Germany in the context of Turkish-German relations (1961–2000). Akademik Izdüşüm Dergisi 2 (2), 1–21.

Danso, H. A. (2006). Immigrants. In: Neil J. Salkind (Ed.). Encyclopedia of Human Development. Sage Publications, 675–678.

Destatis (2022). Fokus Russland und Ukraine: Ausländische Bevölkerung in Deutschland. Available online at https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/03/PD22_N011_12.html (accessed 10/21/2024).

Dijkshoorn, H./Ujcic-Voortman, J. K./Viet, L./Verhoeff, A. P./Uitenbroek, D. G. (2011). Ethnic variation in validity of the estimated obesity prevalence using self-reported weight and height measurements. BMC Public Health 11 (1). https://doi.org/10.1186/1471-2458-11-408.

Diyih (2019). Digm 2019 Yili Raporu. Available online at https://www.csgb.gov.tr/media/83809/diyih-2019-raporu.pdf (accessed 10/25/2025).

Ekşi, H./Demirci, \./Yıldız, C./Ekşi, F. (2015). Almanya'da yaşayan Türk göçmenlerin aile değerleri. Family values of Turkish immigrants living in Germany. Değerler Eğitimi Dergisi 13 (29), 41–82.

Gadd, M./Sundquist, J./Johansson, S.-E./Wändell, P. (2005). Do immigrants have an increased prevalence of unhealthy behaviours and risk factors for coronary heart disease? European Journal of Preventive Cardiology 12 (6), 535–541. https://doi.org/10.1097/01.hjr.0000174829.25388.ed.

Gökdoğan, F. (1988). Orta öğretime devam eden ergenlerde beden imgesinden hoşnut olma düzeyi. Level of satisfaction with body image among adolescents attending secondary school. unpublished Master Thesis.

Goldstein, M. S. (1943). Demographic and bodily changes in descendants of Mexican immigrants. Austin.

Greulich, W. W. (1976). Some secular changes in the growth of American-born and native Japanese children. American Journal of Physical Anthropology 45 (3 pt. 2), 553–568. https://doi.org/10.1002/ajpa.1330450320.

Grogan, S. (2006). Body image and health: contemporary perspectives. Journal of Health Psychology 11 (4), 523–530. https://doi.org/10.1177/1359105306065013.

Grogan, S. (2016). Body image. Understanding body dissatisfaction in men, women and children. 3rd ed. Abingdon, Oxon/New York, N.Y., Routledge.

Hermanussen, M./Erofeev, S./Scheffler, C. (2022). The socio-endocrine regulation of human growth. Acta Paediatrica 111 (11), 2077–2081. https://doi.org/10.1111/apa.16504.

Hermanussen, Michael (Ed.) (2013). Auxology. Studying human growth and development : 89 tables. Stuttgart, Schweizerbart Science Publ.

Jolliffe, I. T. (1990). Principal Component Analysis. A Beginners Guide – I. Introduction and application. Weather 45 (10), 375–382. https://doi.org/10.1002/j.1477-8696.1990.tb05558.x.

Kobyliansky, E./Arensburg, B. (1977). Changes in morphology of human populations due to migration and selection. Annals of Human Biology 4 (1), 57–71. https://doi.org/10.1080/03014467700001961.

Labree, W./van de Mheen, D./Rutten, F./Rodenburg, G./Koopmans, G./Foets, M. (2015). Differences in overweight and obesity among children from migrant and native origin: the role of physical activity, dietary intake, and sleep duration. PloS one 10 (6), e0123672. https://doi.org/10.1371/journal.pone.0123672.

Martin, L./Dorjee, B./Groth, D./Scheffler, C. (2020). Positive influence of parental education on growth of children – statistical analysis of correlation between social and nutritional factors on children's height using the St. Nicolas House Analysis. Anthropologischer Anzeiger 77 (5), 375–387. https://doi.org/10.1127/anthranz/2020/1177.

Mascie-Taylor, C. G. N./Little, M. A. (2004). History of migration studies in biological anthropology. American Journal of Human Biology 16 (4), 365–378. https://doi.org/10.1002/ajhb.20046.

Ministry of Labor and Social Security (2018). Report of the YİH: Developments and Statistical Information Regarding Our Citizens Abroad. Available online at https://www.aile.gov.tr/media/50211/diyih-2018-raporu.pdf (accessed 10/10/2024).

Mjönes, S. (1987). Growth in Turkish children in Stockholm. Annals of Human Biology 14 (4), 337–347. https://doi.org/10.1080/03014468700009121.

Murphy, M./Robertson, W./Oyebode, O. (2017). Obesity in international migrant populations. Current Obesity Reports 6 (3), 314–323. https://doi.org/10.1007/s13679-017-0274-7.

Özbay, F. (2001). Nüfus ve kalkınma: göç, eğitim, demokrasi, yaşam kalitesi. (No Title).

Özer, A./Scheffler, C. (2018). Affinity to host population stimulates physical growth in adult offspring of Turkish migrants in Germany. Anthropologischer Anzeiger 74 (5), 359–364. https://doi.org/10.1127/anthranz/2018/0825.

Özer, B. K. (2008). Secular trend in body height and weight of Turkish adults. Anthropological Science 116 (3), 191–199. https://doi.org/10.1537/ase.061213.

Özer, B. K./Gültekin, T./Sağir, M. (2007). Estimation of stature in Turkish adults usinig knee height. Anthropologischer Anzeiger 65 (2), 213–222. https://doi.org/10.1127/anthranz/65/2007/213.

Porsch-Oezçueruemez, M./Bilgin, Y./Wollny, M./Gediz, A./Arat, A./Karatay, E./Akinci (1999). Prevalence of risk factors of coronary heart disease in Turks living in Germany: the Giessen Study. Atherosclerosis 144 (1), 185–198. https://doi.org/10.1016/s0021-9150(99)00054-4.

Ravenstein, E. G. (1885). The laws of migration. Journal of the Statistical Society of London 48 (2), 167. https://doi.org/10.2307/2979181.

Scheffler, C./Nguyen, T. H./Hermanussen, M. (2021). Vietnamese migrants are as tall as they want to be. Human Biology and Public Health 2. https://doi.org/10.52905/hbph.v2.12.

Shapiro, H. L. (1939). Migration and environment. A study of the physical characteristics of the Japanese immigrants to Hawaii and the effects of environment on their descendants. New York, Oxford University Press.

Siefen, G./Kirkcaldy, B. D./Athanasou, J. A./Peponis, M. (1996). The self-image of Greek, Greek-migrant and German adolescents. Social Psychiatry and Psychiatric Epidemiology 31 (3–4), 241–247. https://doi.org/10.1007/BF00785774.

Statistics Netherlands (2022). New classification of population by origin. Available online at https://www.cbs.nl/en-gb/longread/statistische-trends/2022/new-classification-of-population-by-origin (accessed 10/21/2024).

Weiner, J. A./Louri, J. S. (1969). Human Biology, A Guide to Field Methods. IBP Handbook No. 9 1969.