Effects on general health associated with beach proximity in Barcelona (Spain)

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Summary

Health benefits of blue spaces have been less studied compared with other urban natural environments. As a type of blue space, beaches are also affected by this lack of evidence, despite their cultural and economic importance in lots of coastal regions all over the world. Based on secondary health data from 3192 participants of the Health Survey of Barcelona 2016, we conducted a logit regression analysis to explore the relationship between people's general health and beach proximity from their dwelling place, controlling for several health determinants. Our main results suggested that having good general health was less likely for a 1-km increase in the linear distance to the closest beach from people's dwelling places (OR: 0.93; 95% CI: 0.87, 1.00). Moreover, the probability of having good general health was 45% higher for people living in the first 2 km from the beach (OR: 1.45; 95% CI: 1.01, 2.09), relative to those living >5–10 km from it. Also, these health effects were stronger for people with a low family income. These findings contribute to grow the currently small body of research related to health benefits of beach spaces. Likewise, they encourage fostering the use of these spaces for health promotion in cities, as well as protecting them and improving their accessibility and safety. Further research should lean towards the underlying causes of these health benefits linked to people's exposure to beach spaces.

Key words: salutogenesis, blue spaces, therapeutic landscapes, healthy cities

INTRODUCTION

More than half of the world's population was living in urban settlements in 2016, and the projections suggest that 60% of the global population will be living in urban areas by 2030 (UN DESA, 2016). This growing demographic pressure is pushing public health promotion as a key element to integrate in present and future urban planning. Among the many different paths and options to promote public health in cities, in this paper we focused on the health promotion opportunities arising from people's contact with urban natural environments featuring water (blue spaces) and, in particular, from people's exposure to an specific type of these blue spaces: the beaches.

The salutogenic effects derived from natural environments have been studied by an increasing body of literature in recent years (Hartig et al., 2003; Mitchell and Popham, 2008; Bowler et al., 2010). Evidence in this matter suggests that people's exposure to these natural environments can potentially translate into health benefits related to an increase of social contact and interactions, stress reduction, mental restoration and/or the ractice of physical activity in these areas (de Vries et al., 2013; Hartig et al., 2014; Gascon et al., 2016). Health benefits of green spaces have been widely studied within this research field (Lee and Maheswaran, 2011; van den Berg et al., 2015; Dadvand et al., 2016), however, these have been less studied for blue spaces (Foley and Kistemann, 2015; Gascon et al., 2017).

'Blue spaces' are natural (or manmade) outdoor environments that prominently feature water and are accessible to humans either proximally or distally (Grellier et al., 2017), so these are normally part of the urban space in the form of rivers, lakes, coastal spaces or beaches, among others. Gascon et al. (Gascon et al., 2017) reviewed 35 quantitative studies related to the salutogenesis of blue spaces (blue health), suggesting a positive association between greater exposure to outdoor blue spaces and benefits related to mental health, wellbeing and levels of physical activity. However, the evidence gathered by this systematic review was less consistent about general health, obesity and cardiovascular diseases. There is an important body of these blue health evidence related to the coast. This might be due to coastal spaces covering a much larger area than inland blue spaces and, consequently, allowing for large-scale studies, while inland blue spaces are normally studied more locally or paired with green spaces for larger scale research (Triguero-Mas et al., 2015; de Bell et al., 2017).

In the specific field of research of coastal blue health, most of the existing literature is related to the coast as a whole, understood as the land that is near the sea, which may present different characteristics and landscapes among it. For example, Wheeler et al. (Wheeler et al., 2012) and White et al. (White et al., 2013) developed studies at national level in England, where they explored the salutogenic effects related to coastal proximity for people living in the first 50 km from the coast, suggesting that good health was more prevalent the closer people lived to the coast, as well as better general and mental health when living nearer the coast, respectively.

Among the different landscapes that can be found in the coast, beaches are one of the most singular and representative. Typically formed of sand or pebbles, beach spaces extend along the seashore and provide people with a natural and easy access to the sea (in contrast to other coastal landforms like cliffs or rocky shores, where accessing to the sea for bathing or practicing water sports is often not possible). This makes beaches a key component of the coast; however, their particular health benefits as blue spaces have been barely studied.

To our knowledge, there are just a few studies with a specific focus on the health benefits associated with people's contact with beach spaces. Two of these were developed in Southwest

England, where the authors studied 15 families (Ashbullby et al., 2013) and 33 adults (Bell et al., 2015) and suggested a positive relationship between the well-being promotion of families with young children and their engagement with local beach spaces. Also, Amoly et al. (Amoly et al., 2014) studied 2111 schoolchildren in Barcelona (Spain), which presented an association between beach attendance and their behavioural development, while Edwards et al. (Edwards et al., 2014) suggested a positive relationship between the achievement of recommended levels of physical activity and beach use, based on the study of 1304 adolescents in rural Western Australia.

Besides these studies, Brereton et al. (Brereton et al., 2008) studied the impact of amenities like climate, environmental and urban conditions on the subjective wellbeing of 1500 adults from Ireland, where the authors considered proximity to coast and to beach as two different regressors. Their results suggested a positive association between people living near the coast and a higher life satisfaction, with people living in the first 2 km from it being the more satisfied. However, proximity to beach emerged insignificant in the analysis.

The main objective of this paper was to provide empirical evidence about the effect on people's general health related to beach proximity from their dwelling place, within the city limits of Barcelona (Spain). In addition, we aimed to explore if socioeconomic deprivation could modify the association between people's health and their exposure to natural environments like beaches, as suggested by other authors for green and blue spaces (Mitchell and Popham, 2008; Wheeler et al., 2012). The analysis was based on secondary health data from 3192 participants of the Health Survey of Barcelona for 2016, and a logit regression was used to estimate the effects of beach proximity on the probability of having good general health, controlling for several health determinants.

CASE STUDY

Barcelona is the capital of Catalonia, an Autonomous Region located in the North-East of Spain. With 1.6 million inhabitants, it is the second biggest city in Spain, and it is one of the largest urban areas in the European Union and in the Mediterranean region. This city is a major cultural and economic centre in Europe, as well as one of the most visited places in the world (8.7 million foreign visitors in 2017). The city is structured in 10 districts and each district is subdivided in several census sections (since 2014, there is a total of 1068 census sections) (Figure 1a).

Barcelona has always been closely linked to the Mediterranean Sea. This relationship was primarily related to fishing and the commercial activities that took place in the port area, although, people also liked relaxing, bathing or practicing water sports in the coastal spaces of the city. The demand for the recreational use of these blue spaces kept growing during the 20th century and, thanks to the urban transformations conducted in the 80s (because of the Olympic Games of Barcelona 1992), the connection between the coast and the city was improved.

Nowadays, the city has nine sandy beaches (Sant Sebastia`, Sant Miquel, Barceloneta, Somorrostro, Nova Ica` ria, Bogatell, Mar Bella, Nova Mar Bella, Llevant) with a total length of 5 km and a total area of 3 km^2, approximately (Figure 1b). Since 2010, these beaches have been regularly awarded with the 'Blue Flag', a yearly certification by the international, non-governmental, non-profit organization Foundation for Environmental Education (FEE), which requires these blue spaces to achieve (and maintain) high standards in relation to water quality, environmental management, environmental education, accessibility and safety.

METHODS

The health-related data were obtained from the Health Survey of Barcelona for 2016 (Bartoll et al., 2018) (4000 subjects), provided by the Public Health Agency of Barcelona. Subjects that were missing data for any of the variables needed for the analysis were excluded from the study and, as a result, the final sample had 3192 observations. Every person younger than 15 years old (12% of the total respondents) was missing data for several variables needed for the study, so the analysis was focused on the population aged 15 or older. The subjects' dwelling places were represented with the centroids of the census sections they lived in (ICGC, 2018), which were obtained with ArcGIS 10.1 (ESRI) (Figure 2).

General health was used as the dependent variable of the analysis. Subjects from the Health Survey of Barcelona were asked to report their general health, given the following options: bad, mediocre, good, very good or excellent. For our analysis, this variable was dichotomized, taking a value of 1 if the subject had good general health (good, very good or excellent), and a value of 0 if the subject had poor general health (bad or mediocre). Self-rated health measures have been previously used as valid indicators related to people's perception of quality of life, physical functioning and mortality (Sanderson et al., 2002; Pietz and Petersen, 2007), as well as to analyse health effects of green and blue spaces (Maas et al., 2006; White et al., 2013).

Beach proximity was the key regressor of the analysis. It was measured as the linear distance (km) from each subject's dwelling place to the closest beach (Figure 2a), which was calculated using ArcGIS 10.1 (ESRI). Beach spaces in the city were georeferenced based on the Urban Atlas dataset for 2012 (EU and EEA, 2018). Distance to the closest beach or to the coast has been previously utilized to represent people's exposure to these spaces by several studies (Brereton et al., 2008; Wheeler et al., 2012; Edwards et al., 2014).

In order to complement the analysis based on the linear distance, we also run a second analysis, where beach proximity was measured by using three proximity bands instead, while keeping the rest of the variables the same (Figure 2b). These proximity bands were established based on walking times (considering 5 km/h as the average walking speed) as follows: <2 km (n=522), for people living <20 min walking from the beach; >2–5 km (n=1839), for people living 20 min to 1 h walking from the beach; >5–10 km (n=831), for people living more than 1 h walking from the beach. The furthest band (>5–10 km) was used as reference.

The relationship between people's general health and beach proximity was controlled by several variables that may also have an impact on a person's health. These control variables were selected based on the widely cited model for social health determinants of Dahlgren and Whitehead (Dahlgren and Whitehead, 1991), as well as on the health map by Barton and Grant (Barton and Grant, 2006), and were obtained from the Health Survey of Barcelona. The control variables we used were sex (male), age, disease, normal weight, sleep 6–10 h, exercise, social support, education, income (>18 000 €), crime and green space availability; and they were categorized as follows.

Sex (male) distinguished between male (value 1) and female (value 0). Age was measured in years. Disease indicated if the subject had any chronic disease or disability that was limiting them in their day-to-day activities (value 1) or otherwise (value 0). Normal weight denoted if the subject was in the normal-weight category of the body mass index (value 1) versus underweight, overweight and obese categories (value 0). Sleep 6–10 h indicated if the subject slept from 6 to 10 h a day (value 1) or otherwise (value 0). Exercise indicated if the subject practiced weekly moderate or intense physical activity (value 1) versus practicing light or none (value 0). Social support denoted if the subject had more social support than the average value of the total

observations (value 1) or otherwise (value 0). Education denoted if the subject had completed, at least, secondary education (value 1) or otherwise (value 0). Income (>18 000 €) indicated if the subject's family income was more than 18 000 €/ year (value 1) or otherwise (value 0). Crime denoted if the subject perceived violence as a problem in their neighbourhood (value 1) or otherwise (value 0). Green space availability denoted if the subject had any (accessible) park, garden, forest or field available at <10-min walking (value 1) or otherwise (value 0).

We used StataMP 15 (StataCorp LLC) for the logit regression analysis, which estimated the probability of having good general health, based on people's beach proximity and controlled by several health determinants. We conducted two logit models that included different measures for beach proximity (linear distance and proximity bands), which helped us to explore not only if there was an association between general health and beach proximity, but also if this association could have a different magnitude depending on how far people lived from the closest beach. Finally, we obtained the results stratified by income in order to test if this association could be modified by the subjects' socioeconomic conditions.

RESULTS

Table 1 presents the main results from the logit regression models estimating the probability of having good general health. The left part of the table presents the results for the linear distance model, while the right part presents those for the proximity bands model. In both cases, the overall results are presented followed by the results stratified by the subject's income. All the results are expressed in odds ratios (OR).

According to the result for the linear distance (OR: 0.93; 95% CI: 0.87, 1.00), having good general health would be less likely than having poor general health when the linear distance to the beach from people's dwelling places increased 1 km. If we inverse this ratio (1/0.93 = 1.07), it could be interpreted as the odds of having poor general health would increase 7% for a 1- km increase in the linear distance. Moreover, the results stratified by income presented a significant effect for the linear distance for subjects with low income (≤18 000 €) (OR: 0.89; 95% CI: 0.81, 0.98), while we found no effects for this variable in the case of subjects with high income (>18 000 €) (OR: 0.98; 95% CI: 0.89, 1.09). The inverse OR of the linear distance for people with low income (18 000 e) (1/0.89 = 1.12) suggested that the odds of having poor general health for this population group would increase 12% for a 1-km increase in the linear distance variable.

The results for the proximity bands model showed that the odds of having good general health for people living <2km from the closest beach would be 45% higher (OR: 1.45; 95% CI: 1.01, 2.09), relative to those living >5–10 km from it (reference category). However, people living >2–5 km from the beach area presented no significant health effects (OR: 1.01; 95% CI: 0.78, 1.32), compared with those living in the reference category. The results stratified by income indicated that people with low income (≤18 000 €) and living <2km from the beach would present 66% higher odds of having good general health (OR: 1.66; 95% CI: 1.02, 2.73), relative to those living in the reference category. On the other hand, people with high income (>18 000 €) or living >2–5 km from the beach showed no significant health effects, compared with those from the reference category.

All these results related to people's exposure to the beaches in Barcelona were obtained considering several health determinants, which even included the availability of green spaces (at <10-min walking time from people's dwelling places), as a way to control the potential salutogenic effects associated to other urban natural environments in the city. In fact, this green

space availability variable also presented an association with having good general health (OR: 1.33; 95% CI: 0.95, 1.87), although its significance level was 10%.

The rest of the control variables also presented associations with having good general health, which were towards the expected direction as well. Thus, sex (male) (OR: 1.36; 95% CI: 1.08, 1.71), normal weight (OR: 1.56; 95% CI: 1.24, 1.97), sleep 6–10 h (OR: 2.88; 95% CI: 2.14, 3.88), exercise (OR: 2.21; 95% CI: 1.63, 2.98), social support (OR: 1.66; 95% CI: 1.32, 2.09), education (OR: 1.32; 95% CI: 1.04, 1.67) and income (>18 000 €) (OR: 2.17; 95% CI: 1.72, 2.73) were positively associated with having good general health, while age (OR: 0.97; 95% CI: 0.96, 0.97), disease (OR: 0.12; 95% CI: 0.09, 0.15) and crime (OR: 0.69; 95% CI: 0.51, 0.95) were negatively associated with it. As it can be observed in Table 1, the OR of the control variables remained mostly the same between the linear distance model and the proximity bands model, so we just referred to the later ones in the text.

DISCUSSION

Our main results suggested that people would be less likely to have good general health for a 1-km increase in the linear distance to the closest beach from their dwelling places. In addition, we observed that the probability of having good general health would be higher for people living in the first 2 km from the beach, relative to those living >5–10 km from it. Furthermore, each of the control variables that were included in the model presented associations towards the expected direction and, looking at these, the probability of having good general health associated to living in the first 2 km from the beach (OR: 1.45; 95% CI: 1.01, 2.09) was similar compared with the probabilities associated with having a healthy weight (OR: 1.56; 95% CI: 1.24, 1.97), having social support (OR: 1.66; 95% CI: 1.32, 2.09), having at least secondary education (OR: 1.32; 95% CI: 1.04, 1.67) or having a green space available at <10-min walking (OR: 1.33; 95% CI: 0.95, 1.87), while all of these probabilities were relatively smaller than the probabilities associated with sleeping 6–10 h a day (OR: 2.88; 95% CI: 2.14, 3.88), exercising regularly (OR: 2.21; 95% CI: 1.63, 2.98) or having a family income over 18 000 €/year (OR: 2.17; 95% CI: 1.72, 2.73). Altogether, these findings suggested a positive association between living closer to the beach and a higher probability of having good general health for people in the city of Barcelona.

These results were relatively similar to other coastal blue health studies developed in England, where the percentage of people reporting 'good general health' was higher the closer they lived from the coast, relative to people living more than 50 km away from it (Wheeler et al., 2012), or where living in the first 5 km from the coast was associated with better general health than living 5–50 km from it (White et al., 2013). There are some differences between these studies and ours, as these were conducted at national level and, consequently, explored a bigger distance from the coast (>50 km). However, despite these differences, our findings were still similar to the breakdown values presented by Wheeler et al. (Wheeler et al., 2012) for their proximity bands, where people living <1km from the coast had the highest score regarding the prevalence of good general health, over other proximity bands like >1–5 km and >5–20 km.

Our findings were also in the same line as those from the (not so many) previous studies focused on the salutogenic effects of beach spaces, which had already suggested a positive association between: the well-being promotion of families with young children and their engagement with local beach spaces (Ashbullby et al., 2013; Bell et al., 2015), the behavioural development in children and beach attendance (Amoly et al., 2014) and the achievement of recommended levels of physical activity and beach use (Edwards et al., 2014). Again, there are some differences between the approach and methods used by these studies and ours, as these were mostly based

on primary health data, focused on different population groups and explored different kinds of salutogenic effects. Still, all these studies (including ours) provided evidence about some form of health benefit associated with the exposure to these beach spaces.

Brereton et al. (Brereton et al., 2008) found an association between proximity to coast and a higher life satisfaction in adults from Ireland, while proximity to beach emerged insignificant in their regression. The authors explained that Ireland's climate might contribute to decouple the amenity value of coastal areas from the availability of a beach, which makes sense as the amount (and quality) of activities to be enjoyed at the beach should be reduced if the weather is bad. In contrast, the warmer climate conditions from the Mediterranean region favour the recreational use of beach spaces, which might probably explain (to some degree) why proximity to beach emerged significant in our case study.

Furthermore, consistent with previous studies related to coastal blue spaces (Wheeler et al., 2012) and green spaces (Mitchell and Popham, 2008), our results revealed that the health effects provided by Barcelona's beaches could be modified by the socioeconomic conditions of people. In particular, people with a low family income presented a stronger association between beach proximity and having good general health, while we observed no significant health effects associated with beach proximity for people with a high family income (for both models). As stated by previous studies (Maas et al., 2006; Mitchell and Popham, 2008; Wheeler et al., 2012), these health effects being stronger for population groups with lower socioeconomic conditions could mean that the exposure to these natural environments would help alleviate the health inequalities derived from socioeconomic deprivation.

In summary, this case study in Barcelona provides empirical evidence regarding the positive impact on people's general health derived from living closer to beach spaces and, as consequence, having a greater chance of being more exposed to them. However, when referring to these findings, there are some limitations that should be considered:

First, we had no specific data about the use of beach spaces to measure each person's exposure to them, so we ended up using the distance from people's dwelling places to the beach instead, and assuming that people living closer to these spaces would be more exposed to them. Also, we used a secondary health dataset, which allowed us to have one of the bigger sample sizes among the existing studies that are particularly focused on the salutogenic effects of beach spaces; however, the information in the health survey we used was not directly related with our research question. Third, we were not able to capture the seasonality aspect regarding the health benefits related to people's exposure to the beach, which might be relevant, considering how the climate conditions vary between summer and winter time in the Mediterranean region, presumably affecting the way people experience these spaces during the year. Finally, this was a cross-sectional analysis, so further longitudinal studies would be needed to support the potential associations presented in this one, by preventing potential cohort effects or report biases.

The findings of this paper contribute to grow the currently small body of research related to this matter. Also, researches like this one could make a good serve for health policy makers, urban planners and environmental managers, among others, in Spain (as well as in the Mediterranean region), where beaches (and the coast, in general) have a remarkable interest and importance. More evidence regarding the health effects related to the contact with beaches would help promoting healthy practices based on people's engagement with these blue spaces, which, in turn, would likely encourage a stronger protection, conservation and restoration of these

spaces, as well as their appropriate integration in the urban landscape for public use and recreation.

Further research in this field should continue to explore this relationship between coastal blue spaces and human's health and well-being, by doing longitudinal analyses, by studying more cases in different locations (and climates) and by better acknowledging the underlying causes of these health benefits, considering different population groups, based on factors like their age, socioeconomic status or family structure.

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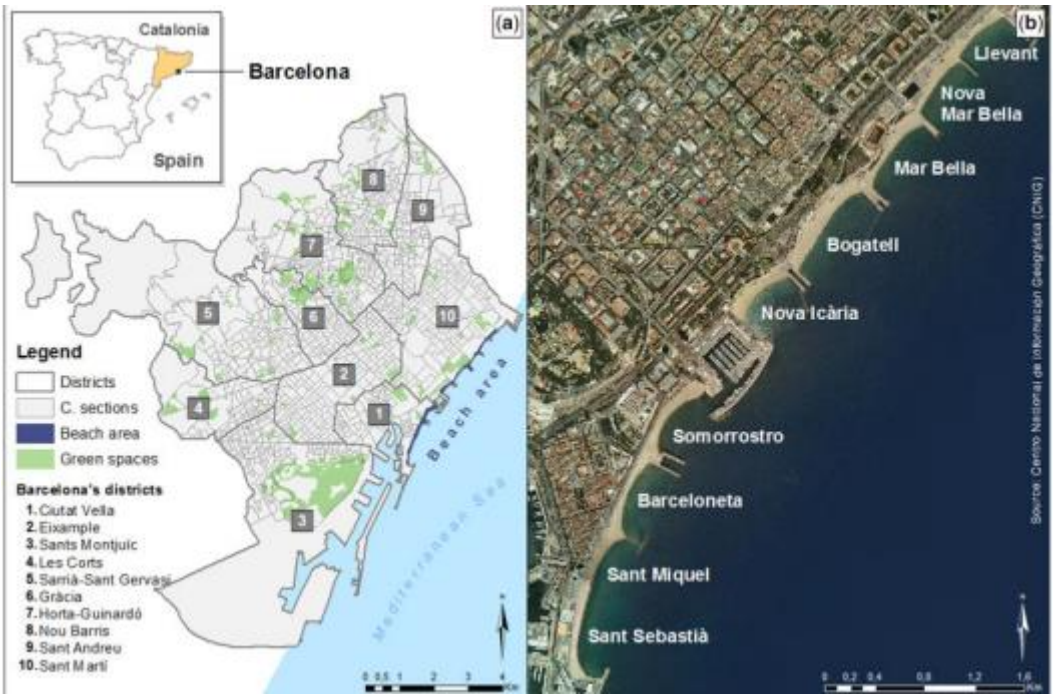

Fig. 1: Administrative divisions (panel a) and beach area (panel b) of Barcelona.

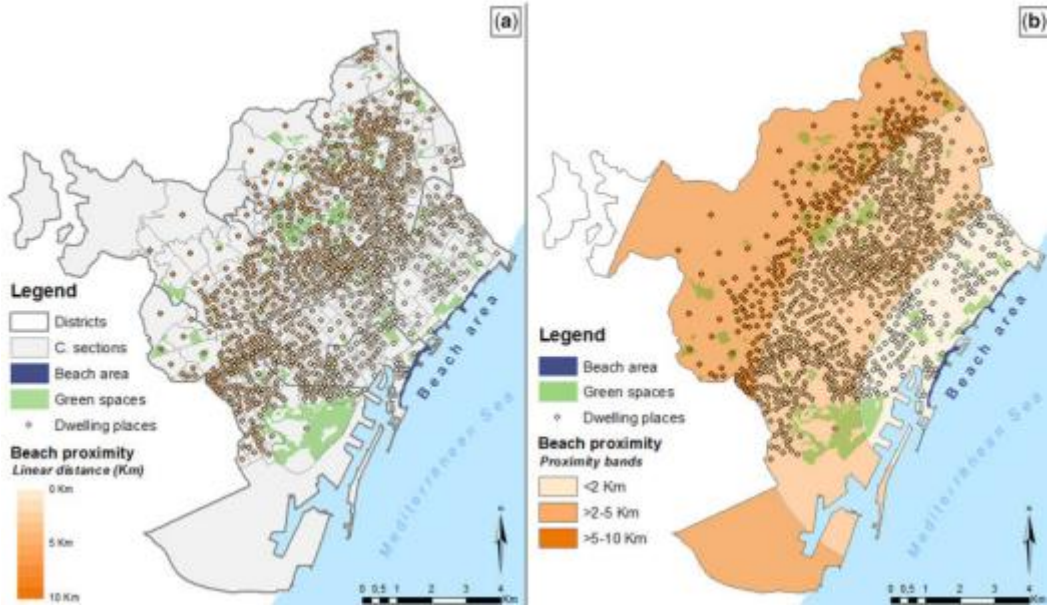

Fig. 2: Subject's dwelling places and beach proximity measures: linear distance (panel a) and proximity bands (panel b).

Table 1: Logit regression results (overall and stratified by income) estimating the probability of having good general health

	Linear distance model			**Proximity bands model**		
	Overall	**Low income (≤18000€)**	**High income (>18000€)**	**Overall**	**Low income (≤18000€)**	**High income (>18000€)**
	n=3192	n=1190	n=2002	n=3192	n=1190	n=2002
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Beach proximity						
Linear distance	0.93 (0.87, 1.00)					
Proximity bands						
<2 km	-					
>2-5 km	-					
>5-10 km	-					
Control variables						
Sex (male)	1.35 (1.08, 1.70)	1.49 (1.07, 2.07)	1.22 (0.89, 1.68)	1.36 (1.08, 1.71)	1.50 (1.08, 2.09)	1.23 (0.89, 1.69)
Age	0.97 (0.96, 0.97)	0.97 (0.96, 0.98)	0.97 (0.96, 0.97)	0.97 (0.96, 0.97)	0.97 (0.96, 0.98)	0.97 (0.96, 0.97)
Disease	0.12 (0.09, 0.15)	0.12 (0.08, 0.16)	0.12 (0.08, 0.16)	0.12 (0.09, 0.15)	0.12 (0.08, 0.16)	0.12 (0.08, 0.16)
Normal Weight	1.56 (1.24, 1.97)	1.62 (1.17, 2.25)	1.46 (1.05, 2.03)	1.56 (1.24, 1.97)	1.64 (1.18, 2.27)	1.46 (1.05, 2.02)
Sleep 6-10 h	2.89 (2.15, 3.90)	3.49 (2.28, 5.33)	2.38 (1.55, 3.65)	2.88 (2.14, 3.88)	3.47 (2.27, 5.30)	2.37 (1.54, 3.65)
Exercise	2.19 (1.62, 2.96)	2.28 (1.44, 3.61)	2.09 (1.40, 3.12)	2.21 (1.63, 2.98)	2.30 (1.46, 3.64)	2.11 (1.41, 3.15)
Social support	1.65 (1.31, 2.07)	1.74 (1.26, 2.40)	1.59 (1.15, 2.20)	1.66 (1.32, 2.09)	1.75 (1.27, 2.43)	1.59 (1.15, 2.20)
Education	1.31 (1.04, 1.67)	1.34 (0.96, 1.87)	1.26 (0.90, 1.77)	1.32 (1.04, 1.67)	1.34 (0.95, 1.87)	1.27 (0.90, 1.78)
Income (>18000€)	2.17 (1.72, 2.73)	-	-	2.17 (1.72, 2.73)	-	-
Crime	0.71 (0.52, 0.97)	0.81 (0.53, 1.23)	0.59 (0.37, 0.94)	0.69 (0.51, 0.95)	0.80 (0.52, 1.22)	0.57 (0.36, 0.92)
Green space availability	1.38 (0.98, 1.93)	1.44 (0.89, 2.33)	1.30 (0.80, 2.11)	1.33 (0.95, 1.87)	1.41 (0.87, 2.28)	1.26 (0.78, 2.06)
Constant	4.79 (2.46, 9.36)	3.89 (1.56, 9.71)	13.84 (5.04, 37.99)	3.50 (1.79, 6.86)	2.22 (0.90, 5.46)	13.19 (4.70, 37.04)

For both models, the Prob > v2 was 0.00, while the percentage of (overall) observations that were correctly predicted was 86.34%.