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Social determinants of overweight among immigrants in Spain and France

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Abstract

This study addresses immigrant health from the point of view of social health inequalities research. We study differences in overweight between immigrants and natives in two countries, France and Spain. Controlling for socioeconomic characteristics, we focus on effects that pertain to the country of origin and to the country of arrival in explaining overweight prevalence. We first estimate and compare between France and Spain, in women and men, the effect of immigration status on overweight when controlled for age, socioeconomic status (SES), and country of origin. We study the role of length of stay as proxied by naturalisation status and according to country of origin. We investigate the role of GDP, HDI and obesity prevalence in the country of origin. We then estimate how differences in population compositions and differences in estimated coefficients contribute to observed differences in overweight between natives and migrants for each country.

We show distinct patterns according to gender. Among women, the overweight probability is higher for immigrants than natives in France and Spain. Among men, the probabilities are identical in France and lower in Spain. In Spain, most of the effect of migration on health arises among more recent immigrants, whereas in France, overweight tends to appear among longer-established immigrants. Moreover, African immigrants (North Africans as well as Sub-Saharans) are more likely to be overweight than other immigrants.

We conclude by addressing overweight inequalities between migrants and natives in Spain and France. Our decomposition results conclude that difference in characteristics is less important than differences in coefficients. In terms of health policy targeting the immigrant sub-population would be a good tool to reduce overweight prevalence. Among immigrants, origin country characteristics (GDP, HDI and obesity) play a role in their overweight prevalence.

Keywords: Migration, obesity, international comparisons, social health inequalities

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Contents

1 Introduction: social health inequalities, immigration, and overweight; an agenda for research and policymaking in Europe

Most Western European countries implemented universal and socialised health systems more than 60 years ago and have nevertheless experienced significant and often growing social inequalities in health (Mackenbach, 2006). While research on health inequalities has shed light on several socioeconomic determinants of health, many issues regarding specific subpopulations remain in need of exploration, such as immigrant populations, whose health and access to health services have attracted major interest at the EU level (WHO Regional Office for Europe, 2014).

There is now vast evidence of a specific effect of migration on health: immigrants and minority groups have a different health status to natives (Buekens, 2001, Gushulak et al., 2010), which can only partly be explained by differences in SES (Jusot et al., 2009). Other factors related to migration itself have to be taken into consideration. Differences between natives and migrants vary in direction and intensity according to health dimension and migrant group. In Europe, migrants present lower risks of cancer, higher risks of maternal and perinatal health problems, and higher diabetes prevalence which varies between groups (Rechel et al., 2011). In France, results based on subjective health self-assessments show health inequalities related to immigration in favour of natives (Jusot et al. 2009). The heterogeneity of the results shows the complexity of the network of causalities that relates migration to health.

Several hypotheses arise from the literature on social determinants of health (Shaw et al., 1999) to explain differences between natives and migrants. The 'healthy migrant selection effect' hypothesis states that emigrants have better health status than non-emigrants in the country of origin because only those with better health status migrate. This selection effect may be offset by the migrants' economic and social situation in the country of arrival, which is most often unfavourable because of factors such as poverty, deprivation, detrimental working conditions, difficulties in gaining recognition for skills acquired abroad and discrimination in the labour market. Second, migration can cause deterioration in health status by provoking isolation through the loss of the original social network. Disruption of social network or lack of emotional support is associated with worsening of physical as well as mental health status (Stansfeld, 1999). Third, lack of knowledge about the healthcare system, imperfect mastery of the language and difficulties in communicating with healthcare professionals can all result in differing healthcare services use and less appropriate responses from the healthcare system (Balsa and McGuire, 2003). Moreover, health status can remain marked by health-care habits and lifestyles brought from the country of origin and by the economic, health or political conditions experienced before migration. A study of immigrants in France showed long-term effects of the economic and sanitary characteristics of the immigrants' countries of birth, which partially explain the heterogeneity of health status among immigrants (Jusot et al., 2009).

On the whole, while some studies focused on hypotheses linked to the country of origin (Jusot et al., 2009) and others to the country of arrival (Berchet and Jusot, 2010) to explain differences in health between immigrants and non-immigrants as well as among immigrants, no study has so far measured country effects from origin and arrival countries. Differences between countries of origin on one hand and between countries of arrival on the other hand can indicate what works and what does not in terms of policymaking directed at minorities and immigrant groups in Europe.

The literature on the health of immigrants focused mainly on their self-reported health status (Jusot et al., 2009; McDonald and Kennedy, 2004; Acevedo-Garcia et al., 2010). In our paper, we focus on overweight for three reasons. First, the number of overweight has exceeded the number of

undernourished people in the world for the first time in history (Popkin, 2008) and it is now highly prevalent in Europe and also in countries from which recent migrants originate, such as North Africa (Ng et al., 2014). Second, it is socially unequally distributed in developed as well as in developing countries. Third, it is linked with individual behaviour, such as diet and physical activity, which can be culturally specific to the country of origin and the country of arrival. According to the World Health Organization, obesity is 'an abnormal or excessive fat accumulation that may impair health' (WHO, 2012). The last two decades of the twentieth century witnessed large increases in overweight and obesity prevalence in developed countries. In France, the per centage of obese and overweight persons began to grow steadily in the 1990s, and so far, the trend has not flattened (Sassi et al., 2009). The obesity epidemic raises public health, financial sustainability of health systems, and equity issues. Overweight affects the health of populations (obesity has a direct effect on co-morbidities such as diabetes, high blood pressure and ischaemic diseases). Obesity epidemics have been associated with an increase in associated medical treatments and expenditures in developed countries (Finkelstein et al., 2009). Last but not least, overweight does not affect social groups identically. In developed countries, the condition is more prevalent among lower SES groups. In France, the epidemic is less severe than in the US but still affects three out of 10 individuals as of 2008 and presents the same unequal distribution pattern across social groups as observed in other developed countries (Expert, 2005). While in developed countries, higher socioeconomic status is often associated with lower body mass index (BMI), developing countries show the opposite gradient, overweight being more frequent among the better off. This relationship progressively reverses when a country's wealth increases (Monteiro et al., 2004).

Immigrant overweight appears to be a relevant issue for research and policymaking in countries of destination. Canadian and US studies show that newly arrived immigrants are less likely to be obese than natives. The longer they stay, the more they tend to exhibit the native overweight prevalence. African and Arab immigrants are more often obese than others, and their BMI converges more quickly and then surpasses that of natives (McDonald and Kennedy, 2005 on Canada; Antecol and Bedard, 2006 on the USA). Moreover, North African countries exhibit a high prevalence in overweight, especially among women (WHO surveys).

This study aims to complement the literature on the determinants of health in immigrants by disentangling effects that pertain to the country of origin and the country of arrival. This is made possible by comparing representative national sources from France and Spain. We first provide an overall description of immigration history and policy in France and Spain. We then describe data and display descriptive statistics on the two samples. In the next section, we present the empirical strategy and the econometric methods. We then present the results in progressive stages. We first estimate and compare in women and men the role of immigration status in overweight assessment, when controlled for age and socioeconomic status. We then measure contributions of differences in population characteristics in explaining differences between migrants and natives. We then study the length of stay (as proxied by naturalisation status).

2 Immigration history and policy in France and Spain

France and Spain largely differ regarding migration history and today show large differences in immigrant populations and minority groups. France has long been a receiving country, while Spain remained an emigration country until recently, when it became an immigration country. European mass emigration that occurred in the nineteenth century to the new world was heterogeneous across countries and time. Northern, Southern and Eastern European countries witnessed the emigration of large segments of their population. In terms of time period, Irish, British and Germans were the first to emigrate, followed by Scandinavians and finally those from Southern and Eastern European countries.

In that context, Spain was at that time an emigration country (Hatton and Williamson 2008). On the contrary, France remained at that time an immigration country, hosting European immigrants, largely from Belgium and Italy.

In the twentieth century, the nature of migrations changed dramatically in Europe. The restriction of immigration to the new world favoured intra-European migration. France remained a country of immigration, hosting mainly Southern European immigrants from Portugal, Spain, and Italy, followed by North African immigrants, and, more recently, Sub-Saharan immigrants due to pro-immigration policies. However, Spain also became in the 1980s a country of immigration, which was partly explained by the rapid economic boom and its entry into the European Union (Cornelius et al., 2004; Castles and Miller, 2009). First, a large return migration of Spanish people from Northern Europe was observed (Cornelius et al., 2004) and then a net increase of foreign immigrants in the 1990s (Bover and Vellilla 1999). From 241,971 immigrants in 1985, this number rose to 499,773 in 1995 and to 895,720 in 2000 (Cornelius et al., 2004). In 2010, the per centage of foreigners in the Spanish population was 14.3 per cent, which slightly exceeded the figure of 11.6 per cent for France (OECD, 2012).

France is the country that hosts the highest proportion of Africans among its immigrants (55 per cent), and Spain is also a top receiver with 21 per cent of immigrants coming from Africa (OECD, 2012). Both countries host large immigrant communities from North Africa, and Moroccan immigrants represent a significant part of them. According to OECD E-DIOC data (Arslan et al., 2014), in 2010, France reported 881,350 immigrants from Morocco (second largest community), and Spain reported 716,645 (largest community). Spain also receives immigrants from Eastern Europe and Latin America, whereas France also attracts other North African and Southern European immigrants (OECD, 2012; Arslan et al., 2014). Differences in immigrant populations also derive from colonial history, whereby shared language, culture, and institutions can explain the choice of destination of immigrants (Beine et al, 2011).

These differences in migration history in turn explain differences in the structures of French and Spanish immigrant populations, mostly in terms of duration of stay, age, reason for migrating, and integration within the destination countries. In France, 74 per cent of immigrants arrived more than 11 years ago, whereas the figure is 28.8 per cent in Spain (OECD, 2012). 44.3 per cent of immigrants in Spain arrived between six and 10 years ago (OECD, 2012). Therefore, as the decision to migrate tends to be at a young age, immigrants in France are older than those in Spain. 20 per cent of immigrants in France are more than 65 years old compared to only 5 per cent in Spain (OECD, 2012). Indeed, the biggest waves of immigration in France occurred after the Second World War, compared to recent immigration in Spain in the 90s. Therefore, immigrants in France have much more time to integrate compared to Spain and that should be captured by the naturalisation rate. In France, 51.3 per cent of foreign-born people had French citizenship whereas in Spain only 16 per cent had it in 2008 (OECD, 2012). Even after correcting for those who are foreign-born with French citizenship at birth, the percentage is still higher in France (35.8 per cent vs 10.3 per cent in Spain). Differences in minimum duration of regular residence (5 years in France vs. 10 years in Spain) may have also contributed to differences in naturalisation (OECD, 2011). As in France during the 50-60s, the reason for immigrating to Spain is employment for 47 per cent of immigrants (compared to only 14 per cent in France) (OECD 2012). Indeed, economic growth rendered Spain attractive and drove selection by migrants in terms of gender and age. France shows some similarities during the 50s–60s when pro-immigration policies favour the recruitment of men in healthy condition to work in the French labour market. As long as these immigrants stay in France, the likelihood of becoming a citizen and the probability of obtaining a visa for their family increase. Currently, in France, 64 per cent of immigrants have come for family

reasons (either family reunification or emigration as a child before the age of 15 years old), whereas in Spain these reasons are attributed to 40 per cent of immigrants.

3 Date and descriptive statistics

We make use of two datasets from national general population health interview surveys from France and Spain. These two surveys are representative of ordinary households.

The French 'Enquête Santé et Protection Sociale' (ESPS) dataset has been collected every two years by the Institute for Research and Information in Health Economics (IRDES) since 1988. It provides information related to health status, access to healthcare, healthcare utilisation, and individual and household demographic and socioeconomic characteristics. From 2006, a questionnaire was included, which aimed to describe immigrants. It collected the country of birth and the nationality at birth and present. Our working sample comprises the 2006, 2008 and 2010 waves, which initially represented 21,204 individuals. We excluded 677 individuals who declared being born French outside France. This group mostly comprises so-called *Pieds-Noirs* who were born in North Africa before decolonisation and immigrated to France for the most part afterward. Large segments of French-born expatriates in developed countries or French-born people born in old colonies immigrated to France after the wave of independence following the Second World War. Due to the specificity of this population group, we dropped it from our analysis to focus our attention only on foreign-born immigrants who were either a non-French citizen at birth or naturalised. Specifically, France reports 1,834 immigrants (8.95 per cent of the sample), and half of them were naturalised.

For Spain, we used the Encuesta Nacional de Salud in 2006/2007, which became a European survey in 2009. Both waves are used in our analysis and are representative of the Spanish population. Our original sample for Spain is composed of 51,666 individuals, of which 3,625 were foreign-born (873 were naturalised). In that sample, we cannot distinguish foreign-born people with Spanish citizenship at birth from those who have acquired Spanish nationality. Therefore, we make the assumption that the 873 naturalised people are viewed as people who acquired nationality. Specifically, for Spain, immigrants represent approximately 7 per cent, of which 2 per cent were naturalised.

These two countries have been chosen for the possibility of identifying immigrant country of origin. In fact, in France and Spain, questionnaires, data privacy limitations, and the encoding structure allow us to know the country of birth of those born abroad. In other European surveys such as Belgium and Italy, the number of immigrants from certain countries and the encoding of questionnaires allow us to discern the region of origin of only large immigrant populations. Because our analysis focuses on the impact of origin region characteristics on the overweight of immigrants, knowing where they come from is crucial and leads us to select surveys that take into account this type of information.

In our surveys, self-reported weight and height are available. These variables could be subject to measurement bias. In fact, it is usually common to find that the perception of weight and height deviated from objective measures. In particular, weight tends to be underestimated, whereas height is generally overestimated for both genders. In this segment of literature, some authors developed a strategy to correct this bias either by correcting the threshold of overweight and obesity (Dauphinot et al., 2009), by predicting deviations between self-reported and measured weight and height (Antecol and Bedard, 2006), or by deriving lower or upper bound obesity rates (O'Neill and Sweetman, 2013). However, these corrections do not eliminate systematic errors (Plankey et al., 1997), and strong correlation is found between measured and self-reported values (Niedhamer, 2000); empirical results in particular about social determinants of obesity are identical as either self-reported or measured BMI is used (Antecol and Bédart, 2006). Hence, we decide to consider subjective weight as itself and height

as itself to define our overweight level. We define overweight according to the BMI definition. We are aware that BMI is a partial indicator to measure overweight because it does not distinguish between bones, muscle or fat. BMI could lead to a misclassification of overweight principally for men and among specific ethnic groups (Burkhauser and Cawley, 2008). Because in our dataset no other alternative measure of overweight is available, we are forced to use self-reported height and weight to calculate overweight prevalence. BMI is calculated as the weight (in kilograms) over the height (in metres) squared[1]. Then, we used the thresholds adopted by the World Health Organization (WHO) to calculate the proportion of overweight and obesity in our sample. Thus, a BMI that exceeds 25 corresponds to overweight individuals. A BMI between 25 and 30 is called 'pre-obese' in our analysis, whereas a BMI over 30 is considered 'obese'. These WHO-calculated thresholds are considered those where 'an abnormal or excessive fat accumulation … may impair health' (WHO, 2012). Even if the health effect of overweight and obesity are extremely controversial (Flegal et al., 2005, 2013; Campos et al., 2006; Sims, 2001, Willet et al., 2013) some large pooling studies found strong evidences of health risk, in terms of cardiovascular disease (which is one of the most important cause of death for overweight individuals), cancer, diabetes, osteoarthritis, and chronic kidney diseases when the BMI exceed 23 kg/m2 (Whitlock et al., 2009; Ni Mhurchu et al., 2004; Wormser et al., 2011; Renehan et al., 2008). Therefore, our study focuses on the probability of being overweight because this threshold suggests the start of medical complications.

Overweight is a biological imbalance between calorie intake and expenditure. We try to find information on the quantity and the quality of food/calorie intake such as the consumption of daily vegetables and fruits and sugar, as well as the reported physical activity. However, this type of information is not available in our survey waves, and it is generally poorly reported or misreported. The overweight process is also related to economic aspects such as social gradients, which we need to investigate more deeply. Hence, our main explanatory variables essentially included demographic and socioeconomic factors as determinants of immigrant health status.

The distribution of BMI reveals some cases of outliers. To minimise this bias in our estimation, we dropped individuals with a BMI below 10 and individuals with a BMI higher than 50, which represent a very small number in our sample[2].

Specifically, given missing values, non-responses in some questions and the restrictions adopted for our analysis, our pooled sample includes 53,584 individuals representative for France (15,384) and Spain (38,200) for a period between 2006 and 2010. Among them, 4,844 (9 per cent) are immigrants; 3,357 (6.3 per cent of our sample) have a foreign citizenship; and 1,487 (2.8 per cent of our sample) are naturalised.

Table 1 reports summary statistics about the per centage of at least overweight (BMI over 25) and obese (BMI over 30) according to the socio-demographic factors previously described. The table is divided into two parts: women and men. Some salient facts can be extracted from this table. First, in general, natives seem to be at least more overweight than foreigners but equally overweight or less than naturalised immigrants. For example, 40.9 (60.4) per cent of women (male) natives are at least overweight, and only 39.7 (54.6) per cent of immigrants are, but the figure is 42.5 (58.3) per cent for naturalised immigrants. However, the situations in France and Spain are quite different. In France, immigrants are at least more overweight than natives, whereas in Spain the opposite is the case

[1] Because in both surveys height is expressed in centimetres, we multiply the BMI by 10,000 to obtain the usual BMI classification.

[2] 16 individuals in France and 22 in Spain, which represent 0.1 per cent and 0.05 per cent, respectively, of the original samples.

regardless of the gender of the individuals. This difference is because immigrant BMI in Spain is less important compared to immigrant BMI in France. However, comparing the BMI of native people across France and Spain shows that the BMI of Spanish people is always higher compared to French people. Therefore, the 'healthy immigrant effect' could be due to the better health of immigrants, but it could reflect as well a reference (BMI of natives) that could be different across countries. Second, disparities exist according to the country of origin of immigrants. For females, North African and Sub-Saharan

African immigrants are at least more overweight and obese, whereas for males, only European and American immigrants are in this case. Third, a social gradient exists for immigrants as for natives. The higher the educational level, the lower is the per centage of overweight/obesity. It is striking that natives are initially more obese than immigrants when the level of education is low. However, when natives reach tertiary education, they are less obese than immigrants. Fourth, the BMI increases with age, which is also confirmed among immigrants. Fifth, higher socioeconomic status and occupation is associated with lower overweight and obesity prevalence. However, no 'immigrant' evidence can be found about these variables.

Table 1: Overweight and obesity by demographic and socioeconomic factors and immigration status (pooled data)
Authors' computations

	Women						Men					
	% overweight + obese (BMI>25)			% obese (BMI>30)			% overweight + obese (BMI>25)			% obese(BMI>30)		
		Immigrants			Immigrants			Immigrants			Immigrants	
	Native	Foreigners	Naturalised	Native	Foreigners	Naturalised	Native	Foreigners	Naturalised	Native	Foreigners	Naturalised
All	40.9	39.7	42.5	13.5	11.9	15.4	60.4	54.6	58.3	16.1	13.6	15.5
France	36	44	47.5	13.1	16.3	18.5	51.2	57.3	53.5	12.7	16.5	12.8
Spain	43.2	38.6	39.2	13.6	10.8	13.3	63.7	54	62.3	17.3	12.9	17.8
Maghreb		47.8	56.6		14.3	23.5		48.7	54.5		11.9	17.9
Sub-Saharan Africa		48.9	46.7		20.7	20		45.8	55.3		9.6	8.5
Europe		35.3	39.6		10.3	11.4		57.2	67		16.8	16.8
Asia		31.3	35.8		12	13.2		51.2	46.4		4.9	7.1
America		41.3	38.1		11.7	14.9		57.1	57.8		13.4	16.9
Primary/No diploma	60.3	50.6	61.9	22.1	17.7	26.1	70.5	56.7	64.4	23.4	17	15.3
Secondary	36.8	37.4	40.6	11.6	11.3	13.8	57.7	53.7	60.4	14.5	11.9	17.1
Tertiary	25.2	34.5	33.3	6.4	7.9	11.2	53.7	53.8	51.3	10.8	12.7	13.2

Age 18–30	21.6	28.5	29.8	6.2	5.8	8.3	33.2	37.6	39.7	6.6	5.4	10.3
Age 30–40	29.5	35.2	38.6	9.2	8.5	14.5	54.5	53.4	56	12.3	13.1	14.2
Age 40–50	35.7	46	40.6	11	17.5	14.4	63.4	63.3	55.6	15.9	17.1	16.1
Age 50–60	50.1	53.7	50.3	17.5	21.5	18.1	69.2	65.7	66.9	20.8	16	14.7
Age 60–70	60	63.5	48.9	20.5	20.2	22.7	72.9	67.7	62.9	22.8	26	17.7
Age 70–75	63.8	79.3	61.9	22.3	31	16.7	72.2	68	84	20.2	22	32
Executive	23.4	14.6	22.2	5.9	4.9	8.9	54.3	46.6	60.3	10.7	12.1	12.1
Employee	37.5	42.5	46	12.6	13.1	18.4	59.1	55.9	38.5	13.4	10.8	13.5
Manual worker	47.8	43.4	51.9	17.3	18.9	19.5	59.5	51.8	58.9	16.6	13.6	15.1
Actives	33.3	37.6	38.6	10.1	10.8	13.3	58.3	54.6	57.1	14.6	12.5	14.8
Inactive	53	44.9	51.9	18.7	14.6	20.4	66	55	64.2	20.2	20.8	18.9

4 Empirical model and methodology

Our empirical model could be considered as the following:

$$(\text{Overweight})i = \beta 0 + \beta 1 * (\text{demographics})i + \beta 2 * (\text{socioeconomics})i + \beta 3 * (\text{immigrant status})i + \beta 4 * (\text{characteristics of origin country})o + \text{time dummies} + \varepsilon i$$

The dependent variable is defined as a dummy variable equal to 1 if an individual's BMI is higher than 25. This category embodies people that are overweight and obese as previously explained. In demographic variables, age and gender are principally investigated. First, age is included with a reference group of 18- to 30-year-old individuals (we restrict our analysis to people ranging from 18 years old to 75 years old). Then, age classification is encoded as 30–40, 40–50, 50–60, 60–70 and 70–75 years old. Second, analysis on the health of immigrants (self-reported health status or obesity) highlights the disparities between women and men (Jusot et al., 2009; Khlat et al., 1998; Khlat and Courbage, 1995). Thus, we follow this literature by providing a separate analysis between genders in our estimation.

The inclusion of economic and social determinants follows the literature on social determinants of health (Marmot and Wilkinson, 1999; Dunn and Dyck, 2000). Beyond age and gender, socioeconomic and cultural factors are much more powerful in explaining the health status of individuals than medical factors. In terms of socioeconomic factors, three main factors are addressed: education, socio-economic status and occupation. First, education is split into three categories: tertiary skilled, secondary skilled and primary skilled/no diploma (as reference). While constructing this indicator, we faced the problem of the comparability of questions within and between countries. In the appendix, Table A.1 addresses this issue. Second, the socio-economic status embodies four categories: executives, employees, manual workers (as reference) and others. Third, the level of occupation refers to the participation in the labour market (active versus inactive). Hence, this variable is divided into six categories: at work (as reference), unemployed, student, retired, housewife, and others. The level of income is difficult to include in our analysis for two reasons: first, the number of missing values for this question is relatively high, which could induce selection bias in our estimation. Second, the ranges of income level suggested in answer to this question are significantly different within and between countries. For these reasons, the level of income is not included in the analysis; however, the inclusion of socioeconomic and demographic variables captures partly and indirectly income distribution and the social classification across individuals. Moreover, these variables should capture much more permanent income rather than temporary income, which is more volatile.

We included, as an additional explanatory variable, the marital status split into single (as reference), married, divorced and others. In the same vein, variables related to the household structure, their type and the number of members, could not be included in the estimation because, in Spain, these questions are not systematically asked.

Our variable of interest is immigration status. Thus, we define immigrants as individuals born in a foreign country but living either in France or in Spain. In the case of France, because we excluded the Pieds-Noirs from our estimation, immigrants are more precisely foreign-born and non-citizen residents.

The methodology that we adopted in this paper is a 'probit' model. Thus, we estimate a probabilistic model for analysing the probability of being overweight (as assessed from BMI measurement) that accounts for demographics, socioeconomic situation and immigration status by gender. The model enables the ability to describe the role of immigration as a social determinant of

overweight and to measure social gradients within immigrant and non-immigrant subpopulations regarding overweight, all of which are from different host countries in Europe.

In the second part of the analysis, our goal is to explain the reasons for which there is a specific occurrence of overweight for immigrants. This effect could be driven either by the fact that immigrant characteristics are not the same as those of natives or by the fact that effects on overweight are different among immigrants and natives or by both effects together. This distinction has been treated in the Oaxaca and Blinder decomposition (1973), whereby the previous model could be written as the following:

First, divide the sample into two parts: natives versus immigrants

Natives: $\overline{obesity^n} = \beta^n \overline{X^n}$, (1)

where indices n represent natives

Immigrants: $\overline{obesity^i} = \beta^i \overline{X^i}$, (2)

where indices i correspond to immigrants.

The decomposition consists of differencing the two previous equations:

$$\overline{(obesity^n} - \overline{obesity^i}) = \beta^n \overline{X^n} - \beta^i \overline{X^i}, \quad (3)$$

This can be expressed as:

$$\overline{(obesity^n} - \overline{obesity^i}) = [(\overline{X^n} - \overline{X^i})\beta^n] + [(\beta^n - \beta^i)\,\overline{X^i}] \quad (4)$$

$$\overline{(obesity^n} - \overline{obesity^i}) = [diff\ characteristics] + [diff\ coefficients] \quad (5)$$

As explained previously, the difference in overweight between immigrants and natives can be decomposed by the first bracket devoted to differences in characteristics (age, gender, education, SES) between immigrants and natives. The second bracket is related to differences in coefficients, meaning that two individuals with the same characteristics observe different impacts of explanatory variables on overweight. This part of the decomposition is often called the 'unexplained' difference, indicating that which is excluded from the objective characteristics; differences in overweight are still observed, which confirm inequality in health between population sub-groups.

Our dependent variable is a dummy variable capturing at least the overweight prevalence. Thus, the linear decomposition of Oaxaca–Blinder is not properly adequate in that case, and here, we adopt an extension of that model developed by Fairlie (1999, 2005). In that technique, the use of a discrete variable as a dependent variable is possible and sometimes converges with the Oaxaca–Blinder results (Fairlie, 2005). Thus, our model could be transformed as a probability of being at least overweight as:

$$(obesity^n - obesity^i) = \left[\sum_{N=1}^{N=N^n} \frac{F(\beta^n.X^n)}{N^n} - \sum_{N=1}^{N=N^i} \frac{F(\beta^n.X^i)}{N^i}\right] + \left[\sum_{N=1}^{N=N^i} \frac{F(\beta^n.X^i)}{N^i} - \sum_{N=1}^{N=N^i} \frac{F(\beta^i.X^i)}{N^i}\right] (6)$$

where N corresponds to the size of the sample and Ni and Nn correspond to the sample size of immigrants and natives, respectively. As previously, the first bracket is devoted to explaining the difference in overweight explained by difference in characteristics, whereas the second bracket is linked to unexplained differences, meaning the differences in coefficients principally. The detailed Fairlie decomposition permits us to associate the relative contribution of each independent variable to the

overall decomposition between immigrant and native groups. Thus, for simplicity and considering that the size of the immigrant and native sample is the same (N = Ni = Nn), we can consider that the contribution of X explanatory variables between the two groups is:

$$\frac{1}{N}\sum_{N=1}^{N=N} F(\hat{\alpha}+\hat{\beta}.\overline{X^n}) - F(\hat{\alpha}+\hat{\beta}.\overline{X^i})$$

Thus, the contribution of X to the difference of overweight is attributed to the change in the probability of being at least overweight if we substitute immigrant distribution (Xi) with native distribution (Xn), all things being equal elsewhere. Thus, the interpretation of results is given in the case in which the characteristics of natives and immigrants are exactly the same. The contribution of X could be interpreted as the change in immigrant overweight probability if immigrants and natives are similar in terms of characteristics. In that paper, we first reported the results developed by Fairlie (1999), and then compared them with the linear decomposition of Oaxaca–Blinder to check the part of the model attributed to coefficient difference. We compare the difference in overweight prevalence between natives and immigrants in France and Spain separately.

In the third part of this analysis, we investigate heterogeneity among immigrants. Thus, we will distinguish between non-citizen residents and naturalised immigrants (French or Spanish citizenship at the time of the survey). As previously mentioned, information about the country of birth of immigrants is now available. It allowed us to distinguish between immigrants from North-Africa, Sub-Saharan Africa, Europe, Asia and America. We highlight the importance of origin country characteristics in the evolution of individual BMI in their host country. Thus, we included as additional explanatory variables two variables: the Human Development Index (HDI) and the obesity prevalence rate already applicable in the origin country of immigrants. Our study is a microeconomic analysis at the individual level; however, the inclusion of these two last variables is performed at the country level. Thus, our analysis appears to be a multi-level analysis in the sense that, in a simple equation, a different level of study (individual and origin country level) is present. However, our analysis differs from a 'pure' multi-level analysis because our model does not include a second equation explaining, for example, the HDI at the origin level. In that case, the repetition of origin-country variables over all individuals coming from the same country could bias standard errors. One way to correct this potential bias is by clustering the standard errors by origin country/region when our analysis is based on the importance of origin factors. Thus, in fine, our analysis consists of a clustered probit study of origin region.

5 Results

In this section, empirical results are presented in three parts. First, we begin our analysis by investigating the role of immigration status in the probability of being overweight. The results are provided in Table 1 and Table 2. Then, we take advantage of information about the country of origin to disentangle the importance of origin from the probability of being overweight. Table 3 reports these results, and Table 4 presents a distinction within immigration status (foreigners versus naturalised). Finally, we finish our analysis by estimating the characteristics of origin countries that could affect the probability of being overweight for immigrants in particular. Two variables are investigated, including, first, the HDI that takes into account income but also the human capital index linked to education and health and, second, the level of obesity in origin country, which could be associated with food habits for immigrants and could drive their BMI at the top; Tables 5 and 6 present these results, respectively.

5.1 Immigrant effects

We analyse the impact of being an immigrant (Table 2) and the status of immigration (Table 3) on the probability of having a BMI over 25 by controlling for other explanatory variables. In our tables, the two first columns are devoted to France and the two last columns to Spain. Because gender specification is important in this type of analysis, we estimate our model separately for men (Columns 1 and 3) and women (Columns 2 and 4). In Table 2, we can describe the results as follows:

First, the probability of being overweight is influenced by the fact of being an immigrant, all things being equal. However, this effect varies with gender and among host countries. Regarding overweight prevalence in France, immigrant men are not significantly different from natives (Column 1); immigrant women are however much more overweight than natives (Column 2). The positive coefficient associated with the immigrant women effect is 0.239 and significant at the 1 per cent level. In terms of marginal effect, it means that immigrant women established in France have a 9.12 per cent greater likelihood of being overweight compared to French natives. This result is confirmed in the case of Spain (Column 4), where the positive coefficient drops to 0.09, which corresponds to a marginal value of 3.37 per cent. The difference between France and Spain is concerning the case of immigrant men, particularly in Spain (Column 3). For Spain, a significantly negative coefficient is associated with immigrant men (-0.110), whereas no significant effect is associated in the case of France. Thus, immigrant men in Spain tend to be less overweight than natives. In terms of elasticity, an immigrant man in Spain tends to be approximately -4.2 per cent less overweight than a man born in Spain. The difference of immigration history between France and Spain explains that this effect is country-specific for Spain. Indeed, the relatively recent migration history for Spain in the 1980–90s, compared to France, explains that immigrants in Spain are settled recently where the most important waves of immigration occurred the 1950–60s. Therefore, the selection effect which is much more visible for newly-arrived immigrants is identified in Spain whereas in France, the integration process is probably already at work. This effect is also gender-specific because it affects only men and not women in Spain. This is also explained by a historical reason because European migration is often linked to labour migration, i.e migration for an employment purpose. Because these jobs were manually intensive, men were preferred over women. Thus, employed men were selected for their good health whereas women entered Spain later though family reunification policies that did not imply any selection. It is for these reasons that we can identify a 'healthy immigrant effect' only for men and only in Spain.

As developed previously, the implicit selective immigration process that includes reason for entry, individual ability, and immigrant history, could be some contributory explanatory factors. Immigration policies, such as family reunification and integration into the labour market could be the main reasons for gender difference in overweight.

Second, age represents an important predictor of the BMI regardless of gender or host country. Hence, the likelihood of being 'overweight' or 'obese' increases as people become older. The coefficient associated with age increases gradually from 30 to 70 years old (with one exception for Spanish women between 30 and 40 years old). After the threshold of 70, the magnitude of the estimator becomes less important because of the occurrence of chronic disease that could affect the BMI in the elderly.

Third, as previously shown in descriptive statistics, the level of education is one of the most important socioeconomic factors that affect overweight prevalence. Compared to unskilled or primary skilled people (reference situation), higher education is linked to a lower prevalence of overweight, all things being equal. Here again, a gradual magnitude could be observed between secondary and tertiary education. A tertiary-educated person is undoubtedly less overweight than a secondary-educated person who, in turn, is less overweight than a primary-educated person. This result confirms the hypothesis of

'social gradient'. A result generally considered to reflect differences in physical activity, nutrition habits and awareness about consequence of risky behaviour (alcohol, smoking).

Fourth, marital status could influence the overweight prevalence. We find evidence that being single is associated with being less overweight than other situations. Being married or divorced or separated (others) is in general linked to a BMI over 25.

Fifth, the socioeconomic status impacts the likelihood of being overweight in the sense that being an executive is linked to being more physically fit than a manual worker, in particular for women.

Sixth, concerning occupation, students are in general less overweight than people in the workforce. However, being retired is associated with a higher likelihood of overweight prevalence. Women seem to be much more affected in the sense that housewives are positively and significantly correlated with a higher prevalence of being overweight.

Table 2: Probit estimation of overweight and obesity prevalence for immigrants versus natives

	MEN	WOMEN	MEN	WOMEN
	France	France	Spain	Spain
Natives	REF	REF	REF	REF
	REF	REF	REF	REF
Immigrants	0.0755	0.239***	-0.110***	0.0859***
	(0.0572)	(0.0507)	(0.0345)	(0.0315)
Age [18–30]	REF	REF	REF	REF
	REF	REF	REF	REF
Age [30–40]	0.194***	0.0586	0.238***	-0.0798**
	(0.0578)	(0.0472)	(0.0332)	(0.0312)
Age [40–50]	0.373***	0.0885*	0.406***	0.0475
	(0.0578)	(0.0475)	(0.0340)	(0.0308)
Age [60–70]	0.547***	0.250***	0.504***	0.316***
	(0.0581)	(0.0482)	(0.0367)	(0.0320)
Age [70–75]	0.375***	0.0683	0.329***	0.352***
	(0.0621)	(0.0530)	(0.0380)	(0.0337)
No diploma/Primary education	REF	REF	REF	REF
	REF	REF	REF	REF
Secondary education	-0.142***	-0.320***	-0.123***	-0.361***
	(0.0477)	(0.0378)	(0.0252)	(0.0230)

Tertiary education	-0.385***	-0.585***	-0.207***	-0.548***
	(0.0579)	(0.0475)	(0.0290)	(0.0276)
Single	REF	REF	REF	REF
	REF	REF	REF	REF
Married	0.258***	0.191***	0.316***	0.222***
	(0.0490)	(0.0459)	(0.0242)	(0.0260)
Divorced	-0.00603	0.142**	0.0403	0.102**
	(0.0729)	(0.0590)	(0.0464)	(0.0398)
Others	0.264***	0.223***	0.294***	0.369***
	(0.0566)	(0.0505)	(0.0725)	(0.0424)
Manual worker	REF	REF	REF	REF
	REF	REF	REF	REF
Executive	-0.00468	-0.133**	0.0338	-0.116***
	(0.0509)	(0.0556)	(0.0385)	(0.0445)
Employee	0.0301	0.0244	0.0295	0.00595
	(0.0601)	(0.0318)	(0.0315)	(0.0282)
Others	0.121**	0.0312	0.0748***	0.106***
	(0.0528)	(0.0537)	(0.0264)	(0.0280)
At work	REF	REF	REF	REF
	REF	REF	REF	REF
Unemployed	-0.0616	0.129**	-0.0640*	0.0369
	(0.0611)	(0.0509)	(0.0365)	(0.0345)
Student	-0.541***	-0.380***	-0.521***	-0.506***
	(0.164)	(0.143)	(0.0616)	(0.0669)
Retired	0.504***	0.372***	0.280***	0.308***
	(0.0618)	(0.0523)	(0.0351)	(0.0382)
Housewife	-0.141	0.182***	0.224	0.133***
	(0.204)	(0.0506)	(0.209)	(0.0273)
Others	0.114	0.237**	-0.0281	0.203***
	(0.0984)	(0.0923)	(0.0687)	(0.0717)

Time dummies	YES	YES	YES	YES
Constant	-0.355***	-0.368***	-0.0765**	-0.292***
	(0.0701)	(0.0659)	(0.0389)	(0.0390)
Observations	6198	9186	17220	20980

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5.2 Fairlie and Oaxaca–Blinder decomposition

The immigrant effect found previously could be explained either by differences in characteristics of individuals or by differences in coefficients between immigrants and natives. On one hand, the effect could be driven by the fact that immigrants and natives do not have the same characteristics. In that sense, it means that if immigrant characteristics are relatively similar to those of natives, the level of overweight prevalence becomes identical between the two groups, all things being equal elsewhere. On the other hand, the previous effect could be due to differences in coefficients, meaning that, if we consider two individuals with the same characteristics, except that one is immigrant and the other is native, we could observe differences in terms of overweight because each explanatory variable does not have the same effect according to the group to which that individual belongs (immigrants vs natives). This difference in the literature of labour economics is often attributed to discrimination; however, in our case, this effect could be attributed to the selection effect, to genetic factors, or to pre-determined factors that are involved in the origin country. Table 3 reports the results with non-linear (Fairlie) and linear decomposition (Oaxaca–Blinder) with country and gender distinction. In the first part of the table, we present the probability of being at least overweight for immigrants and natives with their respective sample size and the difference between both likelihoods. In the second part of the table, we explain the overall difference in overweight probability by either differences in endowments, differences in coefficients, or both[3]. In the case of women in France (Column 1 and 2), 36 per cent of natives are likely to be at least overweight, whereas for immigrants this probability jumps to 46 per cent. The difference between these two probabilities is negative (-0.098), meaning that, on average, natives are less overweight than immigrants. Endowment differences explained only approximately 10 per cent of the overall difference in overweight difference between immigrants and natives. In other words, most of the difference (approximately 90 per cent) is explained by other elements related to coefficient difference or interaction. In the case of men in France (Columns 3 and 4), few significant differences could be observed between immigrants and natives, which explains the 'no immigrant male effect' previously found in the probit results (Table 2) for France. In the case of Spain, the probability of being at least overweight is higher for natives compared to immigrants regardless of gender. Therefore, the likelihood of overweight difference is always significant and positive. The probability of being at least overweight for native women (men) is 43 per cent (64 per cent), whereas for immigrant women (men), it is 39 per cent (56 per cent). Contrary to the case of France, endowment differences represent a larger positive part of this difference. However, because of the negative difference, increasing endowments of

[3] In the Fairlie decomposition, only endowment differences could be identified. Thus, (1 per cent explained by endowment) = unexplained part. In the Oaxaca-Blinder decomposition, the unexplained part could be distinguished between coefficient differences or interactions. Therefore, this part is completed only in linear decomposition.

immigrants should increase their likelihood of weight gain. For women, the per centage is between 167 and 150 per cent; this means that if female immigrant characteristics become identical to natives, the probability of being at least overweight for immigrants becomes higher than for the case of natives. From the Oaxaca–Blinder decomposition, the probability becomes 0.0665 + 0.388 = 0.4545. Difference in coefficients exists and, even if their magnitude never surpasses endowment differences, their magnitude is significant and negative. In other words, for women in Spain, a reduction in immigrant overweight probability should be obtained by reducing the coefficient difference between immigrants and natives. The picture is a bit different for men, for whom the overall difference in overweight probability is equally explained by endowments and coefficients, and both differences are significantly positive.

In terms of policy intervention, the distinction between endowments and coefficient is particularly fruitful. In general, differences in overweight probability between immigrants and natives could be reduced by endowing to immigrants the same characteristics as natives. This effect never applies in our country case because the endowment difference is either not significantly small (France) or it is significantly negative (Spain), i.e., immigrants in Spain should achieve the higher BMIs of natives. Policy consisting of equalising the characteristics of immigrants in our case should produce either a small reduction in the immigrant overweight prevalence in France or an increase in the immigrant overweight prevalence in Spain.

The second policy advocated is much more related to differences in coefficients. Thus, equalising characteristics between immigrants and natives is not sufficient to reduce overweight, but it is much more effective to focus policy on immigrants because they have a predisposition to be more overweight than natives. For instance, an obesity prevention campaign should target to a much greater extent immigrants who are, everything being equal compared to natives, more likely to be affected by an obesity epidemic. This type of policy should be much more efficient in reducing inequality in health between cultural groups. In the case of France, this policy should have the largest effect because it can reduce 90 per cent of the difference in overweight prevalence between immigrants and natives. For Spain, this policy is more mitigated because its effect is smaller than the policy related to endowment equality. Overweight is much more of a public health issue not only for immigrants but for Spanish people in general. Perhaps the cultural food habits specific to Spain should attract policymaker interventions.

Table 3: Comparison between Fairlie and Oaxaca–Blinder Decomposition on the probability of being at least overweight

	France					Spain			
	Women		Men			Women		Men	
	Fairlie	Oaxaca–Blinder	Fairlie	Oaxaca–Blinder		Fairlie	Oaxaca–Blinder	Fairlie	Oaxaca–Blinder
Pr(Natives)	0,36	0,36***	0,512	0,512***		0,432	0,432***	0,637	0,637***
Natives	8487	8487	5616	5616		18994	18994	15643	15643
Pr(Immigrants)	0,458	0,458***	0,555	0,555***		0,388	0,388***	0,557	0,557***
Immigrants	699	699	582	582		1986	1986	1577	1577
Difference	-0,098	-0,0980***	-0,0429	-0,0429*		0,0439	0,0439***	0,0794	0,0794***
Endowments	-0,00917	-0,0127	-0,016	-0,00485		0,0733	0,0665***	0,0399	0,0273***
% Endow in Diff	9,36	12,96	37,30	11,31		166,97	151,48	50,25	34,38
Coefficients		-0.0880***		-0.0272			-0,0279**		0,0394***
% Coeff in Diff		89,80		63,40			-63,55		49,62
Interaction		0.00275		-0.0109			0,00527		0,0128
% Inter in Diff		-2,81		25,41			12,00		16,12

Table 4 reports the detailed Fairlie decomposition with the contribution of each explanatory variable to the overweight gap between immigrants and natives. For France, the difference for women is attributed much more to education, family and socioeconomic status. Applying the same education level of natives to immigrants should explain a decrease in the difference in overweight prevalence to -168 per cent. This means that education should reduce the probability of being at least overweight for immigrants on a level that is lower than those for natives. This effect is counterbalanced by the adjustment in retired people between immigrants and natives, which increases the overweight of immigrants to +145 per cent. Even if the overall endowment difference is not statistically significant for men (Table 3), age, education and socioeconomic status play a role individually. For Spain, contrary to what we find for France, individual characteristics have generally positive effects. This is true for age, education, family and socioeconomic status. The interpretation is completely different from the case of France. Because natives in Spain have a greater propensity than immigrants for being at least overweight, the positive coefficient associated with individual characteristics means that if immigrants have the same endowments as natives, the probability of immigrants becoming at least overweight increases and converges to those of natives. The most important characteristics are education and age. In other words, if immigrants have the same age and education level as natives, the gap between immigrants and natives in terms of overweight should be reduced to 70 per cent due to an increase solely in immigrant overweight probability. This means that Spanish people are much more overweight than immigrants if age and education are similar between these two groups. The same interpretation could be made for men in Spain with exceptions for some age and socioeconomic variables.

Table 4: Explanatory variable contribution to Fairlie decomposition for probability of being overweight

	France		France		Spain		Spain	
	Women		Men		Women		Men	
Diff	-0,098	-0,098	-0,0429	-0,0429	0,0439	0,0439	0,0794	0,0794
Expl	-0,00914	-0,00914	-0,016	-0,016	0,0733	0,0733	0,0399	0,0399
Variables	Coefficients	%	Coefficients	%	Coefficients	%	Coefficients	%
Age [30–40]	-0,00204	0,22319475	-0,000642	0,040125	0,00405***	0,05525239	-0,00900***	-0,22556391
	(-0,00151)		(-0,000465)		(-0,0013)		(-0,00135)	
Age [40–50]	-0,000593	0,06487965	-5,15E-05	0,00321875	-9,35E-06	-0,00012756	-0,000955*	-0,02393484
	(-0,000454)		(-0,00038)		(-0,000131)		(-0,000542)	
Age [60–70]	0,00146***	-0,15973742	-0,0117***	0,73125	0,0101***	0,1377899	0,0138***	0,34586466
	(-0,000403)		(-0,00145)		(-0,0012)		(-0,00113)	
Age [70–80]	0,000851	-0,09310722	0,00314***	-0,19625	0,0112***	0,15279673	0,0107***	0,26817043
	(-0,00072)		(-0,00069)		(-0,00119)		(-0,00125)	
Secondary education	-0,00969***	1,06017505	-0,00567***	0,354375	0,0229***	0,31241473	0,00601***	0,15062657
	(-0,00139)		(-0,00203)		(-0,00156)		(-0,00112)	

Tertiary education	-0,00567***	0,62035011	-0,00824***	0,515	0,00448***	0,06111869	-0,00195***	-0,04887218
	(-0,000829)		(-0,00142)		(-0,000531)		(-0,00029)	
Married	-0,00353***	0,38621444	-0,00885***	0,553125	0,00518***	0,07066849	0,00607***	0,15213033
	(-0,000973)		(-0,00183)		(-0,000716)		(-0,000523)	
Divorced	-0,00155*	0,16958425	-1,55E-05	0,00096875	-0,000916*	-0,01249659	-4,46E-05	-0,00111779
	(-0,000847)		(-0,000506)		(-0,000512)		(-0,000149)	
Others	0,00667***	-0,7297593	0,00485***	-0,303125	0,00692***	0,09440655	0,00137***	0,03433584
	(-0,00166)		(-0,00118)		(-0,00085)		(-0,000369)	
Executive	-0,00071	0,07768053	-0,000538	0,033625	-0,000746*	-0,01017735	0,000339	0,00849624
	(-0,000455)		(-0,00141)		(-0,00041)		(-0,000522)	
Employee	-1,55E-05	0,00169584	-6,85E-05	0,00428125	-0,0001	-0,00136426	0,000205	0,00513784
	(-0,000214)		(-0,000332)		(-0,000379)		(-0,000431)	
Others	-0,000205	0,02242888	0,00029	-0,018125	0,000435**	0,00593452	-0,00114*	-0,02857143
	(-0,000497)		(-0,000271)		(-0,000188)		(-0,000647)	
Unemployed	-0,00233**	0,25492341	0,00227	-0,141875	-0,000299	-0,00407913	0,00265**	0,06641604
	(-0,000954)		(-0,00208)		(-0,000382)		(-0,00124)	

Student	0,000285	-0,03118162	0,00146***	-0,09125	-0,00113***	-0,0154161	-0,00200***	-0,05012531
	(-0,000294)		(-0,000394)		(-0,000149)		(-0,000264)	
Retired	0,0133***	-1,45514223	0,00968***	-0,605	0,00905***	0,12346521	0,0132***	0,33082707
	(-0,00191)		(-0,0014)		(-0,00121)		(-0,0017)	
Housewife	-0,00431***	0,47155361	-0,00011	0,006875	0,00233***	0,03178718	-1,18E-05	-0,00029574
	(-0,00132)		(-0,000879)		(-0,000505)		(-0,0000882)	
Others	-0,000694**	0,07592998	-0,0011	0,06875	0,000224**	0,00305593	-0,000107	-0,0026817
	(-0,000339)		(-0,000727)		(-0,000113)		(-0,000283)	
Observations	9186	9186	6198	6198	20980	20980	17220	17220

5.3 Heterogeneity among immigrants

5.3.1 The importance of duration of stay

The experience of being an immigrant is vast and encompasses different realities. Thus, we try to deepen our analysis by distinguishing those who are naturalised from those who are not. The question of nationality asked at the moment of the survey helps us to disentangle this issue. We called 'foreigners' immigrants who are not naturalised as opposed to those who are 'naturalised' and obtaining the nationality of the country in which they are living (France or Spain). Questions regarding the date of arrival in the territory and the number of years spent in the host country were included because emigration was not a subject that was addressed in our questionnaire. This information is important in the literature to capture the long-lasting process in terms of BMI evolution after emigration. With these data, the literature could investigate whether the migration selection persists or disappears as immigrants stay in the host countries (Antecol and Bedard, 2003; McDonald and Kennedy, 2005). As no information about the time spent in the host country by immigrants was available in our analysis, we create a proxy of duration to distinguish long-established immigrants from recently arrived immigrants by using their nationality. Naturalisation should be viewed as an integration process that should play a role in BMI evolution through the acculturation effect (Jusot et al., 2009; Safi, 2006). Therefore, naturalised immigrants may reveal that they settled in a host country a long time ago. In terms of BMI, we expected that naturalised immigrants are now less affected by the migration selection, and their overweight prevalence should be at the same level or exceed that of natives due to the integration process linked to the number of years spent in the host territory. In comparison to recently arrived immigrants, we should also expect a higher magnitude of the coefficient for those who are naturalised than for foreigners, which would mean that overweight prevalence affects long-established immigrants more than newer immigrants.

Table 5 reports the results and adopts the same structure as before. So, in France (Columns 1 and 2), only immigrant women are much more overweight, which confirms our previous results. This distinction between foreigners and naturalised immigrants shows that both coefficients are statistically positive and significant at the 1 per cent level, all things being equal (Column 2). However, the magnitude is lower among foreigners (0.193) than among naturalised immigrants (0.281). In other words, foreign women are more overweight than natives but less overweight than naturalised immigrants. Transforming these coefficients into marginal values, we obtained that foreign women have a 7.4 per cent greater likelihood of being overweight, whereas for naturalised women, the number jumps to 10.9 per cent. We could attribute this greater effect to the integration process and maybe to living conditions, food habits and behaviour since their emigration. In Spain, the situation is somewhat different. Distinguishing immigration status has put emphasis only on the coefficients regarding foreigners, which are statistically significant. Foreign men are less likely to be overweight (Column 3), whereas foreign women are more likely to be overweight (Column 4). The negative effect for men could be associated with the hypothesis of migration selection for newly arrived immigrants. The coefficient for naturalised men is positive but not significant, which could suggest that the "healthy migrant effects" may be at work. In terms of elasticity, foreign men tend to be less overweight by approximately -5.4 per cent, whereas women are more likely to be overweight by +3.5 per cent.

Table 5: Probit estimation of overweight and obesity prevalence for immigrant status

	MEN	WOMEN	MEN	WOMEN
	France	France	Spain	Spain
Natives	REF	REF	REF	REF
	REF	REF	REF	REF
Foreigners	0.117	0.193***	-0.141***	0.0906**
	(0.0775)	(0.0708)	(0.0383)	(0.0362)
Naturalised	0.0303	0.281***	0.00487	0.0733
	(0.0798)	(0.0692)	(0.0727)	(0.0584)
Age [18–30]	REF	REF	REF	REF
	REF	REF	REF	REF
Age [30–40]	0.193***	0.0586	0.237***	-0.0796**
	(0.0578)	(0.0472)	(0.0332)	(0.0312)
Age [40–50]	0.373***	0.0877*	0.403***	0.0480
	(0.0578)	(0.0475)	(0.0340)	(0.0309)
Age [60–70]	0.548***	0.249***	0.501***	0.317***
	(0.0582)	(0.0482)	(0.0368)	(0.0320)
Age [70–75]	0.376***	0.0683	0.327***	0.352***
	(0.0621)	(0.0530)	(0.0380)	(0.0338)
No diploma/Primary education	REF	REF	REF	REF
	REF	REF	REF	REF
Secondary education	-0.139***	-0.321***	-0.123***	-0.361***
	(0.0479)	(0.0379)	(0.0252)	(0.0230)
Tertiary education	-0.381***	-0.587***	-0.208***	-0.548***
	(0.0581)	(0.0475)	(0.0290)	(0.0276)
Single	REF	REF	REF	REF
	REF	REF	REF	REF
Married	0.259***	0.190***	0.316***	0.223***
	(0.0490)	(0.0459)	(0.0242)	(0.0260)
Divorced	-0.00578	0.141**	0.0401	0.102**
	(0.0729)	(0.0590)	(0.0464)	(0.0398)

Others	0.263***	0.222***	0.293***	0.369***
	(0.0566)	(0.0505)	(0.0726)	(0.0424)
Manual worker	REF	REF	REF	REF
	REF	REF	REF	REF
Executive	-0.00457	-0.132**	0.0334	-0.116***
	(0.0509)	(0.0557)	(0.0385)	(0.0445)
Employee	0.0300	0.0243	0.0296	0.00593
	(0.0600)	(0.0318)	(0.0315)	(0.0282)
Others	0.120**	0.0317	0.0755***	0.106***
	(0.0528)	(0.0537)	(0.0264)	(0.0280)
At work	REF	REF	REF	REF
	REF	REF	REF	REF
Unemployed	-0.0630	0.130**	-0.0642*	0.0371
	(0.0611)	(0.0509)	(0.0365)	(0.0345)
Student	-0.544***	-0.379***	-0.524***	-0.506***
	(0.164)	(0.143)	(0.0615)	(0.0669)
Retired	0.504***	0.370***	0.278***	0.309***
	(0.0618)	(0.0523)	(0.0351)	(0.0382)
Housewife	-0.143	0.183***	0.219	0.133***
	(0.204)	(0.0506)	(0.209)	(0.0273)
Others	0.114	0.236**	-0.0282	0.203***
	(0.0984)	(0.0924)	(0.0687)	(0.0717)
Time dummies	YES	YES	YES	YES
Constant	-0.359***	-0.365***	-0.0745*	-0.293***
	(0.0702)	(0.0659)	(0.0390)	(0.0390)
Observations	6198	9186	17220	20980

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5.3.2 Country of Origin

We analyse the impact of region of origin (Table 6) and the status of immigration (Table 7) on the probability of having a BMI over 25 by controlling for others explanatory variables. As mentioned before, the origin of immigrants could be important to understanding BMI disparities observed between immigrants. 5 regions have been identified. The North Africa region is composed of 3 countries: Morocco, Algeria and Tunisia. This region reports an important diaspora that has settled in France and Spain. The Africa region is devoted to Sub-Saharan Africa countries. Then, the UE region is devoted to all of Europe and not only the European Union. The America region corresponds to North and South America together with the Caribbean and Oceania. Finally, Asia embodies all other regions.

Table 6 reports the results according to the immigrant region of origin. In France (Columns 1 and 2), immigrant men from Europe are more overweight than natives. The coefficient associated with this variable is 0.252 (at the 1 per cent level), which corresponds to a marginal value of 9.9 per cent. In the case of women, immigrants from North African countries (Maghreb) or Sub-Saharan African countries (Africa) are both positively associated with a higher likelihood of being overweight; the magnitude of the coefficient is very high, 0.381 and 0.507, respectively; in terms of marginal value, it corresponds to 0.149 and 0.199, respectively. In other words, North African immigrant women have a 14.9 per cent greater probability of being overweight, whereas Sub-Saharan African women have an approximately 20 per cent greater probability. In Spain, immigrant men remain more physically fit than natives, particularly for those from the Maghreb and Asia. The magnitude of elasticity is 11.7 per cent for North Africa and -13.6 per cent for Asia. These results suggest that a 'healthy immigrant effect' exists only for men and not for women in particular for African immigrants. Many explanations could be advocated for this: first, the immigration policy has favoured the entry of immigrants coming from Africa (former colonies) and has played a different role in the selection of immigrants by gender. Until recently, in the European migration history, the immigration of African men was devoted to labour migration whereas the immigration of African women was associated with family reunification policies (Cornelius et al., 2004; Castles and Miller, 2009). Therefore, the immigration selection targeted mainly the physically fitter men compared to women. Second, the labour market situations of women are less favourable compared to those of men immigrants in the country of arrival that could have detrimental effect on their health. Third, a significant proportion of immigrants are from North Africa where the overweight prevalence rate affects many more women than men (Ng et al., 2014). The higher overweight prevalence for North African women is somehow imported from their country of origin.

Compared to the McDonald and Kennedy 2005 results, it seems that Arab immigrants in Canada are also more affected by overweight prevalence, which surpasses the native born situation after 12 years of settlement. Finally, the case of women from the Maghreb stands out as a similarity between France and Spain. Even if the significance of the coefficient in Spain is only at the 10 per cent level, a positive effect seems to be at work (close to 7 per cent in terms of the marginal effect). This result follows Martin-Fernandez et al. (2012) who found a higher propensity for being overweight for immigrants with Middle East and North African parental origin in Paris. However, the most important result in Spain for women is the positive effect associated with immigrants from America (and certainly Latin America). As the Acevedo-Garcia et al. (2010) results showed, Hispanics in the US reported in general a lower health status than natives. The significance is also very high at the 1 per cent level. The historical links between Spain and Latin America could explain the presence of a large diaspora in Spain and should have an influence on the severity of the migration selection process. It is probable that visa policies and family reunification programs could explain the higher prevalence rate of overweight among Latin American immigrants.

Table 6: Probit estimation of overweight and obesity prevalence for origin of immigrant

	MEN	WOMEN	MEN	WOMEN
	France	France	Spain	Spain
Natives	REF	REF	REF	REF
	REF	REF	REF	REF
Immigrants*Maghreb	-0.0226	0.381***	-0.299***	0.176*
	(0.0954)	(0.0927)	(0.0847)	(0.0996)
Immigrants*Africa	-0.0595	0.507***	-0.210	-0.160
	(0.160)	(0.120)	(0.160)	(0.208)
Immigrants*UE	0.252***	0.114	-0.0917	-0.0609
	(0.0933)	(0.0781)	(0.0561)	(0.0527)
Immigrants*Asia	-0.0416	0.0621	-0.347**	-0.0613
	(0.147)	(0.152)	(0.167)	(0.173)
Immigrants*America	0.211	-0.175	-0.0258	0.185***
	(0.272)	(0.284)	(0.0516)	(0.0423)
Age [18–30]	REF	REF	REF	REF
	REF	REF	REF	REF
Age [30–40]	0.196***	0.0551	0.240***	-0.0807***
	(0.0579)	(0.0473)	(0.0331)	(0.0312)
Age [40–50]	0.374***	0.0890*	0.405***	0.0486
	(0.0579)	(0.0475)	(0.0340)	(0.0309)
Age [60–70]	0.544***	0.253***	0.504***	0.317***
	(0.0582)	(0.0482)	(0.0368)	(0.0320)
Age [70–75]	0.379***	0.0744	0.328***	0.354***
	(0.0621)	(0.0530)	(0.0380)	(0.0338)
No diploma/Primary education	REF	REF	REF	REF
	REF	REF	REF	REF
Secondary education	-0.141***	-0.319***	-0.128***	-0.359***
	(0.0477)	(0.0379)	(0.0253)	(0.0230)
Tertiary education	-0.380***	-0.580***	-0.211***	-0.545***
	(0.0580)	(0.0476)	(0.0291)	(0.0276)
Single	REF	REF	REF	REF

	REF	REF	REF	REF
Married	0.262***	0.199***	0.318***	0.225***
	(0.0491)	(0.0461)	(0.0242)	(0.0260)
Divorced	-0.00386	0.145**	0.0390	0.104***
	(0.0730)	(0.0591)	(0.0464)	(0.0398)
Others	0.262***	0.234***	0.296***	0.371***
	(0.0566)	(0.0507)	(0.0726)	(0.0424)
Manual worker	REF	REF	REF	REF
	REF	REF	REF	REF
Executive	-0.00811	-0.134**	0.0335	-0.115***
	(0.0510)	(0.0556)	(0.0385)	(0.0445)
Employee	0.0339	0.0220	0.0311	0.00623
	(0.0600)	(0.0318)	(0.0315)	(0.0282)
Others	0.120**	0.0291	0.0753***	0.106***
	(0.0529)	(0.0537)	(0.0264)	(0.0280)
At work	REF	REF	REF	REF
	REF	REF	REF	REF
Unemployed	-0.0520	0.124**	-0.0619*	0.0374
	(0.0614)	(0.0511)	(0.0366)	(0.0345)
Student	-0.529***	-0.377***	-0.520***	-0.505***
	(0.165)	(0.143)	(0.0616)	(0.0669)
Retired	0.499***	0.371***	0.279***	0.313***
	(0.0618)	(0.0523)	(0.0351)	(0.0382)
Housewife	-0.124	0.180***	0.220	0.134***
	(0.204)	(0.0506)	(0.208)	(0.0274)
Others	0.120	0.236**	-0.0276	0.203***
	(0.0985)	(0.0923)	(0.0687)	(0.0718)
Time dummies	YES	YES	YES	YES
Constant	-0.359***	-0.377***	-0.0752*	-0.297***
	(0.0701)	(0.0660)	(0.0390)	(0.0390)
Observations	6198	9186	17220	20980

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 7 reports the results when immigrants are split between foreigners (new immigrants) and naturalised (old immigrants). In France, only naturalised immigrant men from Europe are significantly positive and significant. For women, regardless of immigration status (naturalised or foreigner), the coefficient is always positive and significant. Notice that in comparing the coefficients between foreigners and naturalised immigrants, the coefficient remains higher for naturalised immigrants than for foreigners in the Maghreb, but the opposite is the case for Sub-Saharan Africa. In other words, long-established immigrants are more overweight for the Maghreb, whereas newly established immigrants from other African countries are more overweight. Here again, the historical link between France and Africa, the reunification of the family, and labour market integration are likely be the main reasons for this effect. In Spain, all foreign men are more physically fit than natives, regardless of their region of origin. Africans, Europeans and Asians have a negative correlation with being overweight. Thus, the 'healthy immigrant men effect' is more salient in that case because we can easily observe that all coefficients associated with naturalised male immigrants are positive even if they are not significant. In France, naturalised women from North African countries are more overweight than natives. This is the same case for foreign women from America in Spain.

Table 7: Probit estimation of overweight and obesity prevalence for origin of immigrant status

	MEN	WOMEN	MEN	WOMEN
	France	France	Spain	Spain
Natives	REF	REF	REF	REF
	REF	REF	REF	REF
Foreigners*Maghreb	0.0672	0.329**	-0.401***	0.0860
	(0.133)	(0.141)	(0.0973)	(0.117)
Naturalised*Maghreb	-0.119	0.416***	0.0629	0.391**
	(0.133)	(0.121)	(0.179)	(0.194)
Foreigners *Africa	-0.0867	0.575***	-0.331**	-0.0666
	(0.260)	(0.162)	(0.169)	(0.232)
Naturalised*Africa	-0.0411	0.428**		-0.657
	(0.202)	(0.177)		(0.561)
Foreigners *UE	0.138	0.0754	-0.117*	-0.0722
	(0.115)	(0.107)	(0.0618)	(0.0605)
Naturalised*UE	0.465***	0.158	0.0104	-0.0277
	(0.159)	(0.112)	(0.129)	(0.104)
Foreigners *Asia	0.219	-0.0700	-0.454**	-0.0436
	(0.211)	(0.214)	(0.192)	(0.191)
Naturalised*Asia	-0.258	0.161	0.0465	-0.125
	(0.206)	(0.209)	(0.356)	(0.398)

Foreigners *America	0.468	-0.246	-0.0177	0.216***
	(0.527)	(0.390)	(0.0581)	(0.0491)
Naturalised*America	0.115	-0.0967	-0.0571	0.103
	(0.322)	(0.416)	(0.107)	(0.0791)
Age [18–30]	REF	REF	REF	REF
	REF	REF	REF	REF
Age [30–40]	0.196***	0.0552	0.239***	-0.0805***
	(0.0579)	(0.0473)	(0.0332)	(0.0312)
Age [40–50]	0.372***	0.0885*	0.402***	0.0491
	(0.0579)	(0.0475)	(0.0340)	(0.0309)
Age [60–70]	0.542***	0.252***	0.501***	0.318***
	(0.0582)	(0.0482)	(0.0368)	(0.0321)
Age [70–75]	0.376***	0.0745	0.326***	0.354***
	(0.0621)	(0.0530)	(0.0380)	(0.0338)
No diploma/Primary education	REF	REF	REF	REF
	REF	REF	REF	REF
Secondary education	-0.139***	-0.321***	-0.129***	-0.359***
	(0.0479)	(0.0379)	(0.0253)	(0.0231)
Tertiary education	-0.378***	-0.582***	-0.212***	-0.544***
	(0.0582)	(0.0476)	(0.0291)	(0.0276)
Single	REF	REF	REF	REF
	REF	REF	REF	REF
Married	0.265***	0.200***	0.319***	0.225***
	(0.0492)	(0.0461)	(0.0242)	(0.0260)
Divorced	-0.00176	0.146**	0.0397	0.105***
	(0.0731)	(0.0591)	(0.0464)	(0.0398)
Others	0.264***	0.234***	0.293***	0.371***
	(0.0567)	(0.0507)	(0.0725)	(0.0424)
Manual worker	REF	REF	REF	REF
	REF	REF	REF	REF
Executive	-0.00809	-0.133**	0.0334	-0.115***
	(0.0510)	(0.0557)	(0.0385)	(0.0445)

Employee	0.0345	0.0220	0.0327	0.00641
	(0.0601)	(0.0318)	(0.0316)	(0.0282)
Others	0.119**	0.0300	0.0769***	0.105***
	(0.0529)	(0.0538)	(0.0264)	(0.0280)
At work	REF	REF	REF	REF
	REF	REF	REF	REF
Unemployed	-0.0536	0.124**	-0.0607*	0.0390
	(0.0615)	(0.0511)	(0.0366)	(0.0345)
Student	-0.526***	-0.378***	-0.523***	-0.503***
	(0.164)	(0.143)	(0.0616)	(0.0669)
Retired	0.499***	0.369***	0.277***	0.314***
	(0.0618)	(0.0523)	(0.0351)	(0.0382)
Housewife	-0.125	0.181***	0.218	0.134***
	(0.204)	(0.0507)	(0.209)	(0.0274)
Others	0.127	0.235**	-0.0295	0.203***
	(0.0986)	(0.0924)	(0.0687)	(0.0718)
Time dummies	YES	YES	YES	YES
Constant	-0.364***	-0.375***	-0.0734*	-0.298***
	(0.0703)	(0.0661)	(0.0390)	(0.0390)
Observations	6198	9186	17220	20980

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5.3.3 Characteristics of origin countries

Immigrants are affected differently by being overweight according to their country of origin. However, what factors in the origin countries could drive this result? We can easily expect that current immigrant health is linked to the environment of the country of arrival, but it could be also the result of long term-effect driven by the economic and social conditions that they faced before their emigration. This should explain for example why North African immigrant women declared a higher standard of overweight compared to other origin. In other words, the differences in overweight observed among the immigrants by their origin breakdown should be explained by pre-determined factors related to the socioeconomic origin-country situation. We follow Jusot et al. (2009) and test whether the HDI rating of origin countries could be a potential factor that explained immigrant overweight (Table 8). The benefits of this measure are that it embodies the level of income (through the GNI per capita PPP in constant dollars), but it takes into account two other variables related to the level of human capital: the population's health (through life expectancy) and the population's education (through years of schooling). In the case of overweight, the nutrition and food habits acquired in their origin country could be very important for immigrants

when emigration occurs. Hence, the level of overweight/obesity observed in the origin country could be a good proxy of immigrant behaviour in terms of nutrition and food habits in the sense that it could explain the difference in BMI between immigrants. Table 9 addresses this issue and investigates whether obesity prevalence rates in the origin country influence the BMI. We began our analysis with the HDI variable (Table 8), and we finish with the analysis of the obesity variable (Table 9). Table 8 is composed of 12 columns; the first six are devoted to France and the last six to Spain. As previously, our analysis is gender specific, and we introduce the HDI variable first as itself, and then we decompose the indicator in quintiles and by their three dimensions (income, education and health). All robust standard errors in parentheses are clustered by origin region to correct the different level of explanatory variables. In Table 9, eight columns are reported in which the obesity prevalence in the origin country is included first as itself and then divided into quintiles.

In Table 8, the HDI of the origin country has no effect on the probability of being overweight in France (regardless of gender). In columns 1 and 4, neither coefficient is significant. However, when HDI is decomposed into quintiles, it seems that the higher it is, the lower is the overweight prevalence rate. In Column 2, the second quintile is significant and negative at the 1 per cent level. The coefficient of -0.396 corresponds to a marginal effect of -0.135. In other words, if a specific country increases their levels of HDI from the first to the second quintile, women reduce their probability of being overweight to 13.5 per cent. The same interpretation is valid for men in France with a marginal value close to -0.15. One exception exists for the third quintile (for women and men), in which the coefficient is positive and significant at the 5 per cent level. A country with an HDI level in the third quintile has a probability of having individuals with higher BMI (compared to the first quintile). However, the magnitude of the marginal effect is quite small, approximately -0.05 for women and -0.057 for men. The fourth quintile is significantly negative only for women, whereas the last quintile has no effect on the likelihood of being overweight. Finally, the decomposition of HDI by different components is interesting in terms of instructions. For women, education and income indexes appear statistically significant. The education index is negatively significant at the 5 per cent level with a coefficient of -0.864. This magnitude is very high and corresponds to a marginal value of -0.323. In other words, if we observe a doubling of the level of education in a specific country, we could expect a diminution in individual overweight prevalence of approximately 32.3 per cent. This huge effect confirms the benefits of education in nutrition, food habits, inactivity prevalence, and risky behaviour in terms of overweight. Notice that for men, no sub-component of HDI appears significant.

In Spain, the HDI itself is significant and negative only for women (column 7). The marginal value calculated from the coefficient gives us -0.449. In other words, a doubling of the HDI in a source country would be associated with a reduction of close to 45 per cent in the overweight prevalence rate of women. The breaking down into quintiles shows the importance of the last two quintiles with a significantly negative associated coefficient (column 8). For men, the decomposition into quintiles shows that the jump between HDI ranges is not systematically linked to a decrease in the overweight prevalence rate (column 11). The fourth quintile is negatively associated with being overweight, whereas the coefficients for the second and the last quintiles are positive and significant. In comparing the magnitude of the marginal effect, we found that the negative effect largely exceeds the positive effect. In fact, being in the fourth quintile reduces overweight among men by -23 per cent, whereas it is 5.7 per cent for the second and 2.8 per cent for the fifth quintile.

Table 8: Clustered probit estimation of overweight and obesity prevalence with Human Development Index of country of origin

	France	France	France	France	France	France	Spain	Spain	Spain	Spain	Spain	Spain
	WOMEN	WOMEN	WOMEN	MEN	MEN	MEN	WOMEN	WOMEN	WOMEN	MEN	MEN	MEN
Natives	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
Immigrant*Maghreb	0.473***	0.217***	0.467***	0.00585	0.0949	0.00716	-0.160	0.162***	-0.0532	-0.406**	-0.278***	-0.323
	(0.0775)	(0.0802)	(0.0778)	(0.0885)	(0.186)	(0.0969)	(0.154)	(0.0218)	(0.148)	(0.206)	(0.0107)	(0.229)
Immigrant*Africa	0.671***	0.351***	0.736***	-0.00835	0.0630	-0.0899	-0.672***	-0.216***	-0.468***	-0.371	-0.208***	-0.450*
	(0.133)	(0.0829)	(0.156)	(0.157)	(0.185)	(0.165)	(0.220)	(0.0207)	(0.165)	(0.314)	(0.0199)	(0.236)
Immigrant*Europe	0.148***	0.00997	0.130***	0.281***	0.398***	0.274***	-0.107***	-0.0522***	-0.109***	-0.110***	-0.0872***	-0.145***
	(0.0147)	(0.0658)	(0.0119)	(0.0164)	(0.132)	(0.0398)	(0.0239)	(0.0117)	(0.0386)	(0.0369)	(0.0163)	(0.0490)
Immigrant*Asia	0.181**	-0.0636	0.197**	-0.0497	0.0376	-0.0618	-0.324***	-0.110***	-0.311**	-0.437**	-0.353***	-0.456***

	(0.0766)	(0.0781)	(0.0817)	(0.0933)	(0.181)	(0.0965)	(0.110)	(0.0173)	(0.148)	(0.176)	(0.0224)	(0.129)
Immigrant*America	-0.0822**	-0.279***	-0.0147	0.235***	0.319**	0.237***	0.00223	0.168***	0.00453	-0.0821	-0.00485	-0.0855
	(0.0349)	(0.0705)	(0.0557)	(0.0381)	(0.140)	(0.0837)	(0.0852)	(0.0174)	(0.124)	(0.111)	(0.0121)	(0.0974)
Human Development Index	0.382			0.123			-1.147**			-0.369		
	(0.334)			(0.368)			(0.540)			(0.705)		
HDI: First Quintile		REF			REF			REF			REF	
		REF			REF			REF			REF	
HDI: Second Quintile		-0.396***			-0.376***			-0.0687			0.155***	
		(0.0647)			(0.0606)			(0.0512)			(0.0458)	
HDI: Third Quintile		0.132**			0.145**			0.00286			-0.0315	
		(0.0604)			(0.0701)			(0.0196)			(0.0368)	

HDI: Fourth Quintile		-0.292**			0.0709			-0.0483**			-0.581***	
		(0.133)			(0.186)			(0.0194)			(0.0164)	
HDI: Fifth Quintile		-0.106			0.144			-0.0458**			0.0766**	
		(0.0814)			(0.188)			(0.0212)			(0.0341)	
HDI Education index			-0.864**			-0.0994			0.236			0.368
			(0.434)			(1.282)			(0.330)			(0.842)
HDI Health index			0.129			-0.562			0.215			-0.898
			(0.406)			(1.296)			(0.678)			(1.400)
HDI Income index			1.322**			0.555			-1.270			-0.135
			(0.646)			(2.276)			(1.091)			(0.998)
Others explanatory variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Constant	-0.718**	-0.264***	-0.866**	-0.472	-0.504***	-0.200	0.708	-0.298***	0.333	0.247	-0.0463	0.578
	(0.292)	(0.0815)	(0.382)	(0.333)	(0.191)	(0.504)	(0.463)	(0.0515)	(0.403)	(0.618)	(0.0551)	(0.585)
Observations	9,146	9,146	9,146	6,174	6,174	6,174	20,952	20,952	20,952	17,203	17,203	17,203

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All standard errors are clustered by origin regions.

Table 9 reports the results when the obesity prevalence in origin countries is investigated. The first four columns report the French results by gender and in distinguishing the aggregate indicator of obesity prevalence from their quintile. The last four columns are devoted to Spanish results with the same methodology and structure. Heterogeneous results are found according to gender and host country. In France, only women are sensitive to the level of overweight in origin countries. The analysis in quintile (column 2) reveals a positive and significant effect for the third and the fourth quintile. In other words, in an origin country where the level of obesity is relatively high, the probability of women of being overweight is also high. For men, nothing appears statistically significant. Notice that North African and Sub-Saharan African female immigrants are more overweight as well as European men, which confirmed our previous results. Asian male immigrants are also more likely to be more physically fit than natives in France. In Spain, in terms of gender, only men react to the obesity prevalence in origin countries; however, the coefficient associated with obesity is not positive but negative (columns 11, 12). In other words, a high prevalence of obesity in an origin country is correlated with a reduction in overweight prevalence for men. This effect transits through the last quintile of obesity. It means that if a source country is in the last quintile of obesity, we can expect a reduction of overweight prevalence for men of approximately 8 per cent. Notice that immigrant women from Maghreb and America are always more likely to be overweight, and for men, all immigrants are relatively more physically fit than natives. This last result confirms the assumption of the 'healthy immigrant men effect' in the case of Spain. Perhaps the migration story of Spain has begun more recently than in France. Therefore, the newly arrived immigrants in Spain are still young adults with a high migration selection in terms of overweight that is always at work. In France, because the massive immigration episode is now over, immigrants are relatively more long-established and many of them are naturalised. In this particular case, the migration selection that is at work at the beginning of the migration journey is now out of date. Migration selection has been replaced gradually by the social and labour market integration process. Hence, it is logical that in France, we now observe immigrant men that are in general as overweight as natives or more so, whereas in Spain, men are always less overweight than Spanish natives.

Table 9: Clustered probit estimation with obesity prevalence rate of country of origin

	France	France	France	France	Spain	Spain	Spain	Spain
	WOMEN	WOMEN	MEN	MEN	WOMEN	WOMEN	MEN	MEN
Natives	REF	REF	REF	REF	REF	REF	REF	REF
	REF	REF	REF	REF	REF	REF	REF	REF
Immigrant*Maghreb	0.284***	0.348***	-0.00992	0.0735	0.163***	0.148***	-0.398***	-0.492**
	(0.0848)	(0.130)	(0.0522)	(0.0872)	(0.0213)	(0.0147)	(0.0324)	(0.195)
Immigrant*Africa	0.486***	0.514***	-0.0372	0.0341	-0.182***	-0.168***	-0.335***	-0.431**
	(0.0219)	(0.0576)	(0.0923)	(0.0842)	(0.0150)	(0.0495)	(0.0396)	(0.188)
Immigrant*Europe	0.0643	0.0802	0.246**	0.275***	-0.0577***	-0.0578**	-0.123***	-0.153
	(0.0585)	(0.120)	(0.116)	(0.0499)	(0.00344)	(0.0233)	(0.0122)	(0.0982)
Immigrant*Asia	0.0193	0.0706	-0.0705*	-0.0487*	-0.0475***	-0.0557	-0.437***	-0.496***
	(0.0503)	(0.0728)	(0.0398)	(0.0293)	(0.0113)	(0.0647)	(0.0348)	(0.142)
Immigrant*America	-0.334**	-0.187	0.155	0.315***	0.157***	0.147***	-0.0130**	-0.0626
	(0.139)	(0.145)	(0.221)	(0.0809)	(0.0250)	(0.0118)	(0.00550)	(0.0939)
Obesity prevalence rate	0.00744		0.00441		0.00266		-0.00790***	
	(0.00647)		(0.0174)		(0.00231)		(0.00253)	
Obesity: First Quintile		REF		REF		REF		REF

		REF		REF		REF		REF
Obesity: Second Quintile		-0.0235		0.148		0.0171		-0.220
		(0.0867)		(0.140)		(0.136)		(0.194)
Obesity: Third Quintile		0.217*				0.0145		-0.0314
		(0.129)				(0.113)		(0.193)
Obesity: Fourth Quintile		0.306**		-0.201		0.0321		-0.259
		(0.121)		(0.195)		(0.0907)		(0.207)
Obesity: Fifth Quintile		0.0163		-0.0221		0.0832		-0.207*
		(0.153)		(0.206)		(0.107)		(0.114)
Others explanatory variables	YES	YES	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-0.435***	-0.381***	-0.402**	-0.503***	-0.342***	-0.375***	0.0550	0.176
	(0.0466)	(0.0180)	(0.156)	(0.139)	(0.0562)	(0.110)	(0.0590)	(0.219)
Observations	9,153	9,153	6,176	6,176	20,956	20,956	17,204	17,204

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All standard errors are clustered by origin regions.

6 Conclusion

By studying immigrant overweight in two European countries, France and Spain, we intended to contribute to migrant health research by shedding light on country of origin and host country crossed effects. Because the number of overweight exceeds the number of malnourished (Popkin, 2008), and it disproportionally effects Middle East and North Africa (Ng et al., 2014) we chose to focus on overweight as it reflects the lifestyle (physical activity, dietary practices) which allow studying culture and acculturation, and immigration selection effects. France and Spain are neighbouring countries, hosting both large numbers of immigrants, from partly common regions of origin, especially North Africa. Migration histories are nevertheless quite different in France and in Spain, where it appears much more recent. Besides, in France, a great deal of immigrants are naturalised, whereas in Spain, immigrants are more recently settled and naturalisation legislation is more restrictive.

First, we investigated immigration selection effects by analysing whether immigration status had an influence on the likelihood of being overweight. Then, we inquired whether the country of origin and its characteristics could play a role in the BMI of immigrants, in France and Spain. We then addressed the effect of length of stay, using naturalisation as a proxy, to study possible acculturation effects and how they could differ in France and Spain.

Our results show different patterns across countries in differences between immigrant and native overweight.

First, overweight affects more women than men. Family reunification policies and labour market integration may be the main reasons for this effect. Then, among men, Spain shows healthy migration selection still at work, whereas in France, integration appears to have replaced selection. In terms of overweight, it materializes as more physically fit immigrant men in Spain and fewer in France, as compared to natives. Third, significant differences in overweight prevalence were observed according to regions of origin. For women, immigrants from North Africa or Sub-Saharan Africa are more often overweight than other immigrants. Finally, obesity in origin country favours higher BMI for women, whereas for men, overweight is reduced with a high prevalence of obesity.

We conclude that country of arrival matters as well as country of origin, in explaining immigrant overweight. Differences between France and Spain stem from differences in the structure of immigrant populations. In France, a large part of the immigrant population is naturalised, whereas in Spain, immigrants have arrived more recently. Hence, in Spain, migration selection is still at work, whereas in France, integration appears to progressively overtake selection. Our decomposition results conclude that difference in characteristics is less important than differences in coefficients in explaining overweight difference between immigrants and natives. In terms of health policy, prevention campaigns targeting the immigrant sub-population would be a good tool to reduce overweight prevalence as this group is prone to this epidemic. We attribute the specificity of the health of African immigrants to European migration history where male African immigration was devoted to labour migration whereas female African immigration was associated with family reunification policies (Cornelius et al., 2004; Castles and Miller, 2009). Therefore, immigration selection targeted mainly the physically fitter men compared to women from Africa. Moreover a significant proportion of immigrants are from North Africa where the overweight prevalence rate affects many more women than men (Ng et al., 2014). It seems that immigrant origin country characteristics (GDP, HDI and obesity) play a role in their overweight prevalence.

Future research would benefit from investigating impact of host country characteristics (labour market monitoring, health system, prevention, health information and living conditions in general) to

explain the occurrence of overweight among immigrants. Moreover, more should be done to address how length of stay affects immigration effects. Length of stay appears crucial information when studying immigrant health issues but is not always present in migration questionnaires included in general population health surveys.

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8 Appendix

Table A.1: Comparability of education variable within and between countries

COMPARABILITY OF EDUCATION MEASURE		France		Spain	
		Level of education (2006)	Highest diploma obtained (2008 & 2010)	Level of education (2006/2007)	Level of education (2009)
EDUCATION	Primary education / no diploma	51: Rien, aucun diplôme, autodidacte 2 : Maternelle, primaire, Certificat d'étude (CEP)	01 : Aucun diplôme 02 : CEP (certificat d'étude primaires)	03: Estudios primarios o equivalentes	02= Estudios primarios incompletos (ISCED 1) 03= Educación primaria o equivalentes (ISCED 1)
	Secondary education	03 : 1er cycle, 6ème, 5ème, 4ème, 3ème, technique, jusqu'à CAP et BEP 04 : 2nd cycle, 2nde, 1ère, terminale, Bac technique (BT), Baccalauréat	03 : Brevet des collèges, BEPC, brevet élémentaire 04 : CAP, BEP 05 : Baccalauréat technologique ou professionnel 06 : Baccalauréat général	04 = Enseñanza general secundaria 1ª Etapa 05 = Enseñanza Profesional de grado medio 06 = Enseñanza general secundaria 2ª Etapa	04= Educación secundaria de primera etapa (ISCED 2) 05= Estudios de Bachillerato (ISCED 3) 06= Enseñanzas profesionales de grado medio o equivalentes (ISCED 3)

	Tertiary education	05 : Etudes supérieures au Bac	07 : Bac+2 (1er cycle universitaire, Deug, BTS, DUT...) 08 : Supérieur à Bac+2 (2nd et 3ème cycle universitaire, diplôme d'ingénieur, de grande école...)	07 = Enseñanzas Profesionales Superiores 08 = Estudios Universitarios o equivalentes Primer Ciclo 09 = Estudios Universitarios o Equivalentes Segundo Ciclo	07= Enseñanzas profesionales de grado superior o equivalentes (ISCED 5B) 08= Estudios universitarios de 1 y 2 ciclo o equivalentes(ISCED 5A) 09= Doctorado o equivalente (ISCED 6)