



Neighborhood Social Capital and Obesity: a systematic review of the literature

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Conflict of interest:

Authors declare no conflict of interest.

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3 **1 Neighborhood Social Capital and Obesity: a systematic review of the literature**
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8 **3 Abstract**
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10 4 Social capital, defined as the resources accessed by individuals and groups through social
11 5 connections, has been posited to be a social determinant of obesity. However, empirical evidence
12 6 for this association has been inconsistent – viz. some studies have found a protective association
13 7 while others have reported no correlation. We sought to conduct a systematic review on the
14 8 relation between neighborhood social capital and obesity, considering potential differences on the
15 9 results based on the measures used and the covariates and mediators included in the studies.
16 10 PRISMA Statement guidelines were followed. Our results indicate that an association between
17 11 neighborhood social capital and obesity exists, but that it depends on the measures and covariates
18 12 used in the study design. Understanding the role of social capital in the development and/or
19 13 maintenance of obesity will require the use of strong methodological designs and a thorough
20 14 conceptualization of how this relationship may arise.
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31 15
32 16 **Keywords:** Social capital, obesity, neighborhood, systematic review.
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3 25 Because of its high prevalence, its impact on morbidity and quality of life, and its associated
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5 26 economic burden, obesity has been recognized as one of the main health-related challenges that
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7 27 contemporary societies face (1). As a response, the development and implementation of
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9 28 preventive actions to reduce obesity rates have become a priority in most public health agendas.
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11 29 Research on obesity prevention also illustrates this trend: beyond the increase in the volume of
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13 30 publication, there has also been a noticeable shift in approaches to tackle this health issue. During
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15 31 the first decades of research, the focus was on specific nutrient intake, its relation to other
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17 32 diseases such as cardiovascular disease, hypertension or diabetes and behavioral interventions at
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19 33 the individual level. From the late-nineties an important body of research has moved towards the
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21 34 so called “ecological approach” to the obesity pandemic (2–4).

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23 35 This approach reflects a better understanding of the etiology of obesity and acknowledges that the
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25 36 imbalance between energy intake and expenditure that eventually leads to an increase in
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27 37 adiposity is the result of complex interrelationships between biological, behavioral and
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29 38 environmental factors, also referred to as the social determinants of obesity (3–5). The main
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31 39 rationale behind this shift is based on the rapidity and intensity with which the epidemic of obesity
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33 40 evolved during the past decades. These changes cannot be explained by any genetic shift in
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35 41 populations. Rather, the marked rise in obesity more closely mirrors changes in the environment
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37 42 and the way we live. Market globalization, economic growth and the influence of publicity and
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39 43 mass media have been identified to be drivers of individual and group behaviors, whose effects
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41 44 are modulated by different factors at the regional, national and local level (6). Beyond these
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43 45 elements at the macro level, other factors such as income level education, housing, or working
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45 46 conditions, as well as rural vs. urban residence, are also linked to rates of obesity (7, 8).

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47 47 At the beginning of the 2000s, attention turned to “social capital” as a social determinant of
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49 48 overweight and obesity (Kim et al., 2006). Multiple definitions of social capital have been offered.
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51 49 Broadly, social capital can be defined as the resources that individuals can access thanks to their
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53 50 membership in a network or group, which includes both the resources accessible through direct,
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55 51 individual connections as well as the ones that are available to all the members just for belonging
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57 52 to the group (9). In Public Health, social capital has been mainly studied through two approaches:
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59 53 social cohesion and social network. Social cohesion refers to the extent of closeness and solidarity
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61 54 within groups, and as such, the most commonly used indicators tap into perceptions such as sense
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63 55 of belonging, trust and norms of reciprocity (10). Network-based perspectives to social capital are
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65 56 developed by mapping and characterizing individual or group relationships regarding the number
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3 57 of ties, nodes' position, degrees of separation, etc.; and the resources within them. These
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5 58 resources are normally designated as social support, and classified in different subtypes, based on
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7 59 the type of assets that they provide: emotional, instrumental, appraisal or informational (11). For a
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9 60 more thorough discussion of the different conceptualizations subdimensions and measurement
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11 61 approaches to social capital the reader is referred to more specific texts on the topic (12, 13).
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13 62 Social capital can be conceptualized as both, an individual or a collective feature (14). In the latter
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15 63 case, it can be analyzed at different levels or scales, ranging from country to family or workplace
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17 64 settings. Until the date, the neighborhood, family and workplace have been the most studied
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19 65 environments (13), although first researches on social capital and health were conducted at upper
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21 66 scales, such as county and state levels (15, 16). At each of these, social capital is considered to
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23 67 influence health through different pathways, which makes necessary to analyze the different
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25 68 level's separately for accuracy purposes. For example, while social capital at both neighborhood
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27 69 and state level is thought to affect health through collective efficacy and informal control, social
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29 70 support is only hypothesized to operate at the neighborhood level (10). In this review, we focus on
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31 71 the association between obesity and social capital analyzed at the neighborhood level.

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33 72 While the concept of social capital continues to be refined and debated (13, 17, 18) multiple
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35 73 studies have linked different elements of social capital with benefits for health, and its promotion
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37 74 been purported as a promising strategy to reduce inequalities and promote health and wellness
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39 75 (19, 20). Hence, if social capital is to be used in health promotion there is a need to understand
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41 76 how it is linked to the different health problems communities' face, and obesity is certainly one of
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43 77 them.

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45 78 The mechanisms through which neighborhood social capital is associated with overweight and
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47 79 obesity is a topic that requires more elaboration. A good starting place is to consider the
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49 80 mechanisms that have been put forward for social capital in relation to other health outcomes. At
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51 81 the neighborhood level, possible pathways mediating this relationship might include (1) informal
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53 82 control and the *normalization* of health-related behaviors, (2) collective efficacy, (3) exchange of
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55 83 social support (7, 21). It has also been observed that social capital can positively and negatively
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57 84 affect health (22, 23). So, theoretically, it can be induced that, in a community, informal control
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59 85 can legitimate healthy (e.g., the prevalent norms and values of the group is to avoid sugar and
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86 trans-fat intake) as well as unhealthy behaviors (e.g., friends gather twice a week in a bar or pub to
87 drink beer, eat a big burger & fries); collective efficacy can be health promoting (e.g., advocating
88 for car-free spaces that allow children and adults to exercise more easily) or health damaging (e.g.,

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3 89 gathering signatures against soft drink taxation); and social support, too, may reinforce both
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5 90 healthy behaviors (e.g., giving advice about where to get nutritional supervision, where to buy
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7 91 local products) and unhealthy behaviors (e.g., by providing unhealthy foods in community events
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9 92 or spaces).

10 93 The reality, though, is not so straightforward, and beyond the variations due to the measures used
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12 94 to estimate neighborhood social capital, aspects such as the study design, data operationalization
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14 95 and other contextual and compositional features such as SES, age, gender, culture or living in
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16 96 urban or rural environments have been posited to influence and condition how social capital
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18 97 relates to health and, we might expect, to body weight as well (12). These potential interactions
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20 98 and how they might relate to obesity are discussed in the next paragraphs.

21 99 The association between SES and obesity is itself complex, context-dependent, and dynamic.
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23 100 Different pathways could theoretically explain differences in the social capital and obesity
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25 101 association, ranging from body fat acceptance, eating behaviors or leisure time informal norms
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27 102 and values (24–26), nutritional transition moments (27), or the provision of social support in all its
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29 103 forms (28, 29) . For example, in low income settings, being overweight is historically a marker of
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31 104 prestige (having enough to eat), and hence associated with *higher* SES. Being indolent and
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33 105 overweight was linked with being pale (i.e. protected from the sun) as an outward symbol of
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35 106 privilege, viz. not having to toil outdoors in the sun. By contrast, as societies undergo the
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37 107 economic & nutritional transition, it is observed that the socioeconomic gradient in overweight
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39 108 *flips*, i.e. it has become a sign of high status to be thin, and to be tanned.

40 109 Age and gender are relevant characteristics that may influence the association between
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42 110 neighborhood (and overall) social capital and obesity. In the case of age, explanations for its
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44 111 relevance bring us to life-course approaches and to developmental theory, according to which the
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46 112 effect of any variable varies across the life-span (30, 31). In psychosocial terms, for example,
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48 113 adolescents are more prone to be influenced by trendy norms and peer informal control (e.g.
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50 114 around body shape, foods to be eaten, the use of social media or sport practices, etc.), while
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52 115 aspects of trust and reciprocity may be more relevant in adulthood (32, 33).

53 116 The effects of neighborhood social capital on health might also be expected to be dependent on
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55 117 the cultural context (18). Key factors explaining this specificity include differences in the quality of
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57 118 the ties, as well as the shared norms, values and beliefs of the members within the network. For
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59 119 example, it might be expected that the social acceptability of different body shapes varies across

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3 120 different cultures, e.g. the *ideal* of feminine beauty in Latin countries which emphasizes fuller
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5 121 figures compared to an obsession with thinness in East Asian countries. A specific case of the
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7 122 influence of the social context is the comparison between urban and rural settings. Potential
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9 123 differences in the relation of social capital and obesity in urban/rural environments could be
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11 124 theoretically explained by norms about body image, leisure activities and motivations for health,
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125 but no paper in our review actually provides empirical evidence on these topics.

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14 126 As [Mackenbach et al.](#) have described in this very same journal, a further influence in the
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16 127 relationship between social capital and obesity refers to methodological issues (21). The main
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18 128 issue in this point concerns the quantitative operationalization of social capital, considering it as a
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20 129 contextual construct that can be influenced both by individual-level and other community-level
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22 130 variables. Capturing contextual information may be difficult, and most researchers use aggregate
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24 131 individual data (21, 34). When individual information is used to conform community measures,
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26 132 failing to adequately aggregate and adjust social capital as a contextual variable, implies treating
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28 133 neighborhood social capital as a reflection of individual characteristics of the participants in the
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30 134 study.

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32 135 Hence, because consistent data on the association between neighborhood social capital and
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34 136 excess weight is missing and it might be helpful to orientate community interventions to promote
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36 137 health, the aim of this paper is to report a systematic review on the relation between
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38 138 neighborhood social capital and obesity.

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41 140 **Methods**

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43 141 We sought to conduct a systematic review on the relationship between social capital and obesity
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45 142 with the purpose of shedding light in the following questions: (1) What is the association between
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47 143 neighborhood social capital and obesity?; (2) How has it been studied?; (3) Does the association
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49 144 between neighborhood social capital and obesity vary depending on the different
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51 145 operationalization and constructs used in the measurement of social capital?; (4) What are the
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53 146 effects of the different covariates, confounders and mediators on the association between
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55 147 neighborhood social capital and obesity?

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57 148 PRISIMA Statement guidelines for conducting systematic reviews and meta-analysis (35) were
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59 149 followed. After having identified all potential papers meeting our eligibility criteria (see next

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3 150 point), the application of statistical procedures to perform a meta-analysis was not possible due to
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5 151 heterogeneity issues. Hence, we report here only the descriptive results of the systematic review.
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7 152 Place Figure 1 here
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9 153 A detailed search in the PubMed, Web of Science, Psychinfo and Embase databases was
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11 154 conducted in May 2018. Different search strategies were built with the assistance of a medical
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13 155 librarian and Boolean operators were specifically built for each database including different terms
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15 156 for the concept of “obesity” and “social capital” (Table 1). A decision of limiting the sample to
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17 157 studies mentioning explicitly “social capital” was made with the intention of specifically investigate
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158 the use of the social capital theory to study obesity. No time limits were set.
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Pubmed	("Social Facilitation"[Mesh] OR social capital[tw] OR informal control[tw] OR (trust[tw] OR cohesion[tw] OR reciprocity[tw]) AND ("Residence Characteristics"[Mesh:NoExp] OR communit*[tw] OR social[tw] OR neighborhood*[tw] OR neighbourhoood*)) AND ("Overweight"[Mesh] OR "Pediatric Obesity"[Mesh] OR "Body Weight"[Mesh:NoExp] OR obesity[tw] OR overweight[tw] OR over weight[tw] OR body mass[tw] OR bmi[tw] OR body weight[tw])
Web of Science	"social capital" OR "informal control" OR ((trust OR cohesion OR reciprocity) AND (communit* OR social OR neighborhood* OR neighbourhoood*)) AND obesity OR overweight OR "overweight" OR "body mass" OR bmi OR "body weight"
PsycInfo	<p><u>1. Obesity</u></p> <p>search in "all fields" DE "Overweight" OR DE "Obesity" OR DE "Body Mass Index" OR DE "Body Weight"</p> <p>search in title, abstract, key words: OR obesity OR overweight OR "over weight" OR "body mass" OR bmi OR "body weight"</p> <p><u>2. Social Capital</u></p> <p>DE "Social Capital"v= Investing in social relationships by establishing trust, norms, and networks to create social cohesion and facilitate cooperative communities.</p> <p>search in "all fields" DE "Social Capital" OR search in title, abstract, key words: "social capital" OR "informal control" OR ((trust OR cohesion OR reciprocity) AND (communit* OR social OR neighborhood* OR neighbourhoood*))</p>
Embase	<p><u>1. Obesity</u></p> <p>DE 'Social Capital' OR 'social capital':ti,ab OR 'informal control':ti,ab OR ((trust:ti,ab OR cohesion:ti,ab OR reciprocity:ti,ab) AND (communit*:ti,ab OR social:ti,ab OR neighborhood*:ti,ab OR neighbourhoood*:ti,ab))</p> <p><u>2. Social Capital:</u></p> <p>'obesity'/exp OR 'body weight'/de OR obesity:ti,ab OR overweight:ti,ab OR 'over weight':ti,ab OR 'body mass':ti,ab OR bmi:ti,ab OR 'body weight':ti,ab</p>

161 Table 1. Boolean operators used for every database in this systematic review

162 Source: Own elaboration

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3 165 ***Eligibility criteria***
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5 166 Our strategy included one main inclusion criterion: observational studies that reported a statistical
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7 167 test of the relationship between constructs of neighborhood social capital and obesity, defined in
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9 168 terms of BMI. In the social epidemiology literature, it is possible to find studies that use what we
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11 169 have mentioned in the introduction as constructs of social capital (e.g. trust, informal control,
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13 170 collective efficacy) within the theoretical framework of social capital and studies that do not. As
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15 171 previously indicated, only the former were included in our review.

16 172 No specific sample features were established regarding age, gender or other sociodemographic
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18 173 characteristics. Similarly, no geographical nor time restrictions were applied. Publication language
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20 174 was restricted to English and Spanish for logistic reasons.

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23 176 ***Study coding and data analysis***
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26 177 The coding strategy involved several examinations of the studies to be included. Each study was
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28 178 reviewed for: (1) report identification, (2) study setting, (3) sample characteristics, (4) statistical
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30 179 analysis used to test the association between the independent and dependent variables, (5)
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32 180 outcome variables, (6) co-variables reported, (7) constructs used as measures of social capital, (8)
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34 181 level of spatial aggregation at which social capital measures were measured or tested, (9), tested
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36 182 associations of social capital on BMI, (10) operationalization of social capital measures.

37 183 After removing duplicates, references were title and abstract screened by two coders (EC and ML),
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39 184 who judged whether each paper met the inclusion criteria. For each of the references, a “yes”,
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41 185 “no” or “can’t tell” was attributed. Discrepancies between coders as well as the movement of
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43 186 references with one or more “can’t tell” to the full text screening phase was discussed with the
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45 187 authors of this paper. The process complies with standard requirements for reliability testing and
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47 188 was repeated in the full-text stage, with the 42 references that conformed to the inclusion criteria.
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49 189 Inter-rater reliability, assessed by the interclass correlation coefficient, was 0.94.

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194 **Results**

195 The search provided 946 references, which resulted in 665 documents after removing duplicates.
196 After revision by the two coders, a total of 22 papers conformed the final sample, which were
197 tabulated to facilitate the analyses. Table 2 shows the full list of references together with their
198 descriptive data.

Reference	Country	Objectives	Statistical analysis	Sample characteristics	Sample source	Social capital approach	Constructs and measures of SC	SC Operationalization	Overall results	Social capital association with BMI (protective, damaging, null)
Bala-Brusilow, 2010	US	To expand the understanding of childhood obesity in American children by examining the associations between obesity in children and measures of social capital.	Logistic and OLS multiple regression models		2003 National Survey of Children's Health.	Social cohesion	<ul style="list-style-type: none"> • Neighborhood social capital scale: <ul style="list-style-type: none"> - perceptions of neighbors helping each other, - watching out for each other's children, - being able to "count" on the neighbors, - belief that if the respondent's child was "hurt or scared" a neighbor would help the child. • Neighborhood social support: <ul style="list-style-type: none"> - people in this neighborhood help each other. 	Data was collected individually, information about aggregation at the neighborhood level was not available.	Neighborhood social capital was not significant in the full model, when measures of personal and family social capital were included.	Null
Borgonovi, 2010	UK	To examine to what extent social capital can promote individual well-being in the form of good physical and mental health.	Probit models, marginal effects	17.500 adults followed-up for 30 years	Data from the National Child Development Survey (NCDS) and the 1970 British Cohort Study (BCS)	Social cohesion	<ul style="list-style-type: none"> • Membership in groups and associations • Regular attendance in religious services. • Political participation - as a measure of linking social capital. 	Data was collected individually, information about aggregation at the neighborhood level was not available.	Social participation and trust are associated with lower likelihood of being obese, particularly at age 46.	Protective
Christensen & Carpiano, 2014	Denmark	To test hypotheses regarding (a) the extent to which economic, cultural, and social capital possessed by women are associated with body mass index and (b) which specific lifestyle-related attitudes and behaviors regarding healthy eating, cooking, and exercise routines mediate these capital-BMI relations.	Causal steps approach	1376 women	2007 Danish national consumer-scan panel (GFKP).	Social network	<ul style="list-style-type: none"> • Social connections at the employment, apprenticeship, child education and residence contexts. 	Data was collected individually and operationalized into a composite scale whose internal consistency was evaluated. Information about aggregation at the neighborhood level was not available.	<p>Possession of social capital had positive and negative associations with BMI through greater participation in sports and strenuous exercise and through greater cooking interest.</p> <ul style="list-style-type: none"> · Findings for sports and strenuous exercise suggest that women with greater social capital may engage in such exercise activities because they value the social aspects of such exercise. · Findings for social capital being associated with higher BMI via greater interest in cooking suggest a downside to such social engagement. Greater interest in cooking may indicate a desire to entertain friends more so than cooking healthy and nutritious meals. Alternatively, greater social capital may also suggest the receipt of greater demands from others, resulting in preparing meals for oneself and others that are more convenient and time efficient than healthy. 	Protective/damaging – depending on the mediators

Christian et al. 2011	Australia	To examine the individual, behavioral, social and built environment correlates of body mass index (BMI) in an Australian adult population	Multivariate regression	1151 adults	RESIDE project	Social cohesion	<ul style="list-style-type: none"> • Social capital was measured using the Neighborhood Cohesion Scale by Buckner (1988), which includes: <ul style="list-style-type: none"> - Eagerness to remain a resident in the neighborhood - Interaction among neighbors - Emotional connections among neighbors 	Data was collected individually, information about aggregation at the neighborhood level was not available.	BMI was not associated with social capital; it was independently associated with one perceived environment measure (perceived safety from crime).	Null
Cohen et al., 2006	US	To determine whether neighborhood collective efficacy is associated with individual measures of body mass index (BMI) in adolescents.	Hierarchical regression	807 adolescents	2000 Los Angeles Family and Neighborhood Survey (LAFANS)	Social cohesion	<ul style="list-style-type: none"> • Collective efficacy - based on items collected in previous research by Sampson et al. (1997) which reflect a combination of factors related to both social cohesion and neighborhood informal social control 	<p>Measures were collected in a sample of partially independent adults living on the same census districts that the adolescents participating in the study. This is, while some of the respondents had children who constituted the adolescent sample (for whom BMI was measured), most did not.</p> <p>From this adult sample, individual responses to each question were averaged into an adult respondent-level scale of collective efficacy. These averages were further aggregated by 1990 census tract boundaries and subsequently appended to each adolescent residing in the same census tract.</p>	Significant relationships between collective efficacy and all three outcomes, net of levels of neighborhood disadvantage. The associations between BMI and collective efficacy could potentially be explained by several factors, including a metabolic pathway, neighborhood differences in the physical and social environments, or a combination of these two.	Protective
Duke et al., 2012	US	To examine the relationship between parent perceptions of neighborhood and youth aerobic physical activity and weight.	Logistic regression models	64076 children and adolescents (6-17 years)	2007 National Survey of Children's Health	Social cohesion	<ul style="list-style-type: none"> • Trust 	Data was collected individually. The study includes several models, including one in which trust is not aggregated and one in which all neighborhood level variables were aggregated (social capital, physical condition, resource availability, safety). Information about aggregation at the neighborhood level was not available.	Neighborhood characteristics, including social capital, resource availability, and safety were significantly associated with increased likelihood of youth achieving healthy physical activity and normal weight parameters even with adjustment for individual and family-level demographic and behavioral characteristics.	Protective
Evans & Kutcher, 2011	US	To provide evidence on whether the well-documented effect of childhood poverty on the health risks of smoking and obesity would be attenuated among low-income, rural youth living in communities with greater social capital.	Regression Analysis	196 adolescents	Several rural counties in upstate New York	Social cohesion	<ul style="list-style-type: none"> • A social capital index was calculated across three domains: <ul style="list-style-type: none"> - community cohesion, - social control, and - youth' relationships with adults in the community. 	Data was collected individually, information about aggregation at the neighborhood level was not available.	Youth from more disadvantaged households had higher BMIs than those from more affluent families, but only when social capital was low. Childhood income was significantly related to BMI at age 17, and social capital was marginally related to BMI at age 17. Young adults from low income backgrounds had more body fat than their more affluent counterparts, but this was not true if they resided in communities with abundant social capital.	Protective

Greiner et al., 2004	US	To examine the associations between levels of community participation, self-reported community ratings (trust) and health within a public health surveillance survey conducted in Kansas	Multivariable logistic regression	4601 adults	BRFSS	Social cohesion	<ul style="list-style-type: none"> Community trust Social participation 	Data was collected individually. A multilevel analytical approach was incorporated in the logistic regression models to account for the possible clustering effects of respondents at different population density levels. Population density and subject characteristics were considered potential confounders if they were associated or were known to be associated with dependent variables or independent variables of interest based on prior literature.	Obesity was not associated with community ratings nor community involvement.	Null
Mackenbach et al., 2016a	Belgium, France, Hungary, the Netherlands and UK	To assess the reliability of ecometric measures of neighborhood social capital, by comparing ecometric and aggregate measures in relation to self-rated health, weight status and obesity-related behaviors.	Multilevel logistic regression	5900 adults	European SPOTLIGHT survey	Social cohesion/social network	A 13-item scale proposed by Beenackers et al. 2013 measuring both <ul style="list-style-type: none"> social cohesion social network 	Social capital was aggregated at the neighborhood level using ecometric. mean neighborhood scores of social capital and mean neighborhood scores of social capital adjusted for individual scores measures were used. Models were contextually adjusted by neighborhood type (SES and residential density) and some individual characteristics were also considered.	Individuals in the highest quartile of social networks or social cohesion had approximately 30% lower odds of obesity than individuals in the lowest quartile, regardless of how neighborhood scores were estimated. Adjustment for individual social network scores attenuated the coefficients of the mean neighborhood scores. Results with overweight as an outcome were less clear.	Protective
Mackenbach et al., 2016b	France, Hungary, the Netherlands and UK	To explore whether neighbourhood social capital mediates the association of neighbourhood income inequality with individual BMI	Single mediation analyses using multilevel linear regression analyses	4126 adults	European SPOTLIGHT survey	Social cohesion/social network	A 13-item scale proposed by Beenackers et al. 2013 measuring both <ul style="list-style-type: none"> social cohesion social network 	Social capital was aggregated at the neighborhood level using ecometric approaches.	Higher neighbourhood income inequality was associated with elevated levels of BMI and lower levels of neighbourhood social networks and neighbourhood social cohesion. High levels of neighbourhood social networks were associated with lower BMI. Results stratified by country demonstrate that social networks fully explained the association between income inequality and BMI in France and the Netherlands. Social cohesion was only a significant mediator for Dutch participants.	Protective/null – depending on the country
McKay et al., 2007	US	To examine the influence of economic and social context on the odds of being inactive or having above-normal weight and whether the influence differed on the basis of stage of adolescence.	Hierarchical generalized linear modelling	37930 adolescents	2003 National Survey of Children's Health	Social cohesion	<ul style="list-style-type: none"> Community trust Community mutual-aid State-level trust State-level mutual aid 	Social capital measures at both community and state level were respectively aggregated to conform contextual level variables.	Both state-level mutual aid and community social trust were significantly related to the odds of an adolescent not meeting current physical activity recommendations, yet state-level poverty was not. For BMI, all 3 state-level variables were significant predictors of having an above-normal BMI. Evidence was found of the moderating influence	Protective

									of stage of adolescence for both outcomes.	
Moore et al., 2009	Canada	To examine the association of individual trust, participation and social capital with obesity using objective measures of waist circumference (WC), body mass index (BMI) and network measures of social capital.	Proportional odds model with clustered robust standard errors	332 adults 18-55 years old	Data were drawn from the Montreal Neighborhood Survey of Lifestyle and Health (MNSLH).	Social cohesion/social network	<ul style="list-style-type: none"> • Network social capital - Position generator • Trust • Participation 	Data was collected individually, information about aggregation at the neighborhood level was not available.	<p>Network social capital was inversely associated with the likelihood of being in an elevated WC risk category and higher BMI category.</p> <p>Trust and participation were not associated with BMI – the authors warn that it may have been influenced by an insufficient statistical power due to a limited sample size.</p>	Protective/Null - depending on the indicators
Nesbit et al., 2014	US	To test a conceptual model of proximal (home) and distal (neighborhood) environmental correlates of adolescent obesity.	Single-group structural equation modeling	39,542 youth aged 11-17 years	2007 National Survey of Children's Health	Social cohesion	<ul style="list-style-type: none"> - parent perception that the child is safe, - parent perception that others watch for the child, - and parent trust that people will help the child. 	Data was collected individually, information about aggregation at the neighborhood level was not available.	The total indirect effect of Neighborhood Condition on obesity through Social Capital was positive and statistically significant. The indirect effect of Access to Physical Activity on obesity through Social Capital was negative and statistically significant.	Protective
Poortinga, 2006	UK	To examine (1) the associations of the perceptions of the local environment with obesity, self-rated health, and physical activity, and (2) whether physical activity mediates the association between the perceptions of the environment, and obesity and self-rated health.	Multilevel analysis	14836 adults	2003 Health Survey for England	Social cohesion	<ul style="list-style-type: none"> • Social support • Trust • Civic participation 	Data was collected individually, information about aggregation at the neighborhood level was not available.	This study found that perceptions of the friendliness of the local environment were mainly associated with self-rated health; perceived access to leisure facilities with sports activities; perceived access to a post office with walking; and the presence of social nuisances with obesity and poor self-rated health. In addition, positive perceptions of the social environment (i.e., social support and social capital) were associated with higher levels of physical activity, and lower levels of poor self-rated health and obesity. Only limited support was found for the idea that health behaviors mediate the associations between the perceptions of the environment, obesity, and self-rated health.	Protective
Singh et al., 2008a	US	To examine independent and joint associations between several socioeconomic, demographic, and behavioral characteristics and obesity prevalence	Logistic regression	46708 youth aged 10-17	2004 National Survey of Children's Health	Social cohesion	<ul style="list-style-type: none"> • Social cohesion (parental perception) • Trust (parental perception) • Reciprocity (parental perception) 	Data was collected individually, and aggregated at different levels.	Ethnic minority status, non-metropolitan residence, lower socioeconomic status, lower social capital, higher television viewing, and higher physical inactivity levels were all independently associated with higher obesity prevalence. Adjusted obesity prevalence varied by age, gender, race/ethnicity, and SES, but not by social capital	Null

Singh et al., 2008b	US	To examine state- and regional disparities in obesity prevalence among 46,707 US children and adolescents aged 10-17 years before and after adjusting for individual socioeconomic and behavioral characteristics and area deprivation measures	Logistic regression	46708 youth aged 10-17	2004 National Survey of Children's Health	Social cohesion	<ul style="list-style-type: none"> • Social cohesion (parental perception) • Trust (parental perception) • Reciprocity (parental perception) 	Data was collected individually, and aggregated at different levels.	Individual characteristics such as race/ethnicity, household socioeconomic status, neighborhood social capital, television viewing, recreational computer use, and physical activity accounted for 55% of the state and 25% of the regional disparities in obesity.	Null
Veenstra et al., 2005	Canada	To examine the degree to which relationships between social capital and health are embedded in local geographical contexts and influenced by demographic factors, socio-economic status, health behaviours and coping skills	Multivariate logistic regression models	1504 adults	Telephone survey of a random sample of adults	Social network	<ul style="list-style-type: none"> • Breadth and depth of involvement in voluntary associations: type of association(s) and degree of involvement. 	Data was collected individually, and aggregated at for the different areas investigated.	Associational involvement and overweight status were weakly but significantly related after controlling for the other variables; involvement had relationships with self-rated health and emotional distress before but not after controlling for socio-economic status, health behaviors and coping skills. The neighborhood and associational involvement relationships with health were not dependent upon one another, suggesting that neighborhood of residence did not help to explain the positive health effects of this particular measure of social capital.	Protective
Veitch et al., 2012	Australia	To examine associations between aspects of the neighborhood social environment and body mass index (BMI) in youth both cross-sectionally and prospectively; and whether this association was mediated by physical activity, screen-time and sedentary time.	Multilevel linear regression	544 children	1st and 2nd follow-up data collection waves from "Children Living in Active Neighborhoods (CLAN)" study	Social cohesion/social network	<ul style="list-style-type: none"> • Trust/Cohesion (parental perception) • Social network (parental perception) 	Data was collected individually, information about aggregation at the neighborhood level was not available.	Cross-sectional and prospective regression analyses showed that a more positive social network and higher social trust/cohesion was related to lower BMI among children. Associations were stronger for social networks than for trust. There was no evidence that time spent in physical activity or sedentary behaviors mediated this relation, despite significant associations between social networks and screen-time and between screen-time and BMI.	Protective
Xue & Cheng, 2017	China	To explore whether different dimensions of social capital and lifestyle factors are related, and whether lifestyle factors mediate the association between social capital and self-rated health (SRH) and psychological well-being (PWB) in China	Logistic regression	28,916 adults	2014 China Family Panel Studies	Social cohesion	<ul style="list-style-type: none"> • Social trust <ul style="list-style-type: none"> - Generally speaking, do you agree that most people are trustworthy? • Social relationship <ul style="list-style-type: none"> - How do you rate your relationship with your neighbors over the past 12 months (5 options from very harmonious to very tense)? • Social participation <ul style="list-style-type: none"> - Chinese Communist Party membership 	Data was collected individually, information about aggregation at the neighborhood level was not available.	Only social trust is positively related, with social relationship and CCP membership associated with a higher likelihood of being overweight.	Protective/damaging – depending on the measures used.

Yu, 2016	US	To explore the influences of social cohesion and leisure-time physical activity on obesity in older adults, and tested whether these relationships varied by race/ethnicity and income level	Logistic regression	7714 older adults	2013 National Health Interview Study (NHIS)	Social cohesion	Four items survey measuring social cohesion <ul style="list-style-type: none"> • Support <ul style="list-style-type: none"> - People in the neighborhood help one another - People in the neighborhood can be counted on • Trust <ul style="list-style-type: none"> - People in the neighborhood can be trusted • Cohesion <ul style="list-style-type: none"> - Perception of the neighborhood as a close-knit community 	Data was collected individually, and aggregated using mean neighborhood scores	Neighbourhood social cohesion was not associated with obesity for older adults in any of the race/ethnicity groups	Null
Yun-Hsuan et al., 2018	Canada	To examine longitudinally the relationship among social capital, social networks, and obesity	Separate random effects logistic regression	2606 adults	Three waves (2008, 2010, and 2013) of the Montreal Neighborhood Networks and Healthy Aging Study (MoNNETHA)	Social cohesion/social network	<ul style="list-style-type: none"> • Network social capital <ul style="list-style-type: none"> - Position generator • Trust • Participation 	Data was collected individually, information about aggregation at the neighborhood level was not available.	The greater the number of kin ties in a person's network, the greater the risk of obesity. Adults with higher network diversity and high generalized trust were at a lower the risk of obesity. The current study confirmed that higher network capital and trust were protective against obesity, while having kin ties was not.	Protective/damaging – depending on the measures used.
Yoon and Brown, 2011	US	To explore whether higher levels of community social capital reduce the likelihood of being obese in the U.S. adult population, and whether this relationship may differ by levels of schooling.	Structural Equation Modelling	561,102 adults	2001 to 2005 Behavioral Risk Factor Surveillance System for all 50 U.S. states and the District of Columbia	Social cohesion	<ul style="list-style-type: none"> • Petris Social Capital Index (Ratio of full-time employees in voluntary organization to population) 	The PSCI is designed to be a measure of community-level structural social capital and represents community-level resources that promote and maintain Community SC.	Greater community social capital reduces adult obesity risk; and has a larger effect on persons with more schooling. Social capital affects obesity through the promotion of weight-control efforts.	Protective

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200 Table 2. Descriptive data of the papers included in this systematic review

201 Source: Own elaboration

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3 202 ***Study characteristics***
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5 203 Research on social capital and obesity has notably increased during the last years. In 2010, Kim et
6 204 al. identified only four studies that examined the effect of social capital (at different scales) on
7 205 obesity. In 2018, after a search in PubMed, Embase, the ISI Web of Science and PsycInfo
8 206 databases, we came up with 22 observational studies that reported a statistical test of the
9 207 relationship between constructs of social capital measured at a neighborhood/community level
10 208 and obesity. Twelve of these were conducted with adult population, while all other papers refer to
11 209 children and adolescent populations - although, as we shall see, most of the times social capital
12 210 data was provided by parents, caregivers or other community members.

13 211 All but two studies (Borgonovi, 2010; Yun-Husan et al., 2018) were cross-sectional designs. Data
14 212 was mainly drawn from broader health and lifestyle researches with sample sizes ranging from 196
15 213 to more than 500.000 individuals. The biggest differences in these studies concern social capital
16 214 constructs and its operationalization, and covariates and mediators. Tables 2 and 3 respectively
17 215 show such questions in our sample. Main social capital constructs are trust (36–44), social
18 216 participation (37–41, 43, 45, 46), informal control (36, 39, 47, 48) and social cohesion (47–50), but
19 217 the operationalization of each of these constructs is mostly heterogenous from study to study.
20 218 Some researches (37, 38, 43, 44, 48, 49) also combined measures of network social capital and
21 219 social support. Only ten out of the 22 studies included in this review provided information on the
22 220 operationalization of social capital at the neighborhood level (21, 40, 45, 46, 49–53)

23 221 Covariates comprised in the models included sociodemographic variables such as gender, age,
24 222 educational achievement, occupation, income, marital status, household composition,
25 223 race/ethnicity, foreign-born status, as well as health-related behaviors including sedentary
26 224 behavior, physical activity, alcohol consumption, and diet (e.g. saturated fat, fruit and vegetable
27 225 consumption). As observable in table 3, no two studies used the same set of covariates, and
28 226 theoretical rationale for the inclusion of these covariates was included in half of our sample. For
29 227 example, sociodemographic variables such as foreign-born status, age, gender, or SES, among
30 228 others, were considered to be confounders, being able to influence both neighborhood social
31 229 capital and obesity (21, 36, 40, 41, 47, 48, 54, 55). On the other hand, behaviors such as smoking,
32 230 drinking or saturated fat are most likely mediators (39, 45, 47). Christensen & Carpiano (2014) and
33 231 Duke et al. (2012) respectively provide examples of how interest in cooking and the practice of

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232 physical activity may act as both a confounder and a mediator. This differentiation is utterly
233 relevant to further understand the relationship between social capital and obesity.

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Paper	Gender	Age	Educational achievement	Private or Public education	Employment situation	Social class (occupation)	Individual or Family Income	Marital Status	Household composition	Household tenure	Race/Ethnicity	Foreign-born status	Length of residency	Primary household	Metropolitan/Non-metropolitan	Region of residence	Community Income	Household income inequality	Health insurance	Neighborhood conditions	Built environment	Perceived built environment	Access to Physical Activity	Sedentary behavior	Physical Activity	Saturated fat	Fruit and vegetable	Energy balance	Alcohol consumption	Smoking status	Family meal frequency	Self-reported global health	Self-reported psychological	Self-efficacy	Health conscious eating	Interest in cooking			
Bala-Brusilow, 2010																																							
Borgonovi, 2010																																							
Christensen & Carpiano, 2014																																							
Christian et al. 2011																																							
Cohen et al., 2006																																							
Duke et al., 2012																																							
Evans & Kutcher, 2011																																							
Greiner et al., 2004																																							
Mackenbach et al., 2016a																																							
Mackenbach et al., 2016b																																							
McKay et al., 2007																																							
Moore et al., 2009																																							
Nesbit et al., 2014																																							
Poortinga, 2006																																							
Singh et al., 2008a																																							
Singh et al., 2008b																																							
Veenstra et al., 2005																																							
Veitch et al., 2012																																							
Xue & Cheng, 2017																																							
Yu, 2016																																							
Yun-Hsuan et al., 2018																																							
Yoon and Brown, 2011																																							

235 Table 3. Use of covariates in the papers included in the systematic review.

236 Source: Own elaboration

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3 237 ***Findings across Studies***
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5 238 The results across studies are often contradictory, most likely due to the great heterogeneity. In
6
7 239 general terms, association of neighborhood social capital and obesity is eminently protective (15
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9 240 studies showed how higher levels of social capital were associated with lower BMI), while 8
10
11 241 studies found these two variables were not related, and three identified a health-damaging
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13 242 association. In this section, we present these results with greater detail and examine the potential
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15 243 reasons for the result differences among studies, based on the foreseeable aspects developed in
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17 244 the introduction section – social capital measures, socioeconomic status, age, gender, and cultural
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19 245 contexts. Additionally, we set a section on differences based on study design, because of the
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21 246 interest of this question for researchers and epidemiologists.
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24 248 ***Differences in study design***

25 249 All studies in our sample used cross-sectional designs, except for the one by Borgonovi. This is
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27 250 certainly an issue to take into account while interpreting the results of this review, as they are
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29 251 subject to all known study design dependent biases. That being said, and although a consistent
30
31 252 evidence about the relationship between social capital at the neighborhood level and obesity
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33 253 through cross-sectional studies was not found in our sample, 12 out of the 17 studies reported a
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35 254 protective role of social capital on BMI, through a social cohesion approach focusing on trust,
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37 255 social cohesion and collective efficacy (42, 45, 46, 48, 55, 56). In the paper by [Christensen &](#)
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39 256 [Carpiano \(2014\)](#) a different association was found depending on the approach and indicator of
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41 257 social capital used, as we shall see in the next section. No relationship was found in the studies
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43 258 reported by Bala-Brusilow (2010), Christian et al. (2011) [Greiner et al. \(2004\)](#) and [Singh et](#)
44
45 259 [al.\(2008a, 2008b\)](#), all of which had adopted a social cohesion approach (40, 47, 52, 57, 58).

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47 260 The study by Borgonovi (2010) is the used longitudinal data from about 17,500 individuals in the
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49 261 National Child Development Survey (NCDS) and the 1970 British Cohort Study (BCS) (37). Social
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51 262 capital measures included membership in social groups, trust, and shared norms. In their study,
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53 263 different forms of social capital were associated differentially with specific health outcomes: while
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55 264 interpersonal trust was particularly correlated with self-assessed health and mental well-being,
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57 265 membership in groups and associations was strongly associated with lower levels of obesity,
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59 266 alcohol abuse and dissatisfaction with life. However, reverse causation & endogeneity cannot be
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267 rejected even in longitudinal studies. For example, even if a researcher has access to longitudinal

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3 268 data in which the exposure (e.g. social participation) is linked to future outcomes (e.g. trajectories
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5 269 of weight gain over time), we cannot exclude the possibility that *baseline* differences in social
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7 270 participation reflect *unobserved* differences between individuals which confound the association
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9 271 between the exposure and outcomes. Hence, more sophisticated identification strategies are
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11 272 therefore needed to overcome endogeneity bias, e.g. using quasi-experimental designs such as
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13 273 instrumental variable estimation.

14 274

15 275 *Differences in social capital measures*

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18 276 In our review, the most used indicators were social participation and trust. Some papers included
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20 277 perceived safety as a measure of social capital. While we consider safety to be only a *proxy*
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22 278 measure of social capital, i.e. perceptions of neighborhood safety is more likely to be a
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24 279 *consequence* of phenomena more directly linked to social capital (such as informal social control
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26 280 & collective efficacy), we have chosen to discuss their findings on the grounds of providing a
27
28 281 comprehensive overview (as long as it was presented as a construct of social capital). Besides, it
29
30 282 could be rightly argued that some of the indicators used under the label “safety perception” could
31
32 283 rightly be considered as informal control and/or collective efficacy (i.e. as parents, we watch each
33
34 284 other’s children). While it would be too adventurous to draw any definitive conclusions with
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36 285 regard to which indicators might be more strongly associated with obesity, there seem to be more
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38 286 consistent results for social participation and trust. It must be acknowledged, though, that social
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40 287 participation (as an indicator of SC) is more susceptible to reverse causation (i.e. overweight
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42 288 people might be less likely to participate due to stigma and “fat-shaming”) and that, in any case,
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44 289 most studies have not incorporated a strong identification strategy to tease out these endogeneity
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46 290 threats.

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48 291 Greiner, Li, Kawachi, Hunt, & Ahluwalia (2004) found no evidence of obesity being associated with
49
50 292 either trust or social participation (40). These results are similar to those of Christian et al. (2011),
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52 293 which pointed out that social capital measures (not specified) were not associated with BMI -only
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54 294 perceived safety from crime was, but it shall not be considered a direct measure of social capital
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56 295 (47).

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58 296 Moore and colleagues (2009) found that indicators of trust (following the social cohesion
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60 297 approach) were not correlated with obesity, while social capital measured through the position
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62 298 generator (social network approach) was (38). This difference may suggest a stronger influence of

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3 299 body and health-related informal norms than an alternative pathway such as group cohesion, as
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5 300 well as variations according to the approach to social capital adopted. Christensen & Carpiano
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7 301 (2014) also examined the effect of specific types of network social capital (measures of social
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9 302 involvement related to employment, apprenticeship, child education and residence) and found
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11 303 that social capital was both positively and negatively associated with BMI, and that this
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13 304 relationship was mediated through greater participation in sports and strenuous exercise (lower
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15 305 BMI) and greater interest in cooking (higher BMI) (54). While the positive association of social
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17 306 capital and BMI through interest in cooking may seem counterintuitive (home cooking has been
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19 307 associated with lower BMI, eating out increases the risk of obesity (59, 60)), the authors explain
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21 308 their findings in terms of (1) a greater desire to entertain friends as opposed to preparing healthy
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23 309 and nutritious meals and (2) the receipt of greater demands from others, resulting in preparing
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25 310 meals for oneself and others that are more convenient and time efficient than healthy. Various
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27 311 researches have pointed out how cooking interest, sometimes driven by the massive increase in
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29 312 TV cooking shows that promote fancy rather than healthy meals can also explain this association
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31 313 (61, 62). All these possible explanations strengthen the need to refine research indicators: it is not
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33 314 only interest in cooking that matters, but especially, what kind of food and meals are being
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35 315 cooked.

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37 316 From a social cohesion point of view, social participation has been found to be associated with
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39 317 lower risk of obesity and some physical activity-related behaviors. Veenstra et al. (2005) showed
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41 318 associational involvement and neighborhood relationships to be correlated with lower risk of
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43 319 obesity after adjusting for other variables (45). Longitudinal analysis by Borgonovi et al. (2010)
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45 320 support these findings, taking political involvement as a measure of social capital, it was not
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47 321 associated to obesity (37). Poortinga's social capital measures included a 7-item scale on social
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49 322 support, one item on trust and 1 item on social participation, all of them at the individual level. It
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51 323 was found that only trust was protectively associated with obesity, while specific measures of
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53 324 social support, and civic participation were related to behaviors such as walking, sports and overall
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55 325 physical activity, but not obesity itself (39). At the collective level, friendliness of local environment
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57 326 (which can be considered as social cohesion social capital, for being measured through items such
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59 327 "neighbors look after each other") was not associated with obesity.

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328 In a European setting, Mackenbach et al (2016) reported that both, social cohesion and social
329 network were associated with lower odds of being obese (not so clear in the case of overweight)

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3 330 (63). Cohen et al. (2006) is the only study taking collective efficacy as indicator of social capital,
4 331 and it suggested a protective effect on obesity (56).

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7 332 *Differences in the aggregation and adjustment of social capital measures*

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9 333 Except the studies by Yoon & Brown (46) and Cohen et al. (56), which use specific contextual
10 334 measures of social capital, all studies in our review use individual data to measure neighborhood
11 335 social capital. However, only ten provide data on the aggregation and adjustment of social capital
12 336 measures to the neighborhood level (21, 40, 41, 45, 46, 49, 50, 52, 53, 56). The interpretation of
13 337 this finding can be two-fold. On the one hand, it can indicate whether social capital has been
14 338 considered as an individual or collective feature; on the other, it speaks of reporting accuracy of
15 339 the methodological procedures.

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21 340 There appear to be not clear differences in the relationship of social capital and obesity based on
22 341 this fact, as papers in all groups (reporting and not reporting aggregation), show mixed results in
23 342 terms of a protective, damaging and null effect of social capital. It is worth to mention, though,
24 343 that the two studies using contextual measures report a protective relationship. In the case of
25 344 Cohen, the contextual measure is obtained by the aggregation of responses of a much bigger
26 345 sample than the one from which BMI is measured; in the second case (Yoon & Brown), a specific
27 346 contextual scale: the PETRIS Social Capital scale is used.

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36 348 *Differences by socioeconomic status*

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38 349 Sixteen of the studies in our review included some indicator of SES as a covariate in their analysis.
39 350 The other two (Veenstra et al., 2005; Vietch et al., 2012) did not consider SES as a covariate, but
40 351 used neighborhood SES as a stratifying variable in their sampling strategy. However, few studies
41 352 present their results in a way that allows us to delineate whether these socioeconomic differences
42 353 are (partly) due to the influence of social capital (42, 45).

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47 354 One of these studies is the one by Evans & Kutcher (2011). In a sample of 196 rural US adolescents
48 355 they found that differences in social capital (as measured by social cohesion, informal control and
49 356 relations with adults in the community) partly mediated the relationship between low SES and
50 357 obesity (48). Their results are consistent with those of Cohen et al. (2006). Last, Mackenbach et al.
51 358 2016, indicated that individuals the highest quartile of social networks or social cohesion had

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3 359 approximately 30% lower odds of obesity than individuals in the lowest quartile, regardless of
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5 360 their SES (21).

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9 362 *Differences by age and gender*

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11 363 The papers included in our study provide data about children, adolescents and adults. However, all
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13 364 social capital measures are based on adult responses – as youth measures of social capital are
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15 365 derived from parents’/guardians’ or teacher’s responses (the sentences “people in neighborhood
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17 366 help each other out”, “if my child were outside playing and got hurt or scared, there are adults
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19 367 nearby I can trust to help my child” are examples of questions asked to parents of children and
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21 368 adolescents 6-17years-old in the NSCH, the source of data used by Duke et al. (2012), Nesbit et al
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23 369 (2014), and [Singh et al. \(2008a, 2008b\)](#) (36, 52, 55, 58).

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25 370 In this sense, while the US National Survey of Children’s Health (NSCH) provides valuable data
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27 371 about social capital at the neighborhood level in the States -because it is one of the few examples
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29 372 in which adolescent social capital is not measured at the state or country level (Data Resource
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31 373 Center for Child and Adolescent Health, 2015); caution is warranted since measurements are
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33 374 obtained through proxy respondents (parents and guardians), and may not necessarily correspond
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35 375 to the perceptions of the children and teens themselves. With this caveat in mind, researchers
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37 376 using different waves of the NSCH have consistently found social capital to be strongly associated
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39 377 with lower risk of obesity and higher levels of physical activity (36, 55). Cohen and colleagues
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41 378 (2006) found an association between neighborhood collective efficacy and BMI in adolescents. In
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43 379 their study, they used adults’ responses to measure collective efficacy, but their answers were not
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45 380 paired with the different adolescents in the study; rather, they aggregated adult responses by
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47 381 1990 census tract boundaries to create neighborhood measures of social capital (collective
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49 382 efficacy) (56). They hypothesized that this relationship could be explained by several factors,
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51 383 including stress-related metabolic pathways, neighborhood differences in the physical and social
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53 384 environments, or a combination of these two.

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55 385 In an adolescent population, [Singh et al. \(2008a, 2008b\)](#) did not find evidence of social capital
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57 386 (through a social cohesion approach) being associated with obesity in a wide US sample (52, 58).
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59 387 Duke at al. (2012) concluded that higher levels of parental trust on neighbors were linked to a
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388 lower BMI in youth. Also in adolescent population, Evans & Kutcher (2011) showed that social
389 capital (measured through a combination of community cohesion, social control, and youth’

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3 390 relationships with adults in the community) was protective against obesity in low-income
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5 391 teenagers (48). Findings by Nesbit et al. (2004) extend the protective role of social capital on
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7 392 adolescent obesity to all SES levels, in a study in which social capital was measured with a
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9 393 composite scale considering trust, informal control and safety perception (although we do not
10
11 394 consider it a proper measure of social capital) (36). Mckay et al.'s study was also conducted on
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13 395 adolescent population. In their research, higher trust and reciprocity at the state level were
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15 396 associated with lower BMI, although this relationship was dependent on adolescence stage, being
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17 397 more protective on the early ages (10-13 years old) (41). In Australia, cross-sectional and
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19 398 prospective regression analyses by Vietch (2012) showed that a more positive social network and,
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21 399 to a lesser extent, higher social trust/cohesion were related to lower BMI among children (42).

22 400 No gender differentiations were made in any of the papers included in our study.

23 401

24 402 *Differences in societal/cultural contexts*

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27 403 The country sources of studies were quite homogeneous; 16 papers included in our review derived
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29 404 from 10 different countries, but all them could be classified as developed countries.

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31 405 One of the earliest studies on social capital and obesity was reported by Greiner et al. (2004),
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33 406 based on a mixed urban/rural sample in one U.S. state (Kansas) (40). The authors found no
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35 407 evidence of obesity being associated with trust or social participation. By contrast Mackenbach et
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37 408 al (2016) – based on a European sample in BE, FR, NL and HU– found that Individuals in the highest
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39 409 quartile of social networks or social cohesion had approximately 30% lower odds of obesity than
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41 410 individuals in the lowest quartile (21).

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42 411 Results from the RESIDE study, an Australian study in which the influence of both the built and
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44 412 social environment on BMI was assessed, showed no association between any of the measures,
45
46 413 with the exception of perceived safety from crime (47), which is not a direct measure of social
47
48 414 capital. The authors suggest that physical activity could mediate this relationship, due to perceived
49
50 415 insecurity. By contrast, Poortinga (2006) found that although social nuisances (again, one indicator
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52 416 that should not be used a measure of social capital) were related to higher obesity in the UK, this
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54 417 relationship was not mediated by physical activity practices (39).

55 418

56 419 *Differences by urban/rural residence*

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3 420 The comparison between urban and rural settings is a particular case of the influence of the social
4 context is. In our sample, only the study by Greiner et al. (2004), dealt with this aspect (40). In
5 421 their research, no evidence was found of an association between obesity and trust or social
6 422 participation. Lower community rating was related to a poor overall health perception and
7 423 community rating was generally lower in rural areas, but community rating is not a strict measure
8 424 of social capital.
9 425

13 426 **Discussion**

15 427 This is, to our knowledge, the first systematic review on social capital and obesity conducted from
16 428 a social capital theory perspective. In 2016, Glonti et al. published in this journal a systematic
17 429 review on the psychosocial determinants of obesity, which included studies that reported a
18 430 relationship between adult weight status and five psychosocial environmental constructs:
19 431 collective efficacy, social cohesion, social capital and social support (63). From a social capital
20 432 theory approach, as described in the introduction of this paper, all these constructs comprise
21 433 different dimensions of social capital and, in fact, some of the papers reviewed by Glonti et al. are
22 434 part of our study sample, too, as it is the case of Greiner et al (40), Poortinga (39), Christian et al
23 435 (47), Veenstra et al (45), or Yoon and Brown (46). While the method used by Glonti et al (i.e.:
24 436 opening the scope to include all potential studies on the psychosocial determinants of obesity)
25 437 provides a comprehensive overview of the evidence available on these sort of determinants; we
26 438 believe that by organizing evidence under the umbrella of a particular theory it is possible to
27 439 deepen not only into the potential effect of social capital on obesity, but also into the mechanisms
28 440 and pathways through which they occur; thus, gaining a more integrated understanding on how
29 441 social capital influences obesity. In any case, this dispersion of constructs, measures and
30 442 operationalization hinders the obtention of strong and clear evidence on social capital and weight
31 443 status, and our results are coincident with these of Glonti et al, indicating that a consensus on the
32 444 definitions and frameworks used to social capital (and all psychosocial determinants) is needed.

33 445 In this sense, our results reinforce the idea that although research on the topic has increased in
34 446 the last years, further research is needed to untangle the potential use of social capital in obesity
35 447 prevention. Three main questions underlie this observation: First, an inadequate theorization of
36 448 how and why social capital is linked to obesity. We have systematically referred to social capital
37 449 theory to explain why the result differences among studies might arise. When the evidence we
38 450 have about the association between social capital and obesity is inconsistent, a sound theorization

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3 451 of these linkages is called for. With few exceptions, the papers reviewed here have lacked a solid
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5 452 foundation specifying, for example, why each of the different dimensions of social (e.g. network
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7 453 properties versus social cohesion) ought to be relevant to body weight; or acknowledging the
8
9 454 adverse effects that social capital could have on body weight (the “dark side”) or the fact that
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11 455 there could be stark gender differences in how social capital operates depending on background
12
13 456 societal norms, to the point that that any potential “protective association” of social capital for
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15 457 women through social norms might be simultaneously detrimental to their mental health, via an
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17 458 obsession to maintain an ideal body shape, and expressed in the form of strong societal “fat bias”
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19 459 directed toward overweight women. Second, few studies employed a strong identification strategy
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21 460 to overcome endogeneity bias – all but one of the studies have been cross-sectional, which makes
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23 461 causation impossible to establish. Third, testing for cultural and sociodemographic differences has
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25 462 been hampered by the lack of diversity in study settings and the lack of consistency in the included
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27 463 covariates.

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29 464 At the outset we laid out a set of questions to be answered through a meta-analysis, which was
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31 465 not possible due to the heterogeneity of our sample. However, while the wide variability in the
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33 466 conceptualization of social capital, as well as its operationalization/measurement has been
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35 467 consistently questioned (64, 65), it can be affirmed that studies adopting the Social Cohesion
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37 468 approach have been fairly consistent in incorporating three dimensions of: (a) trust, (b) shared
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39 469 norms (e.g. of mutual help), and (b) attachment to the group. Beyond that, we have argued
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41 470 elsewhere how the advancement of social capital study requires us to distinguish how each
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43 471 dimension at the different scales (macro, meso, micro) is related to specific health outcomes (12).

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45 472 This systematic review adds to this statement and provides some evidence about the complexity
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47 473 of the association of social capital and how it varies depending on how social capital has been
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49 474 measured, the covariates included in the analysis, the sampling population or the methodological
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51 475 design of the study. This constitutes, in fact, a limitation of our review. We decided to restrict this
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53 476 review to neighborhood/community studies following homogeneity criteria. However, we must be
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55 477 aware that the relationship of social capital and obesity in other environments such as the family
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57 478 or workplace can be different and, also, that studies conducted using stronger methodological
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59 479 designs, such as the ones by Tsuboya, Tsustumi & Kawachi (66) or Kobayashi et al. (2014) (67),
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61 480 among others, have not been included in this review, as they focused on workplace social capital.
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63 481 Future researches should include these aspects.

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3 482 Therefore, trying to answer our first question, *What is the association between social capital and*
4 483 *obesity?*, our results seem to indicate that an association between neighborhood social capital and
5 484 obesity exists, although clear evidence about the direction, the strength and even causality not
6 485 available. Part of the explanation to this situation might lie in the response to the second question,
7 486 *how has this association been studied?*, as, to date, the relation between neighborhood social
8 487 capital and obesity has been mainly studied through cross-sectional studies. It does not mean that
9 488 this type of studies prohibits to establish causal inference, but that the evidence that we gain from
10 489 them is not as robust as other methodological designs (68). In our sample, only one paper is
11 490 longitudinal, based in two UK cohorts. In this paper, Francesca Borgonovi reported that only
12 491 measures of social participation measured by voting in the last elections (but not when measured
13 492 through club memberships nor religions attendance) was negatively associated to high BMI (37).
14 493 This is something that can also be observed among the cross-sectional studies in our sample, and
15 494 leads us to the third question: *does the association between social capital and obesity vary*
16 495 *depending on the different constructs used in the measurement of social capital?* As shown in the
17 496 results section, the potential effect of social capital on obesity is extremely sensitive to the
18 497 indicators of social capital used and also to the confluence of other social determinants of health
19 498 such as age, SES or the fact of living in a rural or urban context – fourth question *effects of*
20 499 *covariates and mediators on the association between social capital and obesity?* Before these
21 500 circumstances, venturing a conclusion about potential differences would be hazardous. However,
22 501 it needs to be acknowledged that most of the reviewed articles reported a protective relationship
23 502 of social capital on obesity.

24 503 Understanding the role of social capital in the development and/or maintenance of obesity will
25 504 require the use of strong methodological designs and a thorough conceptualization of how this
26 505 relationship may arise. This theoretical focus should encompass not only the larger context in
27 506 which the study is being performed (i.e. urban/rural/other context; study population, etc.), but
28 507 also specify the mechanisms through which social capital is conceived to affect body weight
29 508 (informal control, shared norms and values, social interaction, etc.) and delineating the pathways
30 509 (does physical activity mediates this relationship? dietary choices? psychosocial stress?...). It also
31 510 entails an adequate individual or collective operationalization of social capital measures, as well as
32 511 the proper inclusion of the pertinent covariates. For example, based on the studies in our sample,
33 512 it was not possible to establish the effect of adjusting for neighbourhood SES or to urban/rural due

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3 513 to lack of data. Carrying on this *a priori* theoretical exercise will undoubtedly enhance the quality
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5 514 of the work done in this field.

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7 515 A possible start point in this direction is the taxonomy of the social environment dimensions that
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9 516 influence health behaviors and the pathways through which they operate, established by McNeill,
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11 517 Kreuter, & Subramanian (2006) (69). Using physical activity as an example, they describe how
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13 518 social support and networks; socioeconomic position and income inequality; racial discrimination;
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15 519 social cohesion and social capital; and other neighborhood factors such as exposure to harmful
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17 520 elements can influence behaviors. The mechanisms that they describe regarding social capital are
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19 521 consistent with what was defined by Locher et al (2005) in relation to dietary habits (70).
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21 522 Specifically, they suggest three main mechanisms: (1) cohesive communities may provide more
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23 523 resources and support than non-cohesive neighborhoods; (2) norms and values of sharing meals
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25 524 and foods, and a better commitment with healthy behaviors that are mainly encouraged from
26
27 525 religious institutions; (3) perceptions of a safe environment which promote a more frequent
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29 526 practice of outdoors physical activity. In the case of elderly, too, unsafe neighborhoods can even
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31 527 be associated with a reluctance to go out to buy the groceries. Civic engagement may be an
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33 528 additional pathway through which social capital encourages healthy eating. This can be explained
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35 529 by a higher sense of obligation toward oneself and to others, that would eventually lead to
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37 530 proactive nutrition-related activities, as seen with regard to adherence to Mediterranean diet
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39 531 among pregnant women (71), or better nutritional habits at home when moms had higher levels
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41 532 of social capital (72). Our results indicate that while these mechanisms are valid in our sample too,
42
43 533 collective efficacy should also be taken into account when conceptualizing the relationship
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45 534 between neighborhood social capital and health and, more importantly, that both health-
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47 535 promoting and health-damaging effects need to be considered.

48
49 536 Last, some of the studies did take behavioral intermediates into account, but as far as obesity is
50
51 537 concerned, they almost always referred to physical activity. The link between social capital and
52
53 538 dietary habits is a much less explored area and studies on social capital and nutrition have been
54
55 539 more focused on exploring how social capital can leverage people confronting food insecurity
56
57 540 situations than on obesity-related behaviors (72–74). It means that the little research conducted in
58
59 541 this area has mainly being set out to know to which extent can social capital mediate the
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61 542 relationship between low SES and diet. In the US a moderate protective effect of social capital
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63 543 towards a healthy diet was shown (70, 74–77). In a European context, social participation reduced
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65 544 socioeconomic disparities in vegetables intake in both genders and fruit intake in women (78).

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3 545 Considering that diet is one of the main determinants of obesity and health, and it has an
4 546 important social dimension, understanding how social capital influences dietary behaviors may
5 547 help in the development of effective health-promotion policy.
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15 551 **References**
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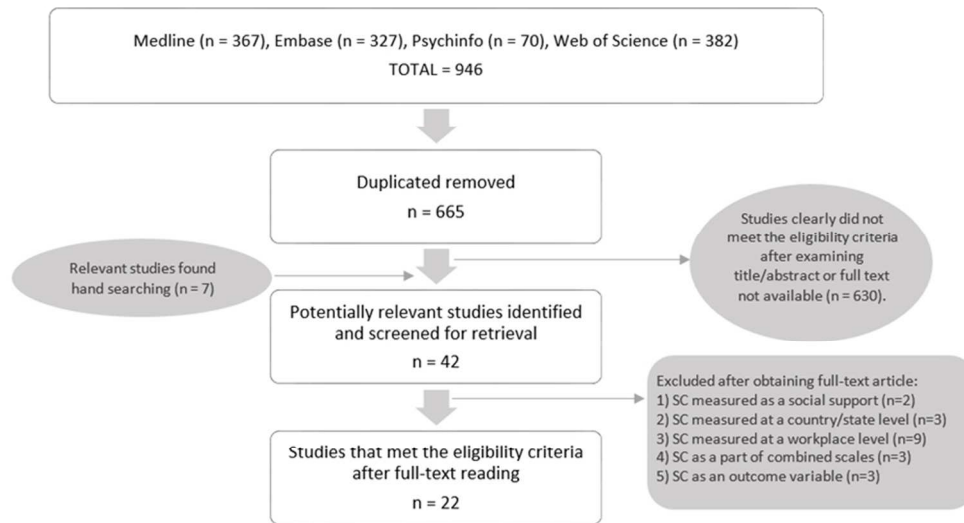


Figure 1. Flow diagram of this study based on PRISMA statement.

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254x190mm (96 x 96 DPI)