Unité de recherche 1303

Alimentation et sciences sociales

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mars 2018

Working Paper ALISS 2018-02

INRA UR 1303 ALISS
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Abstract

In this paper, we ask: How does social isolation shape dietary patterns among older adults? Specifically, we investigate individual and contextual factors on the daily regularity and frequency of meals among adults who are aged 60 and more, retired, and living in Paris and the inner suburbs. The analysis yields three takeaways: 1. Meal frequency may be a valid indicator of nutrition risks among older adults in Paris and the inner suburbs, while meal regularity may be not. 2. Studying dietary patterns among older adults needs handling diverse measures of social isolation, especially differentiating objective and subjective factors. 3. Food access has insignificant effects on meal patterns among older adults in Paris and the inner suburbs.

Keywords: older adults; social isolation; neighborhood effects; food deserts; Paris
JEL-codes: I14; I31; R22; R23; Z13

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* We gratefully acknowledge participants in the INRA-ALISS internal seminar, the Association Française de Sociologie annual meeting, as well as Veronika Duprat-Kushtanina and Marie Plessz, for their helpful comments on earlier versions of this paper.

Introduction

In this paper, we ask: How does social isolation shape dietary patterns among older adults? Specifically, we investigate individual and contextual factors on the daily regularity and frequency of meals among adults who are aged 60 and more, retired, and living in Paris and the inner suburbs. Individual-level factors include sociodemographic characteristics as well as objective and subjective measures of social isolation; contextual-level factors include neighborhood socioeconomic status and food access.

The paper is structured as follows. In Background & Hypotheses, we formulate hypotheses using insights from aging studies as well as the scholarships on neighborhood effects and food deserts. In Data & Methods, we provide information about data sources and variables; next, we present descriptive statistics and the chosen analytic strategy. Model results are reported in Findings; shortcomings of the analysis are discussed in Limitations. In Discussion & Conclusion, we elaborate on the empirical and conceptual takeaways of the paper. Appendix 1 lists data sources.

Background & Hypotheses

This paper aims for an empirical contribution on two fronts: 1. providing cross-sectional quantitative evidence about social isolation and meal patterns among older adults in France, and 2. contributing to the investigation of neighborhood effects and food deserts in French urban contexts.

Social Isolation & Meal Patterns among Older Adults in France

In the American academe, the sociology of aging has historically overlooked qualitative approaches in favor of quantitative ones (Willson, 2007; Settersten and Angel, 2011). By contrast, the French sociology of aging is mostly qualitative (Caradec, 2012). When it comes to food, extant quantitative evidence focuses on food intake patterns rather than meal patterns. Specifically, older adults consume more fresh products compared to the general population (Gojard and Lhuissier, 2003; Amiot-Carlin *et al.*, 2007; Plessz, 2013; Plessz and Gojard, 2013). Qualitative studies are mostly interview-based and adopt a longitudinal approach; they study how life-course events such as widowhood, retirement, and residential mobility, affect meal preparation and content (Cardon, 2010). Studies from nutrition sciences and geriatrics focus on the determinants of malnutrition. Extant evidence highlights two main factors: sex (males are more affected by malnutrition than females) and social network (the absence of outside assistance, be it formal through home care

services or informal through sociability networks, is associated with a higher probability of malnutrition) (Dubois *et al.*, 1999; Locher *et al.*, 2008). From this body of literature, we formulate the following hypothesis:

H1: *In Paris and the inner suburbs, individual isolation has negative effects on meal patterns.*

Neighborhood Effects & Food Deserts in French Urban Contexts

Neighborhood effects and food deserts are two extensively researched urban concepts – primarily in urban sociology and economics for the former, in social epidemiology and agricultural economics for the latter. In the United States, studies on neighborhood effects demonstrate that neighborhood disadvantage has negative effects on individual outcomes (e.g., education, criminality, health, work, mobility), over the effects of individual factors (van Ham *et al.*, 2012; Sharkey and Faber, 2014). Studies on food deserts demonstrate that lack of access to healthy, affordable food has negative effects on individual outcomes (weight, fruit and vegetable consumption, fast food consumption), over the effects of individual factors (Larson *et al.*, 2009; Walker *et al.*, 2010; Hilmers *et al.*, 2012).

In Europe, most studies on neighborhood effects find low or insignificant effects of contextual factors on individual outcomes, over the effects of individual factors (Atkinson and Kintrea, 2001; Friedrichs *et al.*, 2003; Maloutas, 2012: 19-21; Oberti and Préteceille, 2015: 85-86). Studies on food deserts, conducted primarily in the United Kingdom, fail to identify a causal effect of food access on obesity (Cummins and McIntyre, 2002, 2005; Beaulac *et al.*, 2009).

In France, a few studies investigate the effects of individual and contextual factors on individual outcomes. Across France, neighborhood characteristics have negative effects on early school performance (Goux and Maurin, 2007). In Paris and the suburbs, shopping in low-cost stores and stores located in low-socioeconomic status (SES) neighborhoods is associated with higher body mass index and waist circumference (Chaix *et al.*, 2012). In addition, individuals living in low-SES neighborhoods and having limited access to healthy food face a greater obesity risk (Cadot *et al.*, 2011). Similarly, both in Paris and the suburbs as well as in Seattle and King County, individuals living in low-SES neighborhoods and shopping in low-cost stores face a greater obesity risk (Drewnowski *et al.*, 2014). In Paris and the inner suburbs, an increase in the number of stores in the neighborhood of residence can decrease the probability of frequent fruit and vegetable consumption, and an increase in the total food area has slight, but significant and positive effects, on this probability (Caillavet *et al.*, 2015). Nevertheless, the food retail structure has insignificant effects on

body mass (Caillavet *et al.*, 2016).

From this body of literature, we formulate the following hypothesis:

H2: *In Paris and the inner suburbs, a greater access to food outlets has positive effects on meal patterns.*

Data & Methods

Data Sources & Variables

We create two outcomes: 1. meal regularity, 2. meal frequency; and four sets of independent variables: 1. individual sociodemographic controls, 2. individual isolation measures, 3. neighborhood socioeconomic controls, and 4. food access measures. Individual-level data and data on neighborhood socioeconomic controls are drawn from the SIRS cohort study, and data on food access from various data sources listed in Appendix 1.

- *Individual-Level Data & Neighborhood Socioeconomic Controls*

We use the 2010 wave of the Health, Inequalities, and Social Ruptures (SIRS[e]) epidemiological cohort study, which investigates social and spatial inequalities in health in Paris and the inner suburbs (about 6.5 million inhabitants). SIRS's sample design is a three-stage cluster random sample of 3,006 respondents representative of the French-speaking adult population living in Paris and the inner suburbs. We take SIRS's complex sample design into account by using Stata's survey procedures (StataCorp, 2013).

We study the subpopulation aged 60 and more and retired. Age of minimum 60 years (i.e., the statutory retirement age) and retirement status are the two standard criteria used to isolate older adults from the general population in France (Caradec, 2012). In SIRS, 824 individuals (27.41% of the sample) are aged 60 and more and retired.

Meal Regularity. Respondents are asked: "Generally, during the week (outside of weekends and holidays), when it comes to the times of the day when you eat, would you say that…" Answers to be selected are: "More or less always at the same time," "It changes on a regular basis," and "It is very irregular." We regroup these two latter categories into one category "irregular."

[e]Santé, Inégalités et Ruptures Sociales.

Meal Frequency. Respondents are asked: "Generally, how many times a day do you eat even just an apple, so we are counting meals, but also snacks, *goûters*[f], etc., but not drinks?" The three-meal norm (breakfast, lunch, and dinner) is widely observed in France (Lhuissier *et al.*, 2012). Eating one or two meals a day may indicate malnutrition or food insecurity (ALISIRS, 2010), while eating more than three meals a day may indicate disorders (e. g., bulimia, compulsive eating), but also eating a *goûter* in addition to breakfast, lunch, and dinner. In France, official nutrition recommendations prescribe a *goûter* for children, pregnant women, and older adults (Cardon, 2010). As such, we create three categories: 1. One or two meals a day. 2. Three meals a day. 3. More than three meals a day. Since eating four meals or more a day is difficult to interpret, and the outcome of interest when investigating the effects of social isolation is the conditional probability of eating one or two meals a day over eating three meals a day, we do not report results for the conditional probability of eating four meals or more a day.

Individual sociodemographic controls include sex, age, income (per consumption unit), and partnership status (respondents are asked: "Do you currently live with a partner?").

Individual isolation measures include health, well-being, sociability, and loneliness.

Self-Rated Health. Research has demonstrated that self-rated health is a valid proxy for morbidity and mortality patterns (DeSalvo *et al.*, 2006; Schnittker and Bacak, 2014). In SIRS, respondents are asked: "How is your general health status?" Answers to be selected are "Good," "Average," and "Bad." We regroup these two latter categories into one.

Self-Rated Well-Being. Respondents are asked: "How is your psychological and emotional health status?" Answers to be selected are "Good," "Average," and "Bad." We regroup these two latter categories into one.

Sociability. We concatenate three variables, in which respondents are asked: "How often are you in face-to-face contact with your…" 1. children, 2. relatives, 3. friends. In all three variables, answers to be selected are: "several times a week," "several times a month," "less frequently," "rarely or never." We regroup these four categories into two: "several times a week" and "less than several times a week." All in all, the created measure of sociability indicates whether the respondent has face-to-face contact with at least one close person (friends or relatives) on a weekly basis.

Loneliness. Respondents are asked: "Generally, would you say that you feel 1. very lonely, 2. rather lonely, 3. rather surrounded by people, or 4. very surrounded by people?" We regroup these original four categories into two: "lonely" and "surrounded by people."

[f] Light meal taken in the afternoon, usually around 4pm.

Neighborhood socioeconomic controls. Neighborhood socioeconomic status is a composite measure made from a typology of neighborhood socioprofessional makeup (Préteceille, 2003) and an indicator of neighborhood disadvantage (Sensitive Urban Zones[g] as defined by French urban policy). In addition, we include a variable indicating whether the respondent lives in Paris or in the inner suburbs.

- *Food Access*

Number of stores & markets. Stores include convenience stores, supermarkets, hypermarkets[h], and frozen food stores. Data sources and datasets are listed in Appendix 1.

Spatial units. 3 in 50 census tracts[i] sampled in SIRS have no market, no convenience store, no supermarket, no hypermarket, and no frozen food store. Consequently, we define spatial units that are larger than census tracts. We create 50 circles whose radiuses connect the public transportation station[j] to the residential location of the respondent furthest from that station, using the geographic information system QGIS (QGIS Development Team, 2018).

Descriptive Statistics

Table 1 presents descriptive statistics. On average, 84.9% of older adults living in Paris and the inner suburbs have regular meals. 69.2% eat three meals a day; 8.6% eat one or two meals a day. 62.4% are in good health; 76.9% feel well. 68.1% maintain face-to-face contact with a close person (children, relatives, or friends) at least every week; 81.1% feel surrounded by people. Lastly, older adults living in Paris and the inner suburbs have access to an average of 1.8 market and 9.8 stores in their neighborhoods of residence.

Table 1. Descriptive Statistics.

Variables	Mean (SD), weighted	%, weighted
Outcomes		

[g]Zones Urbaines Sensibles.
[h]According to French retail trade entry regulations, convenience stores (supérettes) have floor areas of between 120 m² to 400 m², supermarkets (supermarchés) of between 400 to 1000 m², and hypermarkets (hypermarchés) greater than 1000 m².
[i]IRIS (Îlots Regroupés pour l'Information Statistique – Aggregated Units for Statistical Information). Residential IRIS have between 1,800 and 5,000 inhabitants.
[j]Metro stations and suburban railway stations (Transilien and RER).

Meal Regularity		
Regular		84.9
Irregular		15.1
Meal Frequency		
1 or 2		8.6
3		69.2
4 or more		22.2
Individual Sociodemographic Controls		
Sex		
Male		40.7
Female		59.3
Age	72.11878 (0.3973443)	
Income	2545.938 (134.5465)	
Partnership Status		
Not Living with a Partner		40.4
Living with a Partner		59.6
Individual Isolation Measures		
Health		
Good		62.4
Average / Bad		37.6
Well-Being		
Good		76.9
Average / Bad		23.1
Sociability		
Has face-to-face contact with at least one close person weekly		68.1
Does not have face-to-face contacts with at least one close person weekly		31.9
Loneliness		
Feels Lonely		18.9
Feels Surrounded by People		81.1
Neighborhood Socioeconomic Controls		
Neighborhood Socioeconomic Status		
Middle/High		76.2
Low		14.0
Disadvantaged		9.8
Lives in Paris or in the Inner Suburbs		
Paris		36.9
Inner Suburbs		63.1
Food Access Measures		
Number of Markets	1.807 (0.337)	
Number of Stores	9.807 (1.031)	

Base: Respondents who are aged 60 and more, and retired. Unweighted sample size is 824.
Source: SIRS cohort study (wave 2009-2010). TradeDimensions (2013). Liste des marchés de quartier à Paris (2012). Liste des marchés des Hauts-de-Seine (2011). Les marchés hebdomadaires des villes du 93 (2014). Sites web des communes du Val-de-Marne (2014). Positions géographiques des stations du réseau RATP (2013). Gares et points d'arrêt du réseau Transilien (2013). Authors' calculations.

Analytic Strategy

We run two models: 1. *MR*, a binary logit model for the probability of eating regular meals, and 2. *MF*, a multinomial logit for the conditional probability of eating one or two meals a day over eating three meals a day:

$$MR_t = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_{t3} + \beta_4 x_{t4} + u_t \quad [I]$$

$$MF_t = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_{t3} + \beta_4 x_{t4} + u_t \quad [II]$$

wherein t indexes respondents; x_1, x_2, x_3, and x_4 are vectors, respectively, of individual sociodemographic characteristics, individual isolation measures, neighborhood socioeconomic characteristics, and food access; β are parameters to be estimated; and u is the error term.

Findings

Tables 2 and 3 present the model results. Table 4 presents the marginal effects of individual isolation measures on the conditional probability of eating one or two meals a day over eating three meals a day. Given that the sample size is small and that we use survey procedures (which tend to yield smaller standard errors), we use statistical significance at the .1 level in addition to the standard .05, .01, and .001 levels.

H1: *In Paris and the inner suburbs, individual isolation has negative effects on meal patterns.*

Individual isolation has insignificant effects on meal regularity, controlling for individual sociodemographic characteristics and contextual factors [Table 2].

By contrast, while well-being has insignificant effects on the conditional probability of eating one or two meals a day over eating three meals a day, average or bad health increases the conditional probability of eating one or two meals a day over eating three meals a day by 9.2% [Table 4]. In addition, while (objective) face-to-face contact with close persons has insignificant effects, the (subjective) feeling of being surrounded by people decreases the conditional probability of eating one or two meals a day over eating three meals a day by 12.9% [Table 4].

H2: *In Paris and the inner suburbs, a greater access to food outlets has positive effects on meal patterns.*

Access to food outlets has insignificant effects on meal patterns, controlling for individual-level factors and neighborhood socioeconomic status [Tables 2 & 3]. That said, we should mention a surprising, potentially spurious result: having one additional store in the area of residence increases the conditional odds of eating one or two meals a day over eating three meals a day by a factor of 1.028207 [Table 3].

Table 2. Effects of Independent Variables on the Probability of Eating Regular Meals. Binary Logit Model.

	OR
Sex	
(*Male*)	
Female	.5889225 (.1629659) †
Age	1.023835 (.0151894)
Income	
Partnership Status	
(*Not Living with a Partner*)	
Living with a Partner	1.451419 (.5219325)
Health	
(*Good*)	
Average / Bad	1.162008 (.3187858)
Well-Being	
(*Good*)	
Average / Bad	1.178486 (.4375131)
Sociability	
(*Does not have face-to-face contacts with at least one close person weekly*)	
Has face-to-face contact with at least one close person weekly	.8977077 (.2941505)
Loneliness	
(*Feels Lonely*)	
Feels Surrounded by People	1.431607 (.5952091)
Neighborhood Socioeconomic Status	
(*Middle/High*)	
Low	.716811 (.280495)
Disadvantaged	.816317 (.276392)
Lives in Paris or in the Inner Suburbs	
(*Paris*)	
Inner Suburbs	1.135759 (.3042328)
Number of Stores	1.011015 (.0123028)
Number of Markets	1.003019 (.0398852)
Constant	.9699736 (1.226258)

Table 2 presents the effects of the independent variables on the probability of eating regular meals. †, *, **, *** indicate significance at the .1, .05, .01, and .001 levels, respectively. Robust standard errors are reported in parentheses.
Base: Respondents who are aged 60 and more, and retired. Unweighted sample size is 824.
Source: SIRS cohort study (wave 2009-2010). TradeDimensions (2013). Liste des marchés de quartier à Paris (2012). Liste des marchés des Hauts-de-Seine (2011). Les marchés hebdomadaires des villes du 93 (2014). Sites web des communes du Val-de-Marne (2014). Positions géographiques des stations du réseau RATP (2013). Gares et points d'arrêt du réseau Transilien (2013). Authors' calculations.

Table 3. Effects of Independent Variables on the Conditional Probability of Eating One or Two Meals a Day over Eating Three Meals a Day. Multinomial Logit Model.

	RRR
1 or 2 meals a day	
Sex	
(*Male*)	
Female	.5244451 (.1697193) †
Age	.9690698 (.0201651)
Income	.9998319 (.000154)
Partnership Status	
(*Not Living with a Partner*)	
Living with a Partner	.6252048 (.1572799) †
Health	
(*Good*)	
Average / Bad	1.853818 (.4930223) *
Well-Being	
(*Good*)	
Average / Bad	.7959837 (.3246037)
Sociability	
(*Does not have face-to-face contacts with at least one close person weekly*)	
Has face-to-face contact with at least one close person weekly	1.232142 (.3541191)
Loneliness	
(*Feels Lonely*)	
Feels Surrounded by People	.4476916 (.1763199) *
Neighborhood Socioeconomic Status	
(*Middle/High*)	
Low	.6215837 (.2672138)
Disadvantaged	.9598358 (.2988514)
Lives in Paris or in the Inner Suburbs	
(*Paris*)	
Inner Suburbs	.7659659 (.2528575)
Number of Stores	1.028207 (.0125214) *
Number of Markets	.9414962 (.0512251)
Constant	4.066386 (6.258731)
3 (base outcome)	
4 and more (not reported)	

Table 3 presents the effects of the independent variables on the conditional probability of eating one or two meals a day over eating three meals a day. †, *, **, *** indicate significance at the .1, .05, .01, and .001 levels, respectively. Robust standard errors are reported in parentheses.
Base: Respondents who are aged 60 and more, and retired. Unweighted sample size is 824.
Source: SIRS cohort study (wave 2009-2010). TradeDimensions (2013). Liste des marchés de quartier à Paris (2012). Liste des marchés des Hauts-de-Seine (2011). Les marchés hebdomadaires des villes du 93 (2014). Sites web des communes du Val-de-Marne (2014). Positions géographiques des stations du réseau RATP (2013). Gares et points d'arrêt du réseau Transilien (2013). Authors' calculations.

Table 4. Marginal Effects of Individual Isolation Measures on the Conditional Probability of Eating One or Two Meals a Day over Eating Three Meals a Day. Multinomial Logit Model.

	ME
Health	
(*Good*)	
Average / Bad	.0923694 (.0432168) *
Well-Being	
(*Good*)	
Average / Bad	-.0344477 (.0460866)
Sociability	
(*Does not have face-to-face contacts with at least one close person weekly*)	.024868 (.0365881)
Has face-to-face contact with at least one close person weekly	
Loneliness	
(*Feels Lonely*)	
Feels Surrounded by People	-.1289326 (.0728904) †

Table 4 presents the marginal effects of a discrete change from the base level as for individual isolation measures, on the conditional probability of eating one or two meals a day over eating three meals a day. †, *, **, *** indicate significance at the .1, .05, .01, and .001 levels, respectively. Robust standard errors are reported in parentheses.
Base: Respondents who are aged 60 and more, and retired. Unweighted sample size is 824.
Source: SIRS cohort study (wave 2009-2010). TradeDimensions (2013). Liste des marchés de quartier à Paris (2012). Liste des marchés des Hauts-de-Seine (2011). Les marchés hebdomadaires des villes du 93 (2014). Sites web des communes du Val-de-Marne (2014). Positions géographiques des stations du réseau RATP (2013). Gares et points d'arrêt du réseau Transilien (2013). Authors' calculations.

Limitations

The limitations holding for the analysis are twofold.

First, we should refer to general issues in identifying the effects of food access on individual food-related outcomes discussed in literature on food deserts. These identification issues are neighborhood selection, reverse causality, confounding, and omitted variables.

Neighborhood selection. Individual- and contextual-level factors, including attitudes related to food (Frank *et al.*, 2007; Jago *et al.*, 2007) and food access (Thornton *et al.*, 2009, 2011), can have effects on both individual food-related outcomes and residential choices.

Reverse causality. While we hypothesize that food access has effects on meal patterns, reversely, meal patterns may have effects on food access. That is, markets and stores may make their location choices depending on local food consumption outcomes.

Confounding. The effects of food access on meal patterns may be confounded by factors that have effects on both food access and meal patterns (Thornton *et al.*, 2011), including individual sociodemographic characteristics and individual isolation measures.

Unobservable variables. The aforementioned confounders can be unobservable, for instance,

tastes, distastes, and preferences related to food (Subramanian *et al.*, 2007).

Second, this analysis conducted in Paris and the inner suburbs may not be generalizable to other contexts, including the rest of France.

Discussion & Conclusion

The analysis yields three takeaways: 1. Meal frequency may be a valid indicator of nutrition risks among older adults in Paris and the inner suburbs, while meal regularity may be not. 2. Studying dietary patterns among older adults needs handling diverse measures of social isolation, especially differentiating objective and subjective factors. 3. Food access has insignificant effects on meal patterns among older adults in Paris and the inner suburbs.

At the outset of the analysis, we assume that both meal frequency and meal regularity are indicators of nutrition risks among older adults. Findings validate this assumption when it comes to meal frequency: several measures of social isolation have positive effects on the conditional probability of eating one or two daily meals (i.e., a potential indicator of malnutrition or food insecurity) over the normative three daily meals. By contrast, meal regularity is not affected by any individual or contextual factor. Qualitative studies report that undernourished older adults who have irregular meals are first and foremost hampered by unhealthy dietary intakes and inabilities to cook (Cardon, 2007, 2009a, 2009b, 2013). In quantitative terms, this means that meal regularity may not be a valid indicator of nutrition risks among older adults because it may be confounded by unobservable variables.

Loneliness and average or bad health have negative effects on meal frequency, while contact with relatives and well-being have insignificant effects. Social isolation can thus be conceptualized as a set of various objective and subjective factors that have contrasting effects on nutrition risks. In blunter terms, contrary to the commonsensical view of malnutrition in older adults as resulting from both social withdrawal and lack of well-being, we empirically demonstrate that it is possible to be older, alone, happy, and well-fed.

Lastly, the insignificant effects of both neighborhood socioeconomic status and food access on individual meal patterns lead to neither validate nor refute the relevance of the analytical tools of neighborhood effects and food deserts in the context of Paris and the inner suburbs.

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Appendix 1. Data Sources

The table below lists data sources and license approvals used in this paper:

SIRS	ERES-INSERM – SIRS cohort study (wave 2009-2010) /SOLAL-ALISS-INRA Partnership Agreement
Number of Stores	AC Nielsen SAS GMS – TradeDimensions (2013) / ALISS-INRA Licence
Number of Markets	Open Data Paris – Liste des marchés de quartier à Paris (2012) / OdbL Chambre de Commerce et d'Industrie de Paris-Hauts-de-Seine – Liste des marchés des Hauts de Seine (2011) Seine-Saint-Denis Tourisme – Les marchés hebdomadaires des villes du 93 (2014) Val-de-Marne communes official websites (2014)
IRIS	IGN/INSEE – Contours IRIS...2010 / Sciences Po Licence
Public Transportation Stations	RATP Open Data – Positions géographiques des stations du réseau RATP (2013) / OdbL SNCF Open Data – Gares et points d'arrêt du réseau Transilien (2013) / OdbL