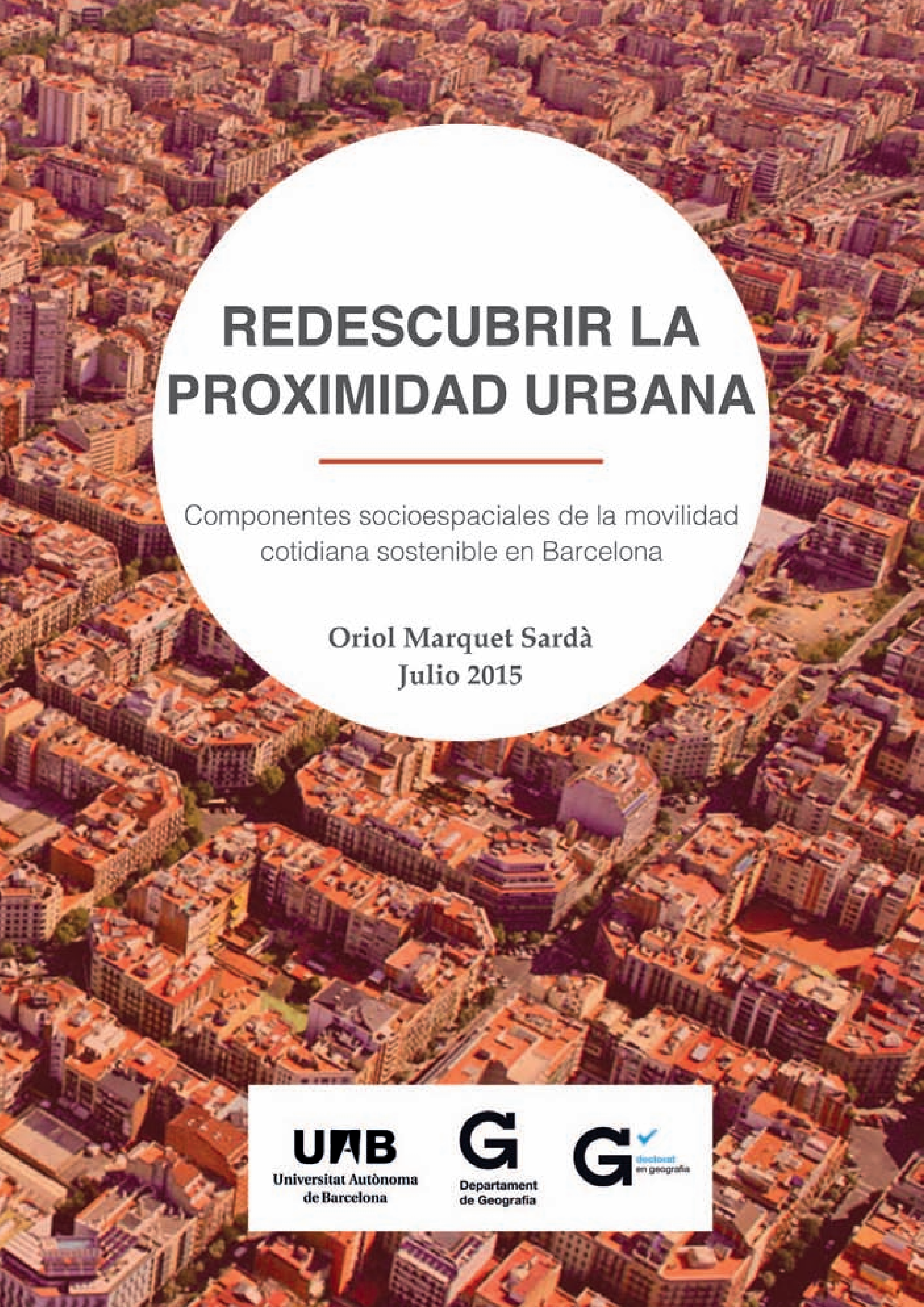

REDESCUBRIR LA PROXIMIDAD URBANA

Componentes socioespaciales de la movilidad cotidiana sostenible en Barcelona

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PARTE III

Metodología general

CAPÍTULO 6

Metodología general y ámbito de estudio

Not everything that can be counted counts, and not everything that counts can be counted

Anthony Townsend (2013, p. 235)

A continuación se exponen los principales criterios metodológicos utilizados para la realización de esta tesis. El capítulo metodológico está dividido en dos partes para distinguir entre los criterios y herramientas utilizadas para la elaboración del apartado teórico (capítulos 4 y 5) y para la elaboración de los casos de estudio empíricos (capítulo 7).

A pesar de que el capítulo se divide muy claramente entre metodología utilizada para la parte teórica y para la parte empírica, es importante remarcar que la realización de ambas partes de la tesis ha sido conjunta y que no es posible entender la una sin la otra. Los capítulos 4 y 5 no se conciben como un simple catálogo de teoría alrededor del concepto de proximidad sino que el análisis de dichas ideas teóricas ha sido fundamental para diseñar los estudios empíricos.

En primer lugar, el pensamiento teórico ha sido esencial para definir qué aspectos era más importante estudiar. El estudio de la literatura también ha servido para decidir las metodologías más apropiadas para cada estudio. Al tratarse de cuatro estudios que tratan aspectos diferentes de la movilidad de proximidad, también ha sido necesario encontrar cuatro metodologías que ofreciesen el tipo de resultados que buscábamos. Por último, también he utilizado el referente de la literatura académica para definir el tipo de metodologías utilizadas no para el análisis sino para la difusión de la investigación. La literatura se ha utilizado en definitiva para saber qué estudiar, qué dejar fuera, como estudiarlo y como difundir los resultados de los estudios empíricos, intentando así integrar el pensamiento con la práctica geográfica (Cresswell, 2013, p. 4).

6.1 Marco teórico: consideraciones generales

La redacción de un marco teórico para esta tesis ha requerido de un intenso trabajo de búsqueda bibliográfica. El principal obstáculo en la confección del marco teórico no ha sido tanto la búsqueda de dichos artículos y libros sino la selección, tratamiento y ordenación de los documentos. Dado el carácter pluridisciplinar del tema tratado, y teniendo en cuenta la facilidad actual del acceso a la información vía internet, el reto ha sido poder encontrar aquellas obras más relevantes de cada disciplina, y a la vez conseguir identificar los vínculos y características comunes entre ellas.

El proceso de recopilación de literatura busca cumplir con los siguientes objetivos:

1. Identificar desde que disciplinas se estudia el fenómeno de la proximidad urbana
2. Identificar los principales debates académicos entorno a la relación entre movilidad y forma urbana
3. Identificar las últimas tendencias temáticas en el estudio de la proximidad y la movilidad sostenible
4. Identificar a los autores y obras clásicas sobre el tema.
5. Identificar las metodologías más comúnmente utilizadas desde cada disciplina
6. Identificar las revistas académicas más especializadas en cada tema en vistas a posibles publicaciones futuras.

El esquema de la confección del marco teórico puede verse en la Figura 22. A continuación sigue una explicación de los principales criterios que se han seguido para recopilar y ordenar los ítems bibliográficos que han fundamentado el apartado teórico.

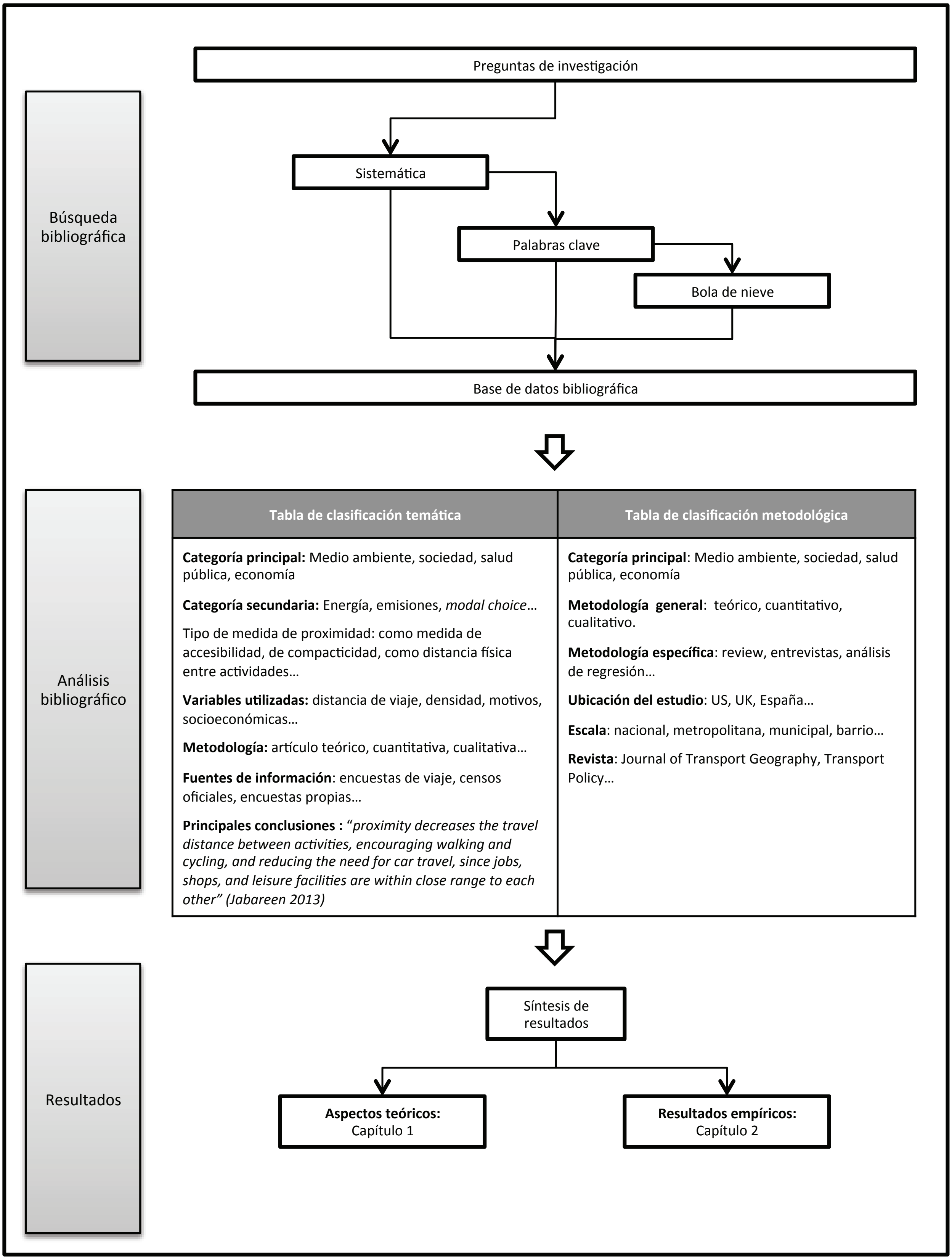

Figura 22: Esquema de la realización del marco teórico
Fuente: elaboración propia

Principios

Desde el principio de esta investigación se tuvo claro que una de las principales dificultades residiría en gestionar un elevado volumen de literatura. Como ya se ha visto en el Bloque II, dedicado a los aspectos teóricos de la proximidad, realizar un *literature review* al uso del fenómeno de la proximidad es un trabajo casi imposible por la dificultad que supone revisar sistemáticamente revistas de ámbitos diversos que incluyen la geografía, los estudios de transporte, *urban planning*, estudios urbanos, medioambiente y salud pública. Sólo el listado de revistas ISI de dichas temáticas incluye 389 revistas y un total de 30.000 artículos indexados . Así pues, ante la imposibilidad de realizar una búsqueda sistemática número por número, se decidió combinar los métodos de búsqueda sistemática, búsqueda por palabras clave y búsqueda por bola de nieve para conseguir un volumen suficiente de literatura, que supusiese una muestra representativa del volumen total de literatura existente. La triangulación de métodos asegura que la tesis incluye, sino todos, la mayoría de trabajos de mayor relevancia a pesar de la dispersión temática propia de esta investigación.

Otro aspecto a considerar es que no toda la literatura utilizada proviene de revistas académicas. De hecho, la primera parte del apartado teórico (Capítulo 4) corresponde no a un *literature review* sino a una exploración teórica acerca del propio concepto de proximidad y su relación con la forma urbana y la movilidad. Para la redacción de este apartado la materia prima no han sido tanto los artículos académicos como los libros, ya sea en formato papel o electrónico. Estos han sido especialmente importantes a la hora de situar el análisis y centrar la posterior búsqueda de estudios empíricos. En términos generales, se ha utilizado los libros para la información general de cada disciplina, para localizar los debates relevantes de cada ámbito y para contextualizar los estudios empíricos con sus correspondientes teorías. La primera búsqueda de libros se realizó a través de palabras clave en el catálogo de la UAB y DIBA. A partir de ahí, el análisis de la propia bibliografía de dichos libros además de la bibliografía de los artículos analizados, ha llevado a descubrir qué obras eran más importantes para cada tema. Dado el limitado tamaño del fondo de bibliotecas UAB/DIBA, se ha intentado aprovechar al máximo las estancias de investigación en Santiago de Chile, Aalborg y Amsterdam, ampliando así el fondo de libros disponible. Asimismo, también se ha hecho un uso intensivo de herramientas online como el catálogo *google books* o libros online de acceso abierto. Por último, también se ha contado con numerosos informes oficiales y reports de agencias como la OMS, la Comisión Europea o la OECD.

La base bibliográfica final consta de 1140 referencias, es tremendamente extensa, y no habría sido posible analizarla sin el uso intensivo de software como Mendeley o Evernote entre otros. Ante la dimensión de los temas tratados, se decidió optar por construir una base bibliográfica amplia y trabajar con bibliografías temáticas más pequeñas para cada tema estudiado. Así, aunque la búsqueda de literatura reunió referencias de temáticas muy diversas, hay que entender que el sistema de catalogación por temáticas permitió filtrar rápidamente los artículos. De esta forma, sólo 140 referencias están dedicadas a la importancia de la proximidad en la salud física de las personas, y de estos, sólo 43 se dedican a la salud física de las personas mayores de 65 años. De esta forma se crea una base de datos dinámica que permite llegar al máximo detalle sin perder la perspectiva general.

Por último, cabe señalar que en ningún momento se dio la base de datos por cerrada, y que por tanto se trabaja con una base bibliográfica viva a la que cada mes se le añaden los artículos relevantes procedentes de las principales revistas de cada sector, que se recopilan por medio de una sistema de alertas vía email.

6.1.2 Métodos para la búsqueda bibliográfica

La búsqueda bibliográfica se estructuró pues en tres fases secuenciales:

1. **Búsqueda sistemática**
2. **Búsqueda por palabra clave**
3. **Búsqueda por bola de nieve**

Búsqueda sistemática: Después de descargar de la Web of *Science* la lista de revistas indexadas de cada temática, se realizó un primer análisis de la temática de cada revista para descartar aquellas que a *piori* estaban dedicadas a temáticas fuera del ámbito de estudio. Este primer filtrado eliminó por ejemplo las revistas de transporte que tratan exclusivamente de accidentabilidad o revistas excesivamente centradas en aspectos técnicos de emisiones contaminantes. Las revistas restantes fueron valoradas en base tanto al índice de impacto de la revista como a su proximidad temática al campo de estudio. Estos dos procesos dieron lugar a un listado de *journals* de alto índice de impacto y que eran temáticamente susceptibles de publicar artículos relevantes relacionados con la movilidad de proximidad en cualquiera de sus vertientes consideradas: medioambiental, social, de salud pública o económica. Esta lista de revistas fue revisada número por número y artículo por artículo a partir de la lectura de títulos y *abstracts* disponibles en los respectivos portales web de cada *journal*. Al encontrar un artículo de posible interés, éste era descargado y almacenado en formato PDF para su posterior análisis y organización. En el caso de los artículos a los que desde la UAB no se tenía acceso, estos se introducían en una lista para poder ser consultados durante las estancias de investigación.

El periodo analizado en un principio fue 2000-2011 pero a medida que el doctorado avanzaba, la búsqueda de bibliografía más intensa se acabó situando en el período 2005-2015. La estrategia de búsqueda consideraba que las fases posteriores de búsqueda por palabras clave o por bola de nieve encontrarían los trabajos más relevantes anteriores al año 2000. Las revistas que mayores resultados aportaron aparecen en la tabla 15, donde también se desglosan año por año el número de artículos encontrados. La figura muestra como de media se encontraron 39 artículos relevantes por año, entre 2005 y 2015. El mayor número de artículos se encontró en 2013 debido principalmente a la aparición en diciembre de un número especial de la revista *Journal of Transport Geography* dedicado exclusivamente a la relación entre forma urbana y emisiones contaminantes derivadas del transporte. Por otro lado, cabe señalar que el menor número de artículos recolectados en 2015 obedece a una cuestión temporal, y no a que la temática haya dejado de tener interés para las revistas internacionales.

Tabla 18: Relación de artículos seleccionados por revista y año
Fuente: elaboración propia

REVISTA	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005 o antes	Total	%
Journal of Transport Geography	0	5	27	4	8	8	3	2	6	6	21	90	17,3%
Transportation Research Part A Policy and Practice	1	5	2	6	6	2	7	6	5	1	26	67	12,9%
Transport Policy	1	2	2	10	8	2	1	4	2	3	14	49	9,4%
Transport Reviews	0	6	10	2	3	3	2	12	0	1	2	41	7,9%
Transportation Research Part D Transport and Environment	0	1	1	0	2	2	5	3	1	2	15	32	6,2%
Health & place	1	9	1	3	1	0	0	1	1	1	1	19	3,7%
Transportation	1	2	0	3	1	1	1	4	1	0	3	17	3,3%
Urban Studies	0	0	0	1	0	1	1	2	1	2	9	17	3,3%
Mobilities	0	0	6	3	2	2	1	1	1	1	0	17	3,3%
Cities	2	0	6	1	1	0	0	0	1	1	4	16	3,1%

Journal of Transport and Land Use	0	7	4	2	1	1	1	0	0	0	0	16	3,1%
American Journal of Preventive Medicine	0	0	0	1	4	1	2	1	3	0	3	15	2,9%
Children's Geographies	0	2	4	1	0	0	1	1	1	1	0	11	2,1%
Environment and Planning A	0	0	0	1	0	1	5	0	0	2	2	11	2,1%
Journal of Urban Planning and Development	0	0	0	3	2	0	0	0	1	2	2	10	1,9%
Social science & medicine	0	2	2	1	1	0	2	0	1	0	1	10	1,9%
American journal of public health	0	0	0	0	2	2	1	0	0	0	4	9	1,7%
Transportation Research Part F Traffic Psychology and Behaviour	0	0	0	0	1	2	3	1	1	0	1	9	1,7%
Journal of Urban Economics	0	0	0	0	0	0	2	3	1	0	2	8	1,5%
Annals of the Association of American Geographers	0	0	0	2	0	1	0	0	2	0	3	8	1,5%
Progress in Human Geography	0	0	3	0	1	0	0	0	0	0	3	7	1,3%
The Annals of Regional Science	0	0	1	4	0	0	0	0	1	0	1	7	1,3%
Accident Analysis & Prevention	1	0	2	1	0	1	1	0	0	0	1	7	1,3%
International Journal of Urban and Regional Research	0	1	1	1	0	0	0	1	0	1	2	7	1,3%
Journal of the American Planning Association	0	0	0	1	0	0	0	1	0	2	3	7	1,3%
Preventive Medicine	0	2	1	0	0	3	1	0	0	0	0	7	1,3%
Regional Studies	0	0	1	0	0	0	0	0	0	0	5	6	1,2%
Total	7	44	74	51	44	33	40	43	30	26	128	520	100,0%

Búsqueda por palabras clave: Para complementar la búsqueda sistemática se realizó una búsqueda por palabras clave en buscadores online especializados en literatura científica. Uno de los resultados más importantes de la búsqueda sistemática de literatura fue observar una serie de términos que se repetían en buena parte de los artículos seleccionados como interesantes. De esta observación salieron un total de cinco keywords: *proximity, compact city, sustainable mobility, non-motorized, y walkability*. Las dos primeras palabras clave –*proximity y compact city*- se refieren a las características de la ciudad, mientras que las dos siguientes –*sustainable mobility, non-motorized*- se refieren a las características del desplazamiento. Por último, el término *walkability* es un término de moda en los últimos años en la literatura anglosajona y representa el punto de unión entre características de la ciudad y tipo de movilidad, al considerar los entornos urbanos bajo el prisma de si son transitables a pié o no.

Estas cinco palabras clave fueron introducidas en los siguientes buscadores online de literatura académica: Sciencedirect, Scopus, Jstor, Dialnet, Redalyc. Los dos primeros, generaron la mayor parte de los resultados al tratarse de buscadores de amplio rango que integran la mayor parte de revistas de transporte y medio ambiente de ámbito anglosajón. Jstor por su parte, a pesar de ser también de ámbito anglosajón produjo muchos menos resultados de los esperados, debido seguramente a su orientación hacia el ámbito de las humanidades, cada vez más alejado de las ciencias sociales. Finalmente Dialnet y Redalyc fueron utilizadas para cubrir el ámbito español y latinoamericano. Comparativamente, estos dos últimos buscadores devolvieron pocos resultados de estudios empíricos pero sí que encontraron algunas aportaciones relevantes a nivel teórico.

El resultado final de la búsqueda por palabras clave cuyas características pueden consultarse en la tabla 16, fue un aumento muy importante en la cantidad de literatura encontrada, principalmente proveniente de revistas de temática muy diversa y que hubieran pasado totalmente desapercibidos con solo la búsqueda sistemática ya que solo aportaron uno o dos artículos de interés por revista. Sirva como muestra de ello el hecho que el 42,3% de los artículos en la base de datos final provinieron de revistas que aportaron cinco o menos artículos relevantes, lo que significa que sin la búsqueda por palabras clave hubiesen pasado desapercibidos unos 392 artículos relevantes.

Tabla 19: Relación de palabras clave y buscadores online utilizados
Fuente: elaboración propia

PALABRAS CLAVES	BUSCADORES
Proximity	Sciencedirect
Compact city	Scopus
Sustainable mobility	Jstor
Non-motorized	Dialnet
Walkability	Redalyc

Búsqueda por bola de nieve: La búsqueda de trabajos y artículos mediante el método de bola de nieve consiste en consultar las bibliografías y listas de referencias de los artículos más interesantes recolectados en las fases previas de la investigación. Estas listas de bibliografía aportan no solo trabajos interesantes que pueden haber escapado de las fases previas de la investigación sino que también señalan trabajos anteriores al periodo temporal cubierto por la búsqueda sistemática. El método *snowball* es especialmente útil para identificar los trabajos clásicos que a menudo fueron pioneros en una línea de investigación determinada, así como también identificar aquellos trabajos contemporáneos más citados.

Dado que la búsqueda sistemática de literatura se había diseñado para cubrir el periodo 2005-2015, se utilizó el método snowball especialmente en su vertiente retrospectiva, es decir, para señalar aquellas obras clásicas más relevantes dentro de cada ámbito. Por otro lado se utilizó de forma muy ocasional la otra vertiente del método bola de nieve, que consiste en consultar qué obras más modernas han citado un determinado trabajo.

6.1.3 Software

Gestor bibliográfico: A pesar de que esta tesis se empezó utilizando el software Refworks, como gestor de citas bibliográficas, rápidamente se optó por Mendeley como software de base no solo para la gestión de las citas sino como repositorio de artículos, organizador y buscador dentro de la base de bibliografía acumulada. Mendeley es un software gratuito que ofrece una doble utilidad, por un lado actúa como red social académica, y por otro como base de datos personal de artículos y documentos académicos. Su primera vertiente, la de red social destinada a investigadores, ofrece la posibilidad de compartir artículos, acceder a bibliografías temáticas compiladas por otros usuarios o simplemente contrastar opiniones acerca de la búsqueda bibliográfica con otros académicos. Aunque el potencial de sus funcionalidades 2.0 es muy grande, esta tesis apenas ha utilizado Mendeley como red social, sino que ha explotado principalmente su capacidad como base de datos de bibliografía.

Mediante su software para escritorio, Mendeley ofrece la posibilidad de tener una biblioteca de bibliografía personal sincronizada por medio de la nube, en varios ordenadores, así como la posibilidad de organizar todo en carpetas temáticas, catalogar los documentos según tipo, publicación, año o palabras clave. Más relevante aún, integra la mayoría de funcionalidades propias del Acrobat PDF Reader de forma nativa, lo que permite no tener que salir del entorno Mendeley para realizar tareas como subrayar los artículos o realizar anotaciones. Por último, su motor de búsqueda permite realizar búsquedas por palabra no solo dentro de los campos titulo/abstract sino también dentro del cuerpo del propio artículo, lo que facilita la gestión de bibliografías extensas.

Gestión de notas y archivos: Dropbox y Evernote han sido dos software especialmente útiles para la gestión de archivos y notas en la nube. El primero ha permitido no tener que depender de una memoria física para sincronizar el trabajo en diversos dispositivos. Además, gracias a la posibilidad de compartir carpetas, dropbox también ha sido el repositorio en común para la supervisión y corrección de la tesis.

Evernote por otro lado ha permitido tener un bloc de notas online en el que apuntar todas las ideas que han surgido fuera del horario de trabajo o las notas interesantes de seminarios y conferencias.

El uso de estas herramientas ha sido especialmente importante dado que casi el 25% del doctorado se ha realizado en el extranjero, gracias a los ocho meses invertidos en tres estancias de investigación en centros internacionales. La necesidad de movilidad obligaba pues a no depender de notas físicas sino aprovechar al máximo los recursos que nos otorgan los servicios móviles 2.0 y de almacenaje en la nube.

Gestión de libros electrónicos: Por último, cabe reseñar la importancia del programa Calibre, para la gestión y organización de la bibliografía en formato libro. Buena parte de los libros consultados fueron en formato electrónico, ya fuese en formato *.epub*, *.mobi* o *.pdf.* La dificultad que supone gestionar un elevado número de libros en formatos diferentes ha sido solventada en gran parte mediante el software libre Calibre, que ha permitido tener un repositorio central a partir del cual los libros podían ser transformados en formato Acrobat PDF para ser añadidos a Mendeley y así tratados como un elemento adicional de bibliografía, o para ser transformados a formato MOBI para poder ser leídos con mayor comodidad mediante un lector de libros electrónicos o una tablet.

6.2 Estudios empíricos: consideraciones generales

Respecto a la metodología de los estudio empíricos, se ha optado por explicar aquí de forma conjunta las fuentes de datos y los análisis estadísticos utilizados, dejando los aspectos metodológicos más detallados de cada caso de estudio al texto original de cada artículo presentado.

Todos los estudios de caso tienen evidentemente un denominador en común, que es el estudio de la movilidad de proximidad. Los estudios comparten también un mismo enfoque metodológico general que consiste en utilizar métodos de estadística descriptiva combinadas con técnicas analíticas de tipo cuantitativo. Los métodos descriptivos sirven para identificar los puntos de análisis relevantes, sobre los que se focaliza con mayor profundidad eligiendo en cada caso el tipo de método estadístico más adecuado. En la tabla 17 se puede encontrar una tabla resumen de las metodologías utilizadas para la realización de cada uno de los estudios de caso.

Tabla 20: Tabla resumen de los estudios de caso
Fuente: elaboración propia

	ESTUDIO DE CASO 1	ESTUDIO DE CASO 2	ESTUDIO DE CASO 3	ESTUDIO DE CASO 4
Objetivos	(1) Contabilizar y cartografiar los desplazamientos de proximidad en Barcelona. (2) Explorar la relación de la proximidad con las variables socioeconómicas y de entorno urbano	(1) Analizar que grupos sociales hacen un mayor uso de la movilidad de proximidad	(1) Analizar como la vida en entornos donde es posible la movilidad de proximidad afecta a la salud tanto física como mental de las personas mayores	(1) Analizar como la vida en entornos donde es posible la movilidad de proximidad afecta a la salud de los jóvenes y niños
Fuente de datos	EMQ06 Servicio de estadística, Ayuntamiento de Barcelona	EMQ06 Servicio de estadística, Ayuntamiento de Barcelona	EMQ06	EMQ06
Población	Mayores de 16 años residentes en Barcelona (municipio).	Población en edad activa (16-64) residentes en Barcelona (municipio)	Población igual o mayor de 65 años residente en la Región Metropolitana de Barcelona (RMB)	Población menor de 16 años residente en la Región Metropolitana de Barcelona (RMB)
Desplazamientos analizados	Desplazamientos con origen y destino dentro del municipio de Barcelona	Desplazamientos con origen y destino dentro del municipio de Barcelona	Desplazamientos con origen y destino dentro de la Región Metropolitana de Barcelona	Desplazamientos con origen y destino dentro de la Región Metropolitana de Barcelona
Año	2006	2006	2006	2006
Métodos	Estadística descriptiva + Análisis bivariable	Estadística descriptiva + Análisis CHAID	Estadística descriptiva + tablas de contingencia + medidas de asociación	Estadística descriptiva + tablas de contingencia + medidas de asociación
Variable objetivo	Uso de la proximidad	Uso de la proximidad	Inmovilidad, número de actividades, tiempo invertido en andar	Número de actividades, tiempo invertido en andar
Variables dependientes	Densidad, Renta	Variables socioeconómicas, Variables de transporte	Vitalidad urbana, género, edad	Vitalidad urbana, género, edad

6.2.1 El camino hasta los viajes de proximidad

El objetivo de los cuatro casos de estudio era profundizar en el conocimiento de los desplazamientos de proximidad en la Región Metropolitana de Barcelona. Para hacerlo se parte de una fuente de datos común (ver sección 6.2.2) y de una metodología de identificación de los viajes de proximidad también común.

El primer paso obligatorio para analizar el uso de la movilidad es evidentemente diseñar una metodología válida para observar los desplazamientos de proximidad. Esta metodología se usará en todos los análisis posteriores para definir lo que es un desplazamiento de proximidad y lo que no lo es.

Debido a las características de nuestra principal fuente de datos (una encuesta de movilidad) nuestra primera aproximación a los viajes de proximidad no fue en base a la distancia recorrida sino a través del tiempo transcurrido en cada desplazamiento. Tal y como hemos visto en el apartado teórico, los seres humanos calculamos mucho mejor tiempos de desplazamiento que no distancias recorridas (Hess, 2012), y es por eso que las encuestas de movilidad preguntan por el tiempo invertido en cada desplazamiento registrado, y no por la distancia cubierta. En base a la variable tiempo, nuestro primer objetivo fue aislar aquellos viajes de la base de datos que se correspondían con un viaje breve. El criterio para definir lo que era un viaje breve fue extraído de la literatura, donde es frecuente la utilización de un umbral de 10 minutos de viaje para referirse a este tipo de viajes (Audirac, 1999; Mander, Brebbia, & Tiezzi, 2006, p. 717; Ryley, 2008). Estos viajes breves fueron analizados principalmente en mi trabajo de fin de máster, y publicados en la primera parte del Caso de estudio 1 publicado en Cities y en Miralles-Guasch y Marquet (2013) publicado en CyTET.

Los resultados extraídos fueron importantes a la hora de refinar el análisis posterior que buscaba tratar ya no los desplazamientos breves sino los desplazamientos de proximidad. Y es que si bien en el contexto de la ciudad peatonal histórica, 10 minutos de viaje se correspondían con una distancia constante, en la actualidad la disponibilidad de medios de transporte a nuestro alcance y sus respectivas velocidades asociadas hacen que el tiempo de viaje haya dejado de estar calibrado respecto al peatón. Tal y como se muestra en la figura 23, un viaje de 10 minutos puede cubrir distancias muy distintas según se realice andando, en bicicleta, en transporte público o en vehículo privado. Es por eso, que los viajes breves no son suficientes para medir la proximidad sino se tiene en cuenta la elección modal de cada viaje. En este punto, cabe remarcar que los viajes breves a pesar de ser interesantes por sí mismos, no integran las cualidades propias de la proximidad. Así tener una movilidad urbana caracterizada por la abundancia de viajes breves genera externalidades positivas en términos sociales ya que permite una mayor flexibilidad en el uso del tiempo. Sin embargo, este tipo de viajes no integran las bondades de la movilidad de proximidad en términos medioambientales, económicos ni de salud pública.

Figura 23: Territorio al alcance de un desplazamiento de 10 minutos en coche (izq) o a pié (der)
Fuente: elaboración propia a partir de Google maps

Tal y como indica Rodrigue et al., (2006) solo incorporando el medio de transporte al análisis podemos realmente alcanzar a ver la distancia recorrida en el desplazamiento. En este sentido, los medios de transporte que se relacionan en mayor medida con la proximidad son los no motorizados, especialmente el ir a pié. Ir a pié representa la forma más fundamental de movilidad a nuestro alcance, un modo de transporte sin costes y universalmente accesible que no contamina, no discrimina y no requiere de habilidades sobre aprendidas. Además mientras que las velocidades en medios motorizados son altamente variables y dependen en gran medida del contexto, la velocidad a pié en un entorno urbano presenta una regularidad que oscila entre los 4km/h y los 5km/h. La tabla 21 muestra una breve relación de estudios empíricos dedicados a estudiar las velocidades medias de cada transporte en entorno urbano, y puede servir de referencia a la hora de calcular distancias recorridas a partir de las variables tiempo de viaje y modo de transporte.

Tabla 21: Velocidades medias de transporte en entorno urbano
Fuente: elaboración propia

MEDIO DE TRANSPORTE	FACTORES QUE MODIFICAN	VELOCIDAD	REFERENCIA
Ir a pié	Edad; capacidad física;	4 km/h	(Duffy & Crawford, 2013; Ritsema van Eck et al., 2005)
		4.4 km/h	(Rodrıíguez & Joo, 2004)
		4.5 km/h	(McCormack, et al.,, 2007)
		4.6 km/h	(Michael et al., 2010)
		5 km/h	(Banister, 2011; Rabl & de Nazelle, 2012)
Bicicleta	Edad; capacidad física; infraestructura;	14.5 km/h	(Börjesson & Eliasson, 2012)
		16 km/h	(Litman, 2013)
		17 km/h	(Rabl & de Nazelle, 2012)
		20 km/h	(Duffy & Crawford, 2013)
		16-20 km/h	(Hendriksen et al., 2010)
Transporte Público	Tipo de transporte público, infraestructura, congestión, prioridad de paso	12 km/h (Autobus)	Barcelona TMB
		18 km/h (Tram)	Barcelona TRAM
		20 km/h	(Duffy & Crawford, 2013)
		27 km/h (Metro)	Barcelona TMB
		29 km/h (BRT)	(Gehl, 2010, p. 334)
		32 km/h (Metro)	(Landry, 2006, p. 83)
Coche	Infraestructura, congestión, entorno, prioridad de paso.	7 km/h (peak hour)	(Nakamura & Hayashi, 2012)
		16.5 km/h	(Chatman, 2008)
		20 km/h	(Duffy & Crawford, 2013; Limtanakool, Dijst, & Schwanen, 2006; Rabl & de Nazelle, 2012)
		21 km/h	(Mander et al., 2006, p. 595)

La combinación de un tiempo de viaje y una velocidad media de transporte nos da la distancia recorrida y esta distancia es la que podemos definir categóricamente como proximidad o lejanía. Es importante sin embargo entender que la utilización de las variables tiempo y modo de transporte no es solo un método para obtener una distancia final, sino que para definir proximidad desde el punto de vista subjetivo del individuo, tan importante es el tiempo y el modo de transporte como la distancia físicamente viajada.

Para ilustrar esta afirmación podemos imaginar las siguientes situaciones:

a) Una distancia euclidianamente corta puede requerir de mucho tiempo de desplazamiento. Podemos pensar en cómo cruzar una vía urbana de cinco carriles, o cuánto tiempo invertimos en recorrer un par de calles en coche cuando circulamos en plena hora punta. La distancia en estos casos puede ser poca, pero la percepción del individuo no es de proximidad

b) Un tiempo de desplazamiento puede ser breve pero recorrer mucha distancia. La velocidad potencial de los medios motorizados nos permiten cubrir una gran distancia en poco tiempo, pero eso no significa que estemos realizando un desplazamiento de proximidad

c) Aún cuando la distancia sea corta, y el tiempo de viaje breve, el destino no se halla próximo de un individuo si el desplazamiento requiere de la utilización de un medio de transporte que no está a su alcance. Los trayectos que requieren de la utilización del transporte privado rompen la correlación entre distancia, tiempo y accesibilidad y por lo tanto, serán desplazamiento cercanos para aquellos que puedan hacer uso de dichos transportes, pero desplazamientos lejanos para aquellos que no tengan tal acceso.

La proximidad requiere pues de los tres elementos, tiempo de viaje breve, desplazamiento accesible a todo el mundo y distancia recorrida corta, pero es importante entender que la distancia no es el elemento fundamental de un desplazamiento de proximidad sino un mero resultado de la combinación del tiempo y el modo de transporte. Cuando finalmente juntamos el criterio temporal (<10 min) con el criterio modal (uso del transporte no motorizado) obtenemos un viaje de proximidad (figura 24).

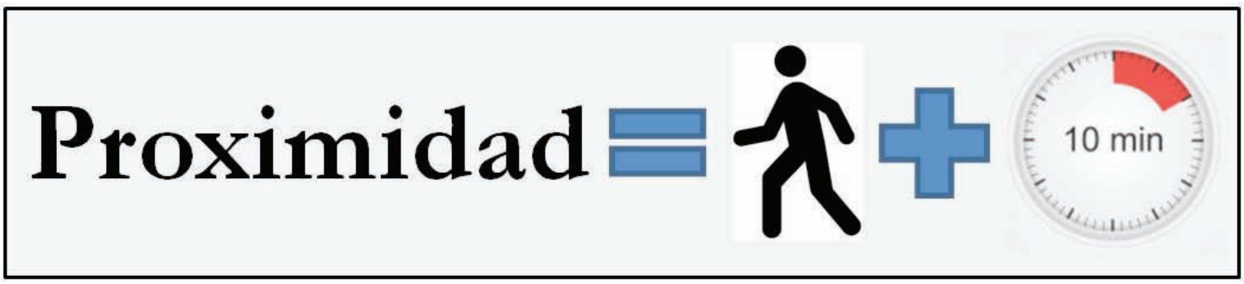

Figura 24: Esquema del viaje de proximidad
Fuente: elaboración propia

Este tipo de desplazamiento tiene una serie de características formales:

a) Distancia máxima recorrida de entre 640 y 800 metros lineales

b) Desplazamiento no contaminante[19].

c) Desplazamiento eficiente en términos de distancia recorrida por consumo de recursos.

d) Desplazamiento accesible a toda la población, sin restricciones de edad, habilidad, raza, género o riqueza.

e) Desplazamiento que genera actividad física.

f) Desplazamiento que aumenta nuestra creatividad.

Una vez establecida la metodología para identificar desplazamientos de proximidad, es posible ver que los 650-800 metros de distancia se hallan dentro de lo que la literatura ha venido considerando como *walkable distance* (Li et al., 2005; McCormack et al., 2007; Scheiner, 2010b; Sugiyama et al., 2010). Nuestra metodología también coincide con los cinco minutos andando desde casa que utiliza Richard et al. (2009) para medir la accesibilidad de las personas mayores, o los 10 minutos andando hasta el transporte público que se utiliza en Munoz-Raskin (2010). Esos mismo cinco minutos andando son también centrales para los planteamientos de renovación urbana del movimiento *New Urbanism* en Estados Unidos (Romero González & Lejano, 2009). Susan Handy (1996) por su parte utilizó también la frecuencia de viajes de 10 minutos andando como medida de accesibilidad espacial, usando la movilidad como un indicador de la ciudad de una forma similar a la que se utiliza en los casos de estudio 3 y 4 de esta tesis. Por último, existen varios casos de estudios que utilizan los 10 minutos andando para medir la extensión funcional de un barrio o un área de estudio (Lachapelle & Noland, 2012; Parks & Schofer, 2006).

Todos estos vínculos con la literatura reafirman la utilidad de la metodología empleada para llegar a los desplazamientos de proximidad utilizando los datos disponibles en las encuestas de movilidad.

6.2.2 Principales fuentes de datos

En los cuatro estudios de caso, la principal fuente de datos ha sido la Encuesta de Movilidad Cotidiana 2006. Para los estudios de caso 1 y 2 también se han utilizado fuentes secundarias alternativas como el Servicio Estadístico del Ayuntamiento de Barcelona, o la base cartográfica del ICC. Estas fuentes secundarias han sido necesarias para complementar los datos de movilidad provenientes de la encuesta.

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[19] Técnicamente, y dado que los alimentos que necesitamos para movernos también generan emisiones al ser producidos, se podría argumentar que andar también contamina. El estudio de Duffy y Crawford (2013) sin embargo demuestra que aún incorporando los costes de la producción de alimentos al cálculo de emisiones, andar sigue siendo el modo de transporte menos contaminante que existe.

Fuente principal: Encuesta de Movilidad Cotidiana 2006

Las Encuestas de Movilidad Cotidiana son una iniciativa del la Autoridad del Transporte Metropolitano (ATM) y la el Departamento de Política Territorial y Obras Públicas (PTOP) de la Generalitat de Cataluña. Las encuestas fueron diseñadas con el objetivo de conocer los hábitos de movilidad de la población catalana y en principio se estructuraron en base a una periodicidad quinquenal. Con ese criterio, ha habido tres ediciones de la encuesta, en los años 1996, 2001 y 2006. La siguiente edición, programada para 2011 no se pudo realizar por restricciones presupuestarias. La edición de 2006 es pues la fuente de datos de movilidad, con un tamaño de muestra adecuado, más reciente a nuestra disposición[20].

En su edición del 2006, la EMQ toma la forma de una encuesta de movilidad basada en el hogar, que estudia de forma exhaustiva la movilidad de la población para el conjunto del ámbito territorial de Cataluña. La encuesta se realizó mediante metodología CATI (Computer Assisted Telephone Interviews) con la que se preguntó a los encuestados acerca de su movilidad el día anterior a la realización de la encuesta. El universo fue el del conjunto de la población mayor de 4 años y residente en Cataluña. Las cifras totales de encuestados por cada ámbito territorial se pueden consultar en la tabla 22.

Tabla 22: Muestra disponible en la Encuesta de Movilidad Cotidiana 2006
Fuente: elaboración propia a partir de EMQ06

ÁMBITO	ENCUESTAS REALIZADAS	POBLACIÓN TOTAL	DESPLAZAMIENTOS REGISTRADOS	DESPLAZAMIENTOS TOTALES
Cataluña	106.091	6.830.755	358.351	23.084.291
Región Metropolitana de Barcelona	71.994	4.635.422	245.417	15.801.351
Municipio de Barcelona	24.088	1.550.950	79.823	5.139.452

[20] En paralelo a las encuestas EMQ, y desde 2004 la ATM y GENCAT también impulsan la Encuesta de Movilidad en día Laborable (EMEF) con una periodicidad anual. Dicha encuesta sin embargo es de carácter mucho más reducido y a pesar de que las preguntas son similares a la EMQ, el menor tamaño de muestra impide a la práctica realizar muchos de las desagregaciones necesarias para observar los viajes de proximidad.

El objetivo final de la encuesta es proporcionar información acerca de la movilidad cotidiana de la población, haciendo especial hincapié en el modo de transporte utilizado, el tiempo de desplazamiento, su distribución horaria a lo largo del día y el motivo del desplazamiento. En términos de variables socioeconómicas, la encuesta incorpora información acerca de la edad, género, ocupación o acceso al transporte privado del entrevistado. En términos territoriales, la encuesta permite analizar el origen/destino de cada desplazamiento a nivel de comarca/municipio/barrio o a nivel de tamaño del municipio. Las ediciones 2001 y 2006 también recogen algunas dimensiones subjetivas referidas a las percepciones y valoraciones de la movilidad por parte de los usuarios. Esta dimensión subjetiva de la encuesta sin embargo no ha sido utilizada en los casos de estudio.

El uso de encuestas de movilidad oficiales para estudios de transporte tiene una larga tradición desde que se empezaron a utilizar en los años 1950 (Shen & Stopher, 2014). Con el tiempo han evolucionado desde el formato de encuesta origen/destino hasta ser encuestas preocupadas por el conjunto de la movilidad. En la actualidad son la forma más común de análisis y gestión de la movilidad a nivel internacional (Rodrigue et al., 2006, p. 197) y han demostrado que a pesar de sus limitaciones, son aún la fuente de datos de movilidad más fiable y extensa a nuestra disposición. Su principal ventaja es que son capaces de analizar la movilidad de grandes territorios como municipios o áreas metropolitanas, mientras que su principal inconveniente es su elevado coste. Cuando se trata de analizar la movilidad y frente a encuestas ad hoc, datos provenientes de estudios con GPS/Smartphones o estudios cualitativos, las encuestas de movilidad presentan las siguientes ventajas.

a) Representatividad estadística en todas las áreas de la ciudad/territorio.
b) Tamaño mostral elevado permite desagregaciones y profundidad de análisis tanto geográfico como temático
c) Incorporan datos socioeconómicos/territoriales de contexto.
d) Pueden incorporar datos subjetivos del usuario.
e) Metodología homogénea a nivel internacional, permite comparaciones con otros ámbitos territoriales.
f) La metodología no ha cambiado mucho a lo largo del tiempo, permiten análisis de evolución temporal.

Aún así, las encuestas de transporte también tienen algunos defectos, debido a que la mayoría no están diseñadas exclusivamente para el estudio de la movilidad sino para la gestión de la demanda de transporte. Así podemos identificar los siguientes inconvenientes:

a) Tratan los desplazamientos de forma independiente, no es posible reproducir la cadena completa de viajes de un solo individuo

b) Metodología excesivamente orientada a los desplazamientos en medios motorizados. Los medios no motorizados aparecen en las encuestas más recientes pero la metodología no es la óptima para su análisis/descripción[21].

c) Resultados sujetos a las desviaciones propias de la subjetividad de la persona entrevistada.

d) Dificultad para representar los viajes más cortos ya sea en términos de tiempo o distancia.

e) La información territorial y socioeconómica que incorporan es limitada.

Fuentes secundarias:

Una de las principales limitaciones de muchas de las encuestas de viaje en general y de la Encuesta de Movilidad Cotidiana 2006 en particular es la falta de variables socioeconómicas y territoriales que incorporan. En los estudios que buscan analizar cuantitativamente los determinantes de la movilidad es fundamental contar con variables de contexto de tipo territorial y socioeconómico y si estas no se encuentran dentro de la base de datos de la encuesta es necesario utilizar fuentes de datos adicionales para incorporarlas al análisis. Aunque esta es una metodología ampliamente aceptada que emana de las limitaciones propias de las encuestas de viaje, no está exenta de inconvenientes, puesto que la agregación de datos territoriales o socioeconómicos adicionales solo se puede realizar de forma agregada. Así, mientras la matriz de datos de la EMQ06 distingue entre todos los desplazamientos hechos por cada individuo, la agregación de datos socioeconómicos no se podrá hacer en base al individuo, sino que se tendrán que buscar proxys como el barrio donde vive o el propio perfil socioeconómico. Estos métodos de agregación presentan problemas especialmente cuando en un mismo análisis incorporamos variables originales de la encuesta (y por tanto desagregadas a nivel de individuo/desplazamiento) con variables adicionales que provienen de fuentes externas (y por tanto desagregadas a nivel de barrio/municipio).

[21] Los desplazamientos cortos y los desplazamientos en medios no motorizados aparecen típicamente sub-representados en las encuestas de movilidad. Rietveld (2000) estima una sub-representación de este tipo de desplazamientos de entre el 20 y el 30%

Dichos problemas se reproducen en esta tesis principalmente en el caso de estudio 1, donde se utilizan variables como la densidad de población o el nivel de renta disponible en cada barrio. Estas no son variables disponibles en la matriz de la encuesta sino que provienen del Servicio de Estadística del Ayuntamiento de Barcelona. En ambos casos, se buscó la desagregación territorial más pequeña posible (nivel de barrio) para ser integrada en la matriz de desplazamientos. También se aseguró que los datos fueran los correspondientes al año 2006. En el caso de estudio 1, ambas variables independientes (densidad de población y nivel de renta) provienen de una fuente de datos externa a la encuesta, pero dado que el objetivo de parte del estudio es entender qué relación tienen densidad y renta en la configuración de los desplazamientos de proximidad en Barcelona, este hecho no provoca desviaciones significativas.

El uso de fuentes externas es ligeramente más problemático en el caso de estudio 2, donde la variable renta (*Income*) y la variable oferta de Transporte Público (*Public transport supply*) que provienen del Servicio de Estadística del Ayuntamiento de Barcelona y están desagregadas a nivel de barrio, se incorpora al modelo CHAID en situación de igualdad con otras variables socioeconómicas que provienen de la matriz de encuesta y que por tanto están desagregadas a nivel de individuo. Este desequilibrio provoca que la importancia de la variable renta o la oferta de transporte público seguramente aparezca algo diluida con respecto a las otras variables. Aún así, este desequilibrio solo afecta a la relación de las variables con otras variables y no así en lo que respecta al análisis bivariable entre movilidad de proximidad y niveles de renta en Barcelona, o los niveles de oferta de transporte público.

Para el caso de estudio 1, también se utilizó la base cartográfica del municipio de Barcelona disponible en el portal cartográfico ICC. A partir de la base municipal en formato vectorial se pudo cartografiar el uso de la proximidad en las diferentes zonas de Barcelona, así como los niveles de densidad de población y de renta de cada zona.

6.2.3 Selección de métodos para cada caso de estudio

El diseño de la tesis en forma de cuatro casos de estudio responde a la voluntad de estudiar con detalle diferentes aspectos de la proximidad que no son necesariamente analizables con los mismos métodos. Es por eso que dentro del marco de un análisis cuantitativo que parte siempre de una misma fuente de datos (EMQ06) y de una misma métrica de la proximidad (P=Andar + <10min) los métodos utilizados varían en cada caso de estudio. El procedimiento exacto seguido en cada caso se puede leer en cada caso de estudio y por tanto en este punto solo se exponen las principales características de cada método utilizado.

Ante cada pregunta de investigación se utilizó el método que se consideró más adecuado, consultando libros especializados en análisis de datos en las ciencias sociales y utilizando la bibliografía especializada como referencia a la hora de valorar las ventajas y desventajas de cada método. Asimismo, cabe reseñar que a pesar de que esta tesis utiliza métodos cuantitativos, el foco no se ha puesto en la complejidad de los métodos sino en la respuesta a las preguntas de investigación. Esta tesis no utiliza modelos cuantitativos revolucionarios sino que se preocupa más por las preguntas y por la interpretación del análisis, que no en el método en sí. A continuación se explica brevemente cuales han sido las consideraciones para utilizar un método u otro en cada caso de estudio.

Caso de estudio 1: El objetivo principal era el de testear la métrica "Proximidad = andar en 10 minutos o menos", como método válido para medir el uso de la proximidad en Barcelona. Para este objetivo no se necesita más que el uso de cartografía y estadística descriptiva. Solo en la parte final del análisis, en que se busca comprobar si la densidad de población y el nivel de renta juegan algún rol como factores explicativos de la presencia de proximidad en las diferentes zonas fue necesario utilizar métodos como el test Chi-Cuadrado y las tablas de contingencia. La utilización de dichos métodos es adecuada porque estamos tratando con variables categóricas y porque nos permiten descartar la hipótesis nula (que la proximidad se halla homogéneamente distribuida entre las zonas, independientemente de su nivel de densidad/renta). Por otro lado, las tablas de contingencia y el análisis de sus *p-values* localizados por celda nos permiten localizar dónde se hallan los valores significativos.

Caso de estudio 2: El objetivo principal era el de explorar que grupos sociales utilizaban en mayor medida la movilidad de proximidad. El punto fuerte del análisis no está en el método utilizado, sino en centrarse en el ámbito socioeconómico de la movilidad, un ámbito que tradicionalmente ha sido menos estudiado que los determinantes espaciales. El análisis se centró en la relación que cuatro variables socioeconómicas (edad, género, situación profesional y renta) y dos variables relativas al acceso al transporte (acceso al vehículo privado y oferta de transporte público en el barrio de residencia) tenían con la utilización de viajes de proximidad. En una primera fase del análisis, se estudió la relación bivariable de cada una de las variables independientes con la variable dependiente. Para ello se utilizaron tablas de contingencia y chi-cuadrado. En una segunda fase, en que se buscaba un análisis multivariable se utilizó un árbol de decisión de tipo CHAID especialmente adecuado para tratar con variables de tipo nominal. Se optó por el método CHAID y se descartó la posibilidad de realizar una regresión logística porque el objetivo no era cuantificar al detalle el peso exacto de la variable *n* en el *outcome* de realizar un desplazamiento de proximidad, sino observar la jerarquía de factores y clasificar los grupos sociales que más estaban utilizando este tipo de desplazamientos.

Casos de estudio 3 y 4: Los casos de estudio son muy similares entre sí, y buscan entender de qué manera el hecho de vivir en zonas donde es posible la movilidad de proximidad afecta a la salud de dos grupos sociales de especial interés como son la gente mayor (Caso de estudio 3) y la población infantil (Caso de estudio 4). El análisis consiste en observar como algunos aspectos de la movilidad que son especialmente relevantes en términos de salud pública, como son la tasa de inmovilidad, la frecuencia de los viajes andando o el total de minutos caminados al día cambian por el hecho de vivir en una zona donde es posible la movilidad de proximidad o en una zona donde no lo es. Este tipo de análisis se resuelve mediante tablas de contingencia y chi cuadrado, y la única diferencia entre los casos de estudio 3 y 4 es el uso del riesgo relativo o el *odds ratio* para comparar los resultados obtenidos en las zonas vitales (aquellas donde es posible moverse mediante viajes de proximidad) y los resultados de las zonas no vitales. En este sentido, y aunque el uso de riesgo relativo es perfectamente válido, el análisis por *odds* ratio supone una aproximación más fidedigna a la posibilidad de realizar un desplazamiento de proximidad. Una vez más, la novedad de los estudios de caso no reside en la complejidad de los análisis estadísticos sino en el planteamiento del problema y las preguntas de investigación. En este caso, la novedad consiste en utilizar un indicador de movilidad (uso de viajes de proximidad) como variable que nos habla del diseño y las características de la forma urbana. Eso nos permite comparar zonas urbanas no en base a sus características morfológicas sino en base al tipo de movilidad que permiten, una aproximación mucho más cercana a las necesidades reales de la población.

6.2.4 Principales métodos de análisis

Chi-Square Tests:

El test de chi cuadrado es uno de los tests estadísticos más utilizados en las ciencias sociales (Healey, 2009, p. 260). Dentro de sus múltiples dimensiones, esta tesis lo usa casi exclusivamente como test de independencia entre variables. Se considera que dos variables son independientes cuando la clasificación dentro de una primera variable no afecta en nada a la clasificación de la segunda variable. Es decir, que vivir en un barrio con alta densidad de población o vivir en uno con baja densidad de población, no afecta en nada al hecho que utilicemos los desplazamientos de proximidad. El test de Chi-cuadrado asume la independencia de las variables como hipótesis nula, y compara la distribución actual de los valores de las variables con la distribución real esperada. Como menor sea la diferencia entre la distribución real y la distribución esperada más cerca estaremos de confirmar la hipótesis nula: que no existe relación entre las variables y que por tanto son independientes. Por el contrario, como mayores son las diferencias entre las frecuencias observadas y las frecuencias esperadas más probable es que estemos ante dos variables dependientes y por tanto se rechace la hipótesis nula.

Cuando se usa el test Chi-Cuadrado hay que tener siempre en cuenta que el test demuestra dependencia pero no nos dice nada de qué tipo de relación se establece entre las dos variables. Así, no es posible deducir causalidad entre dos variables por el mero hecho que el test de chi-cuadrado sea significativo. El test de chi-cuadrado es el primer paso para un análisis más profundo y sus resultados se complementan perfectamente con el siguiente método utilizado: las tablas de contingencia.

Tablas de contingencia:

El análisis de las asociaciones entre variables se halla en el corazón de cualquier análisis estadístico multivariante (Agresti, 2007, p. 21). Cuando tratamos de variables categóricas, como en el caso de la proximidad que es una variable de tipo binaria (es un desplazamiento de proximidad: SI/NO) el método más frecuente de estudiar las relaciones entre las variables son las tablas de contingencia. El uso de tablas de contingencia nos permite observar la distribución de los resultados incorporando hasta tres variables distintas (*three-way contingency tables*).

Tanto en el caso de estudio 1 como en el caso de estudio 3 y 4 se utiliza las tablas de contingencia como las diferencias en las variables A y B afectan a la variable C. En el caso de del estudio de caso 1, las variables A (densidad de población) y B (renta) modificaban el uso de C (Viajes de proximidad). En el caso de los estudios de caso 3 y 4, las variables A (Edad) y B (Género) modificaban el uso del caminar como forma de transporte dependiendo de C (Vitalidad del barrio). Lo que se analiza utilizando tablas de contingencia es si la posibilidad de emprender un desplazamiento de proximidad es igual independientemente de la densidad de población y la renta del barrio donde se reside, o si la posibilidad de emprender un desplazamiento andando es igual en barrios con una vitalidad elevada que en barrios con una vitalidad baja.

Para el análisis de las tablas de contingencia se utilizan tres métodos distintos:

- Diferencia de proporciones (Estudio de caso 1): es el tipo de análisis más sencillo y consiste en comparar la proporción de desplazamientos que sí son de proximidad con la proporción de desplazamientos que no son de proximidad.
- Riesgo relativo (Estudio de caso 3 y 4): El uso de riesgo relativo es especialmente recomendable cuando los valores de las variables observadas son muy distintos entre ellos (Agresti, 2007, p. 28). Así, al analizar el riesgo de inmovilidad de las personas mayores que viven en zonas vitales/no vitales, dado que algunos valores se hallan entorno al 25% y otros entorno al 6% es necesario usar el riesgo relativo para poder comparar en qué punto son más significativas las diferencias. Un punto porcentual es mucho más importante en los valores bajos que en los valores altos, y el riesgo relativo permite incorporar esta diferencia a los resultados.
- Odds ratio (Estudio de caso 4): dado que para el estudio de caso 4 se utilizan dos variables binarias como son la posibilidad de caminar (Si/No) en entornos vitales o entornos no vitales cabía la posibilidad de utilizar odds ratio como medida para analizar la posibilidad de un evento (desplazarse andando) en condiciones distintas (en un entorno vital vs un entorno no vital). Además, el método odds ratio es muy utilizado en el ámbito de la medicina para medir la posibilidad de que se produzca un evento determinado. Su uso también permite comprar odds ratio entre variables como el género o la edad.

Árbol de decisión de tipo CHAID:

Los árboles de decisión son diagramas que en origen estaban pensados para ilustrar caminos de decisión en estudios de marketing y psicología. Dentro de este grupo de técnicas, el método CHAID (Chi-square Automatic Interaction Detector), propuesto por Kass (1980) empieza en un nodo que contiene toda la muestra del estudio, y a partir de ese nodo se clasifican la muestra en base a la fuerza predictiva de cada variable. Dado que la variable dependiente es siempre categórica, los *p-value* que sirven como criterio para ordenar los predictores se calculan mediante Chi-cuadrado (Badea-Romero & Lenard, 2013).

En el caso de estudio 2, el árbol CHAID es utilizado para explicar cómo diferentes variables socioeconómicas y de transporte pueden predecir el uso de los desplazamientos de proximidad. El método CHAID evalúa la relación de cada una de las variables independientes con la variable dependiente (uso de la proximidad) y escoge la variable más fuerte como primera partición de la muestra. A partir de ahí el proceso se repite en cada nodo de forma independiente segmentando la muestra hasta que el proceso acaba con todas las variables significativas. Al segmentar progresivamente la muestra el método CHAID requiere de muestras elevadas con lo que no es adecuado para encuestas *ad hoc* pero si para encuestas de movilidad con un tamaño mostral grande como la EMQ06.

Este método está siendo adoptado cada vez más en estudios de transporte (Badea-Romero & Lenard, 2013; Pitombo et al., 2011; Yang et al., 2013; Zhang, Yu, & Chikaraishi, 2014) debido a que es especialmente adecuado para entender las relaciones entre variables que afectan a una decisión como puede ser la elección modal o en nuestro caso, la utilización de un desplazamiento de proximidad. Asimismo, el método permite trabajar con variables de tipo nominal. Los puntos fuertes de este método son su elevado componente visual y su facilidad de interpretación, lo que es útil no solo a nivel de análisis de resultados sino también en el momento de la difusión de la investigación.

El método CHAID es un método de análisis multi-variable orientado en base a los datos introducidos en el modelo con lo que necesita de un diseño previo que debe fundamentarse en el análisis teórico de la literatura y en la interpretación de las relaciones bivariables. Asimismo, los resultados también deben interpretarse entendiendo las fortalezas y debilidades del método utilizado. En nuestro contexto, no podemos hablar de una causalidad entre los factores que el método CHAID clasifica como más importantes y el uso de la proximidad, sino que el método nos sirve para identificar que grupos utilizan más frecuentemente este tipo de desplazamientos y como recurso visual para identificar tendencias entre las variables.

6.2.5 Software

SPSS: El paquete de software estadístico conocido como IBM SPSS (originalmente Statistical Package for the Social Sciences) es uno de los software estadísticos más extensamente utilizados en el ámbito de la academia. Esta investigación ha utilizado la versión 19 de dicho software, por motivos de disponibilidad. SPSS permite una extensa variedad de procesos estadísticos y de manipulación de grandes bases de datos. Una de las principales ventajas respecto a otros software como R es su interfaz funcional en base a ventanas y menús, siendo el funcionamiento por sintaxis una posibilidad adicional y no un requisito para su utilización. Esta facilidad de uso ha sido de gran importancia para el aprendizaje de nuevas técnicas y posibilidades, así como el proceso de prueba y error que ha llevado a los resultados finales que se presentan en esta tesis. La popularidad del producto ha permitido también la resolución de problemas mediante la consulta de material online, respuestas de otros usuarios en foros especializados o incluso el aprendizaje de nuevas técnicas mediante tutoriales.

SPSS ha permitido trabajar con facilidad con la base de datos de la EMQ06 desde casi cualquier ordenador a nuestro alcance, procesando con facilidad una matriz de desplazamientos que en origen contaba con 143 variables (Matriz EMQ06 original) pero que al final de esta tesis sumaba hasta 253 variables. En total con 406.366 entradas y 253 variables, el uso de SPSS ha permitido trabajar con 102,2 millones de valores una cifra que da valor a la importancia del software estadístico utilizado y también da dimensión a la cantidad de información que las encuestas de movilidad son capaces de proporcionar.

ArcGIS: el paquete de software de análisis SIG comercializado por ESRI ha sido el principal software cartográfico utilizado en esta tesis. Gracias a la licencia de uso de la UAB se ha podido utilizar uno de los mejores software disponibles para la producción de cartografía temática y análisis SIG. Siendo estrictos, esta tesis ha utilizado la herramienta ArcMap 10 principalmente para la realización de cartografía temática para el estudio de caso 1 y el capítulo 6.3 dedicado a la descripción del ámbito de estudio. Aunque muchos de los análisis SIG realizados no han acabado formando parte de la tesis en su versión final, el software arcGIS ha sido importante porque ha permitido observar la distribución territorial de las zonas con mayor uso de la proximidad en lo que ha supuesto el primer paso imprescindible para después llegar a los casos de estudio concretos que aquí se presentan. Asimismo, el uso del SIG ha sido importante también para la realización de materiales visuales en las presentaciones en congresos que se han llevado a cabo durante el periodo doctoral.

6.3 Ámbito de estudio

Esta tesis se ubica en la región metropolitana de Barcelona, pero dado que los casos de estudio 1 y 2 se centran exclusivamente en el municipio de Barcelona, y los casos de estudio 3 y 4 se ocupan del conjunto de la RMB, esta sección describe los ámbitos de estudio de forma separada. Tal y como ya se ha expuesto, el ámbito de estudio sirve solo como escenario para el desarrollo de casos de estudio vinculados con el uso de la proximidad. El objetivo no es tanto describir la proximidad en Barcelona como utilizar Barcelona para ampliar nuestro conocimiento sobre la movilidad de proximidad. A continuación se describen las principales características de los dos ámbitos de estudio. Dado que la principal fuente de datos corresponde al año 2006, la descripción de los ámbitos de estudio también se ha realizado en base a este año.

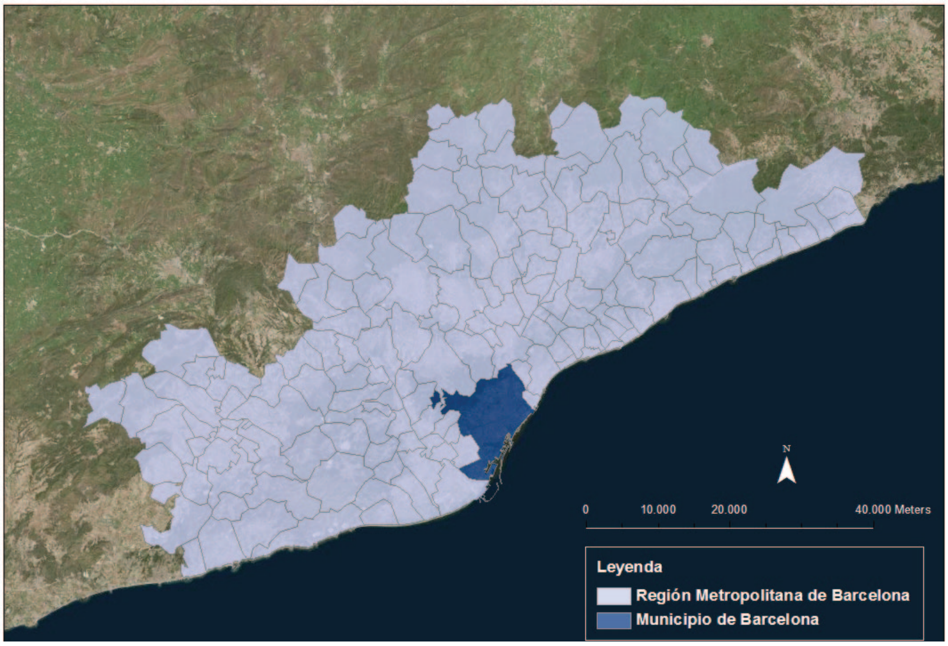

Figura 25: Situación geográfica de las áreas de estudio
Fuente: elaboración propia

6.3.1 Municipio de Barcelona

El municipio de Barcelona ocupa 101 km2 y concentraba en 2006 1.605.602 habitantes. El número de habitantes en Barcelona desciende desde 1983 hasta el año 2000 año en que se registran 1.49 millones de habitantes. A partir de ese año, la población se recupera lentamente hasta estabilizarse en torno a los 1,6 millones, cifra que se mantiene aún hasta 2014. En 2006 la población de Barcelona representaba el 22,6% del total de la población catalana, y el 33,1% de la población de la Región Metropolitana.

La ciudad se divide administrativamente en 10 distritos (desde 1984) y en 73 barrios (desde 2006). La extensión de la urbanización en Barcelona ha casi colmatado los límites municipales, produciendo unos niveles de densidad de población entre altos y muy altos. Así, la densidad bruta de población para el conjunto del municipio de unos 15.903 hab/km2 el cálculo por distritos permite ver que existen zonas de la ciudad muy densamente pobladas. El distrito del Eixample marca el máximo de densidad de población con 35.576 hab/km2 mientras que el de Sarria Sant Gervasi marca el mínimo con 7.040 hab/km2. En términos de barrio aún podemos encontrar mayores diferencias, con una densidad máxima de población de 59408 hab/km2 en Sants-Badal y una mínima de 368 hab/km2 para el caso de Vallvidrera y el Tibidabo.

La tabla 23 contiene algunos datos adicionales acerca de las características morfológicas de la ciudad, donde destaca la alta proporción del tejido residencial de alta densidad o histórico en relación con el tejido residencial de baja densidad. Solo los distritos de Les Corts y Sarrià-Sant Gervasi contienen zonas importantes de residencia de baja densidad.

Tabla 23: Características morfológicas de los distritos de Barcelona
Fuente: elaboración propia a partir de Ajuntament de Barcelona (2015)

Distrito	Densidad de población (hab/km2)	Renda familiar 2006 (euros/año)	Tejido residencial alta densidad (%)	Tejido residencial histórico (%)	Tejido de baja densidad (%)	Superfície dedicada a servicios (%)	Superfície dedicada a equipam. (%)	Superfície dedicada a Z.Verdes (%)	Superfície Industrial (%)
Ciutat Vella	24289	11919	7,8%	47,3%	0,0%	1,5%	22,7%	18,7%	0,5%
Eixample	35671	19260	78,1%	0,0%	0,0%	0,3%	12,2%	9,4%	0,0%
Sants-Monjuic	8048	13356	15,7%	2,8%	0,0%	1,0%	18,8%	23,9%	25,2%
Les Corts	13871	23075	30,3%	1,4%	12,8%	0,3%	35,1%	16,1%	0,0%
Sarrià-Sant Gervasi	7241	29599	42,2%	6,1%	18,9%	0,0%	20,4%	12,2%	0,0%
Gràcia	29346	17306	48,3%	21,2%	0,4%	0,1%	12,0%	18,0%	0,0%
Horta-Guinardó	14372	14154	47,2%	2,4%	1,2%	0,4%	26,5%	22,1%	0,1%
Nou Barris	21131	11337	55,6%	0,0%	0,6%	1,1%	16,1%	19,4%	0,6%
Sant Andreu	22329	13645	40,9%	4,7%	0,0%	2,9%	9,5%	17,1%	17,5%
Sant Martí	22126	14182	38,5%	5,2%	0,0%	0,9%	12,8%	20,5%	2,2%
BARCELONA	15970	16555	41,7%	6,4%	3,6%	0,8%	19,9%	19,9%	7,6%

La distribución del comercio minorista también es altamente homogénea y ha sido tradicionalmente uno de los puntos fuertes de la vida cotidiana en la ciudad tal y como puede verse en la figura 26. La distribución homogénea de los servicios y comercios en todos los barrios de la ciudad asegura que las variaciones de uso de proximidad no se deben a diferencias en la distribución interna de los comercios dentro del barrio. Esta distribución homogénea también explica que en el 2006 el 45,5% de los habitantes de Barcelona declarasen realizar sus compras cotidianas dentro en su mercado municipal más cercano o en la tienda de su barrio (Ajuntament de Barcelona, 2006, p. 44).

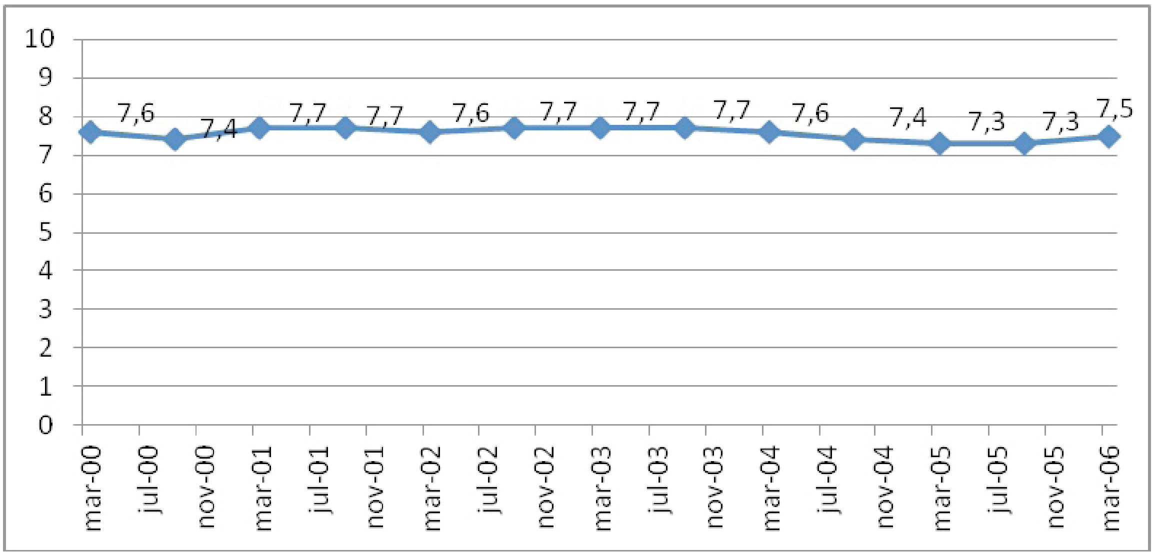

Figura 26: Grado de satisfacción con la oferta comercial en Barcelona
Fuente: elaboración propia a partir de Ajuntament de Barcelona (2015

En lo que se refiere a estructura socioeconómica Barcelona se caracteriza por una importante separación espacial en términos de renta. A pesar de que en términos cuantitativos la mayoría de barrios se hallan cercanos a la media de ingresos familiares del conjunto de Barcelona, existen importantes excepciones tanto en positivo como en negativo. Estas excepciones además, tienen un alto componente espacial. Así, ocho de las diez zonas con un mayor nivel de renta disponible se hallan en el distrito de Sarriá San-Gervasi. Por el contrario, ninguna de las 26 zonas que conforman el distrito de Nou Barris llega cerca de la media de ingresos de la ciudad (Calvo, Güell, & Salabert, 2007, p. 58)[22].

[22] Si bien entre el 2000 y el 2006 se produjo un lento proceso de disminución de las diferencias de renta, los efectos de la crisis han hecho que la desigualdad en la ciudad haya aumentado considerablemente en el periodo 2006-2014. Si en 2006 el área más rica ingresaba 5,7 veces más que la más pobre, en 2011 esta diferencia era ya de 7,1 (Ajuntament de Barcelona, 2011).

Los niveles de renta determinan en buena medida también los niveles de motorización en la ciudad. De media, en 2006 había 457 vehículos dedicados al transporte privado (turismos/motos) por cada 1000 habitantes. Se trata de una tasa de motorización superior a otras ciudades europeas como Bruselas (434), Berlín (320) o París (416) pero inferior a otras como Madrid (513) o Roma (684) (EUROSTAT, 2013). La correlación entre motorización y renta es estrecha en su parte más alta, siendo los barrios más ricos los que claramente tienen también una mayor tasa de motorización (Figura 27: abajo, izq.).

La figura 27 también muestra la distribución de población mayor de 65 años (arriba, izq.) y la distribución de población infantil (arriba der.) y permite observar que si bien la población mayor se halla muy repartida por el conjunto de la ciudad, la población infantil tiende a concentrarse en los barrios periféricos de la ciudad.

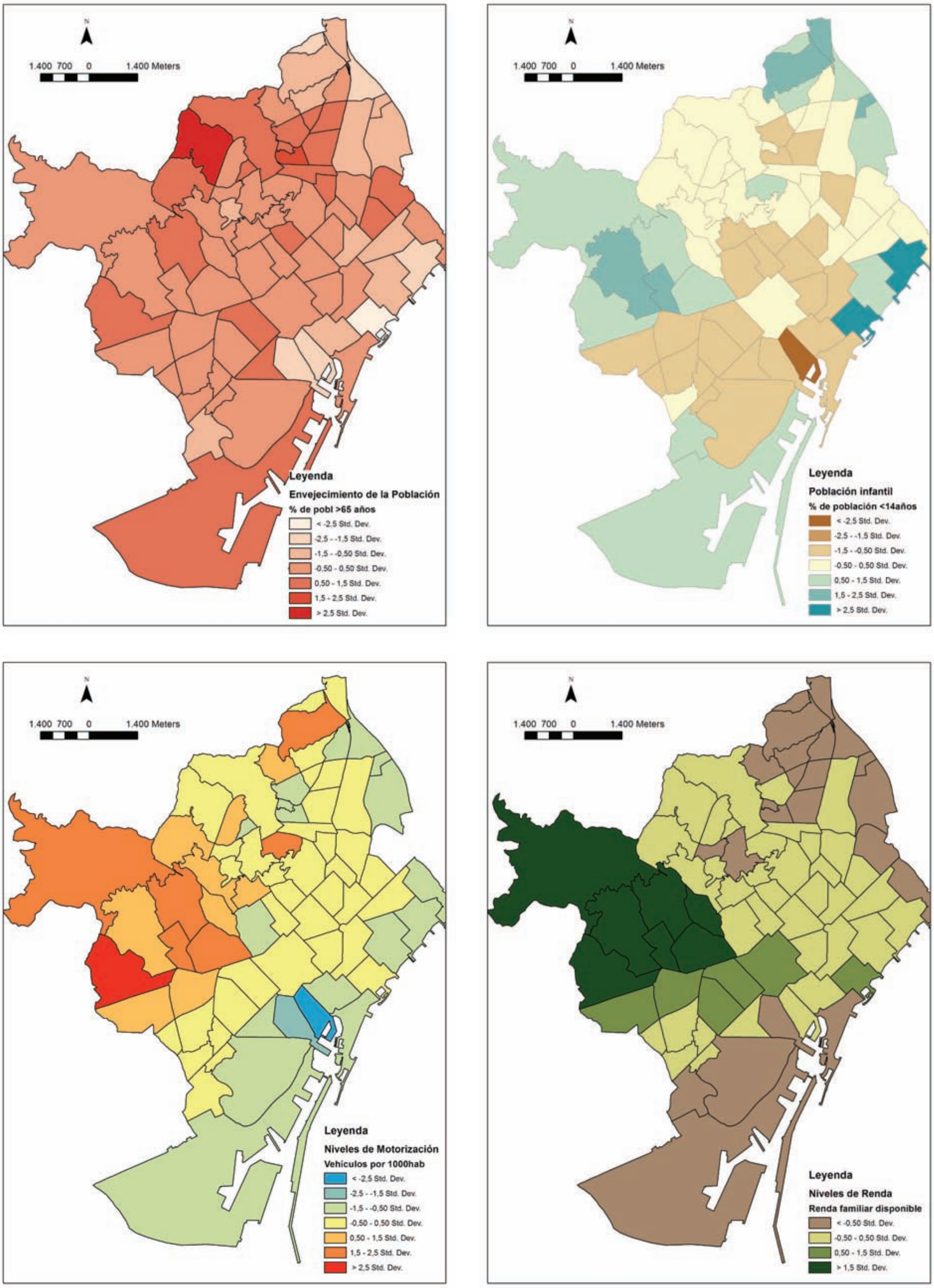

Figura 27: Datos socioeconómicos de la ciudad de Barcelona
Fuente: Elaboración propia a partir de datos Ajuntament de Barcelona (2015)

En términos de movilidad, Barcelona se caracteriza por una elevada presencia de los desplazamientos no motorizados (48%. Figura 28 izq,). Esta es una característica que comparten la mayoría de las grandes ciudades históricas europeas como París (50%), Berlín (43%) o Londres (38%) (EPOMM, 2012). Una particularidad de Barcelona sin embargo es que el protagonismo dentro de esa movilidad no motorizada recae casi exclusivamente sobre el peatón, debido a la escasa implantación de la bicicleta (1,4%)[23]. El modelo de movilidad de Barcelona consigue niveles de movilidad no motorizada similares a los de las grandes capitales de la bicicleta como Copenhague (46% no motorizado, 26% bicicleta) o Ámsterdam (44% no motorizado, 22% bicicleta), pero lo hace básicamente gracias a la movilidad a pié. El resto de la movilidad cotidiana se reparte entre el transporte público (29%) y el transporte en vehículo privado (23%).

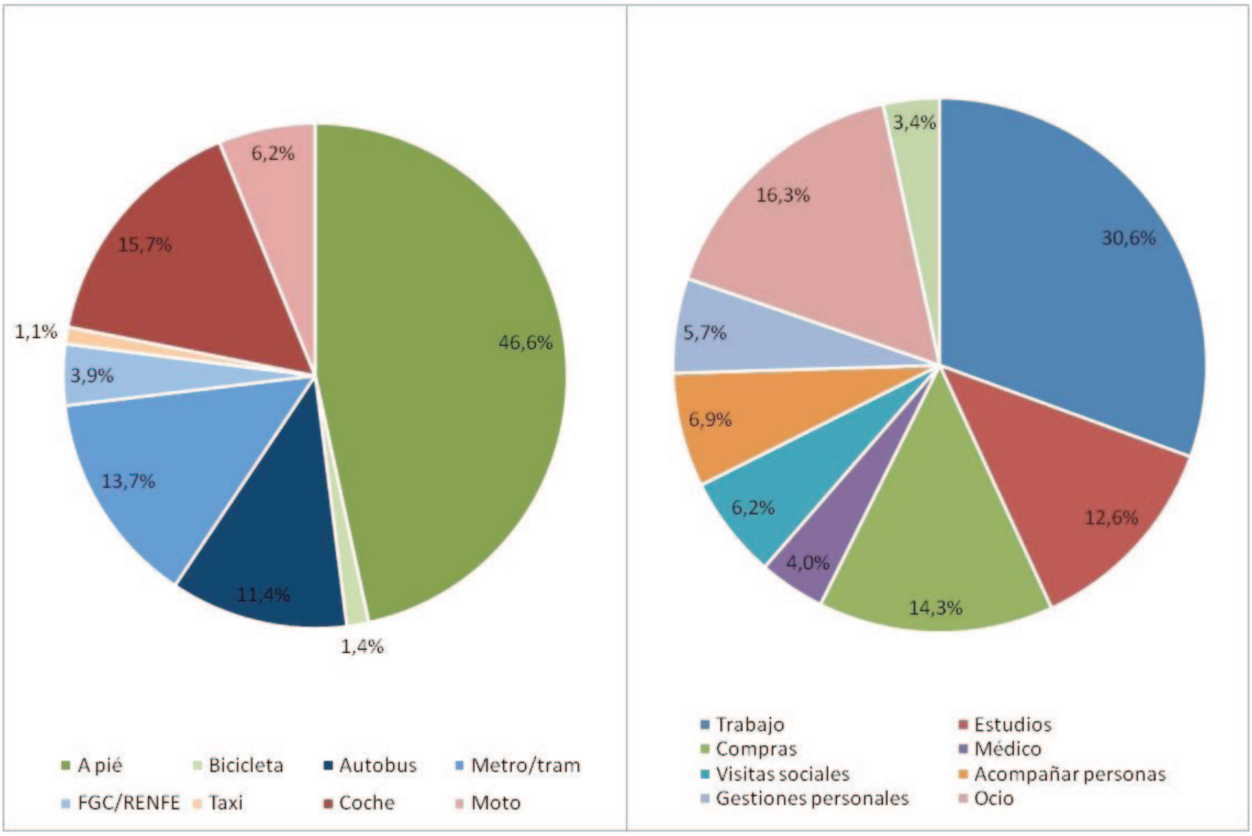

Figura 28: Reparto modal de Barcelona (izquierda) y reparto de los desplazamientos por motivo (derecha)

Fuente: elaboración propia a partir de datos EMQ06

La figura 28 (derecha) también muestra el desglose de motivos de desplazamiento de la movilidad cotidiana en Barcelona. El gráfico, que excluye los desplazamientos de

23 El papel de la bicicleta ha aumentado ligeramente entre 2006 y 2012, pero en los últimos datos disponibles (EMEF 2012) sigue representando solo el 2,1% de toda la movilidad en Barcelona.

vuelta a casa, permite ver que el desplazamiento al trabajo solo representa un tercio de la movilidad en la ciudad, y que de hecho el 56,9% de los desplazamientos se realizan por motivos personales. Es dentro de esta movilidad personal donde, como veremos, se concentran la mayoría de desplazamientos de proximidad.

Por último, las figuras 29 y 30 muestran la distribución temporal de los desplazamientos en Barcelona. En primer lugar se observa que un 34,9% del total de viajes se llevan a cabo en menos de 10 minutos[24], y solo un 17,7% conlleva más de media hora.

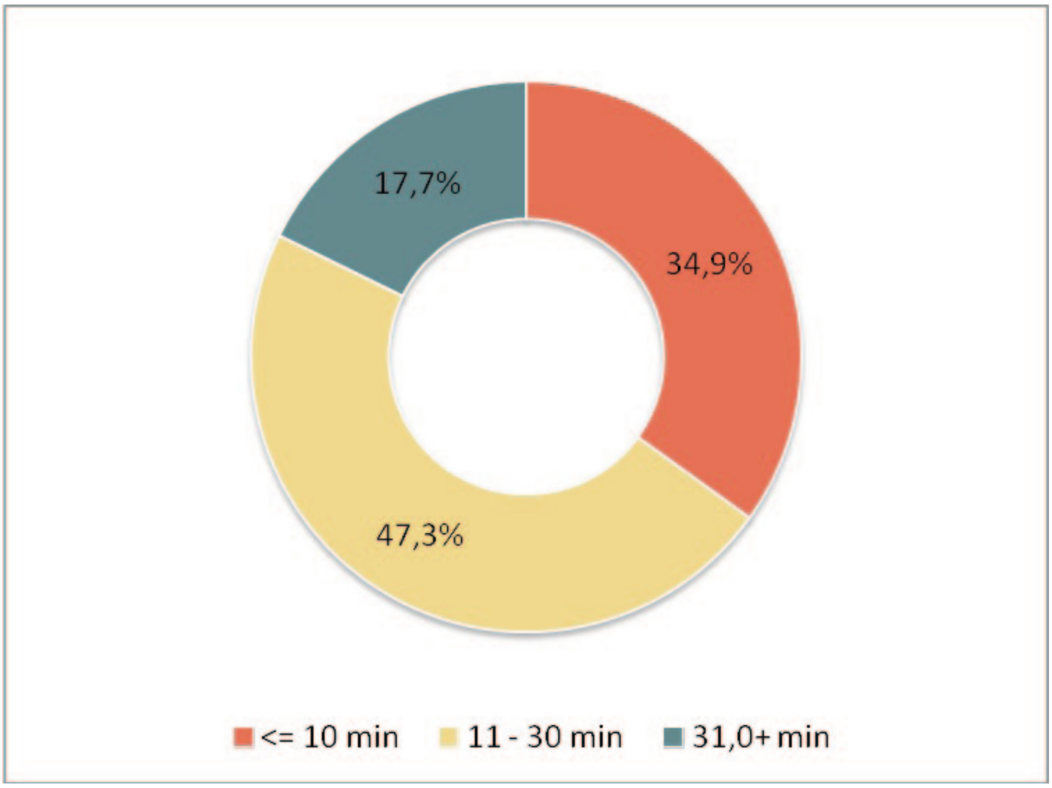

Figura 29: Distribución temporal de los desplazamientos en Barcelona
Fuente: elaboración propia a partir de datos EMQ06

Asimismo, la figura 30 también muestra como esta distribución temporal también varía en función del medio de transporte. Mientras que un desplazamiento andando conlleva de media 16 minutos, uno en transporte privado conlleva 25, y la media para aquellos hechos en transporte público es de 33 minutos. En la figura 30 también se observa como los desplazamientos a pié se concentran principalmente dentro del intervalo 0-15

24 Nótese que esta cifra es ligeramente superior a la proporcionada por el estudio de caso 1, ya que en este apartado metodológico se describe la movilidad del conjunto de la población y no sólo los mayores de 16 años como es el caso del Estudio de caso 1.

minutos, mientras que los desplazamientos hechos en vehículo privado se reparten casi igualitariamente desde los 10 hasta los 25 minutos[25].

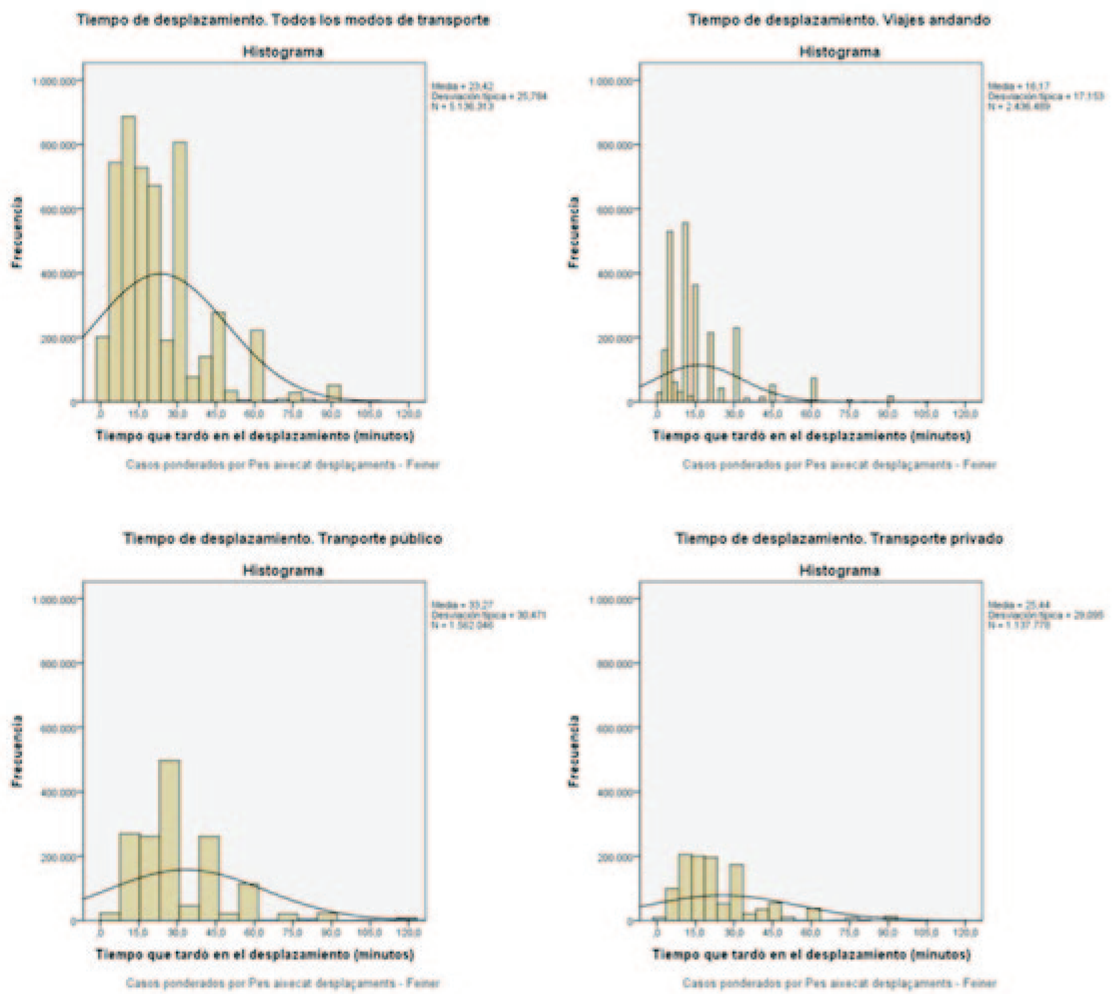

Figura 30: Histogramas del coste temporal de los desplazamientos por modo de transporte.
Fuente: elaboración propia a partir de datos EMQ06

Las diferencias en costes de tiempo de los viajes en distintos modos de transporte se expresan en la figura 31 en forma de líneas de tendencia logarítmicas. La línea de tendencia que corresponde a los viajes a pié es más alta en los valores pequeños de tiempo y desciende de forma pronunciada en cuanto el tiempo de desplazamiento aumenta. Las líneas de tendencia que corresponden con los viajes en transporte Privado y en transporte público en cambio, son mucho más planas, siendo la línea del transporte público la que menos depende del tiempo total del desplazamiento.

[25] Otro aspecto interesante de la figura es constatar como los desplazamientos se concentran en los valores múltiples de 5 (5, 10, 15, 20 minutos). Esto es consecuencia tanto de la forma en que los seres humanos contamos y percibimos el tiempo como de la metodología empleada para la recolección de los datos.

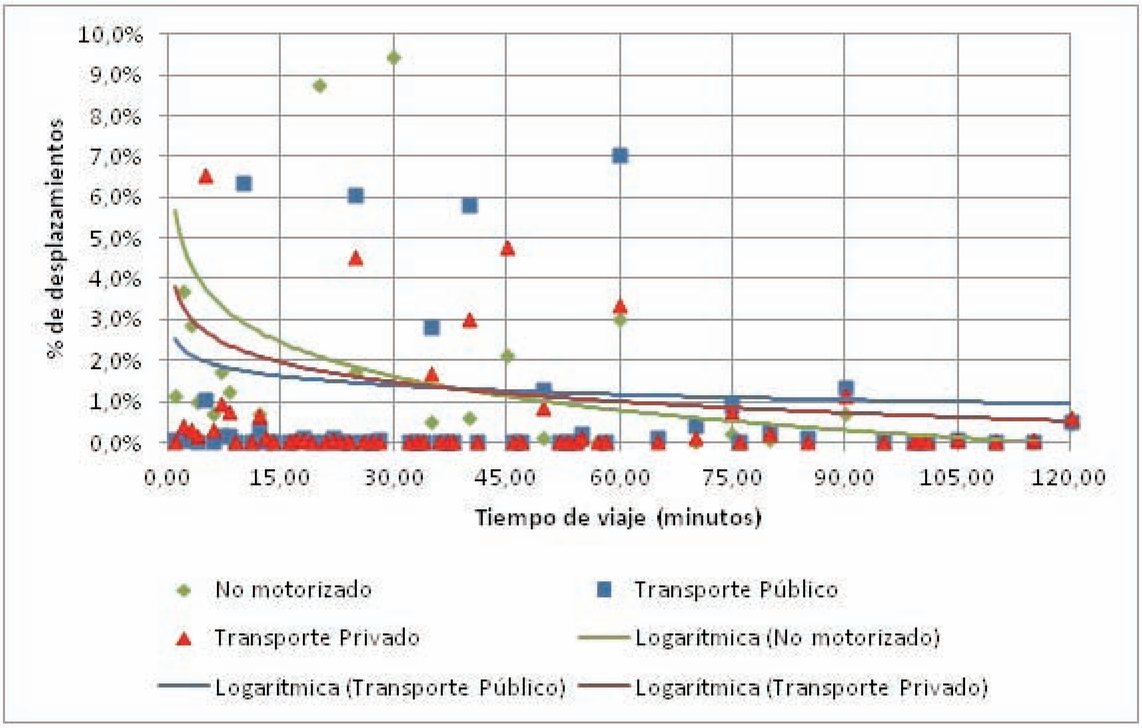

Figura 31: Funciones Time-Decay por modo de transporte en Barcelona

Fuente: elaboración propia a partir de EMQ06

La elección de Barcelona como ámbito de estudio es especialmente indicada ya que el modelo Barcelona ha sido durante mucho tiempo la referencia no solo de cómo construir ciudades atractivas en la escala internacional sino también como referente de diseño de pequeña escala y ciudad compacta (Hall, 1988, p. 458). Así, la combinación de actuaciones en la escala de barrio con proyectos estratégicos de escala internacional ha sido referente en el urbanismo mundial durante mucho tiempo. Desde el inicio del periodo democrático el urbanismo en Barcelona buscó solventar la carencia de servicios y equipamientos herencia del modelo franquista, con una especial atención a la escala de barrio y con un modelo de urbanismo de base *bottom-up*. Esta tendencia caracterizó la primera etapa del modelo Barcelona y creó un importante tejido local alrededor de cada barrio que ha perdurado con el tiempo. En el año 2005 se intentó reforzar esta dinámica de barrio mediante medidas institucionales como el proyecto "La Barcelona dels Barris". Este proyecto buscaba delimitar de forma precisa los barrios de la ciudad y calcular la provisión de servicios necesaria para cada unidad barrial. El trabajo acabó con la delimitación oficial de 73 barrios en 2006 de alrededor de 25.000 habitantes cada uno, creados a partir de criterios históricos y demográficos. Sin embargo, y tal y como remarca Busquets (2005) esta institucionalización de las políticas de barrio coincide con una deriva urbana hacia las políticas top-down, a medida que los proyectos estratégicos que buscan posicionar la ciudad en el ámbito internacional consuman el cambio de escala definitivo. Es en este momento en que Balibrea (2006) sitúa la mutación de modelo Barcelona hacia la marca Barcelona y que supone un abandono progresivo de las políticas efectivas de escala de barrio.

La Barcelona que utilizamos como ámbito de estudio es pues una ciudad compacta donde la estructura socioeconómica y sociodemográfica es más variable que la estructura morfológica del tejido urbano. Es un ámbito urbano además que en el año 2006 presentaba unos importantes niveles de utilización de la escala barrial[26], que es la dimensión que más nos interesa cuando analizamos las dinámicas de proximidad. Finalmente la elección de Barcelona nos permite situarnos en el centro del debate internacional con una ciudad que sigue siendo referente del modelo de urbanización compacta y que representa una escala urbana (ciudad de 1.6 millones de habitantes que desarrolla una extensa región metropolitana a su alrededor) muy común en el ámbito europeo.

6.3.2 Región Metropolitana de Barcelona

La Región Metropolitana de Barcelona agrupa 164 de los 946 municipios que conforman Cataluña. Ocupa el 10,1% del total de superficie de Cataluña pero concentra el 32,1% del total de población. La región se estructura a partir del municipio de Barcelona ocupa unos 3.000 km2 en un radio de unos 30-45km y se compone de un primer anillo metropolitano conectado físicamente con el núcleo central y un segundo estructurado a partir de diversas ciudades de tamaño medio (Miralles-Guasch & Tulla Pujol, 2012).

La primera corona de municipios alrededor de Barcelona se caracteriza por densidades medias altas con discontinuidades en forma de zonas de agricultura y parques periurbanos (Garcia-Sierra & van den Bergh, 2014). Esta primera corona contiene tres ciudades por encima de los 100.000 habitantes (Hospitalet de Llobregat, Badalona y Cornellà de Llobregat) con una densidad de población igual o superior a la de Barcelona. El conjunto de la corona sin embargo tiene una densidad bruta de población de 2319 hab/km2.

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[26] A pesar del cambio de enfoque en las políticas públicas, los últimos datos disponibles para el año 2012 (EMEF12) indican que el uso de la escala de barrio no ha hecho más que aumentar desde 2006. Ello parece indicar tanto una inercia larga en los espacios de actividad como una revalorización de la escala local vinculada con los efectos de la crisis económica.

La segunda corona se estructura a partir de siete ciudades históricas: Mataró, Granollers, Sabadell, Terrassa, Martorell, Vilafranca del Penedès y Vilanova i la Geltrú. Estas siete ciudades suman el 25% de la población de esta segunda corona metropolitana, y generan a dinámicas submetropolitanas a su alrededor. El resto del territorio lo ocupan municipios de pequeño tamaño y tejido disperso (Figura 32) con un grupo de municipios extremadamente dispersos (con densidades por debajo de los 1000 hab/km2) pero que suman 700.000 habitantes. Tal y como se puede observar en la Figura 32 la tipología edificatoria predominantes en esta segunda corona es la de las viviendas unifamiliares aisladas o adosadas.

Con esta configuración territorial, un 48% de la población metropolitana vive en municipios con densidades altas, por encima de los 10.000 hab/km2. Un 9% adicional vive en municipios con densidades medias de entre 5.000 y 10.000 hab/km2. Y finalmente, el 43% vive en municipios dispersos con menos de 5.000 hab/km2. Esta distribución obedece a distintas dinámicas demográficas, una de las cuales es la dispersión de la población en el territorio desde las ciudades más pobladas y de mayor densidad hacia núcleos pequeños y zonas de baja densidad (Pujadas, 2008). A partir de los años ochenta, en Barcelona y en otras ciudades medias del entorno metropolitano se han producido pérdidas de población debidas a migraciones residenciales. En las coronas metropolitanas, y especialmente en la segunda, en su parte más periférica, se ha experimentado un proceso inverso, con el aumento de la población por saldos migratorios positivos. Entre 1981 y 2008, la población de la segunda corona metropolitana pasó de poco más de un millón de personas a más de 1.700.000, lo que significa un aumento del 52%. El crecimiento de la primera corona ha sido mucho más discreto, con un aumento de la población de apenas 180.000 personas, lo que significa un incremento del 14%, una dinámica de población que da cuenta de la creciente importancia de las periferias metropolitanas en los contextos urbanos actuales (Méndez, 2009).

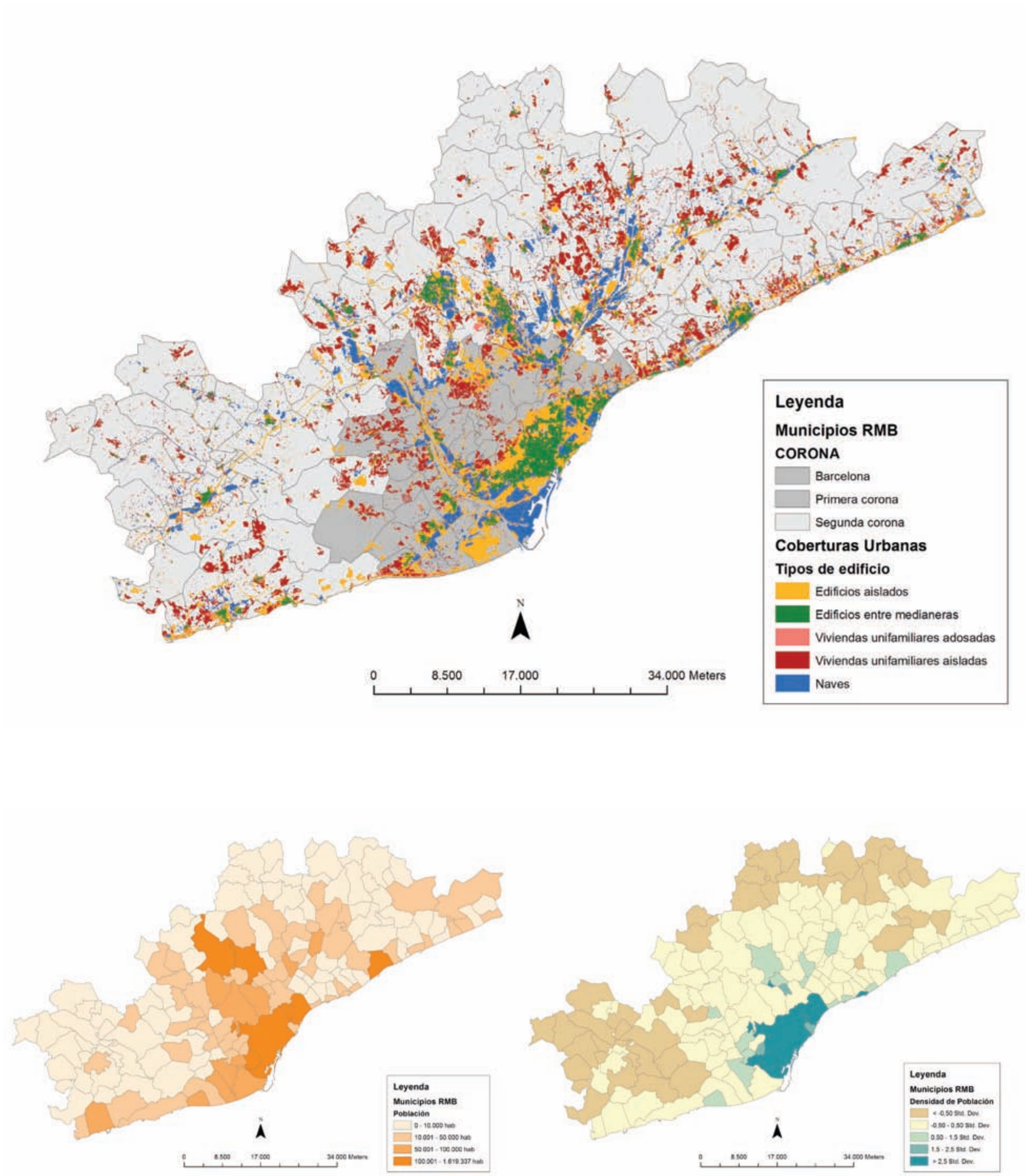

Figura 32: Mapas de la Región Metropolitana de Barcelona. Coronas metropolitanas, coberturas urbanas, población total por municipio y densidad de población.

Fuente: elaboración propia a partir de Mapa de Coberturas del Suelo de Cataluña (CREAF) y datos IDESCAT

Éste aumento de población del área metropolitana en relación al centro también se reproduce en la concentración de la actividad económica con un proceso de "vaciado industrial" de los centros urbanos. El conglomerado de actividad económica resultante se traduce en un aumento considerable de lugares de trabajo en el área metropolitana, proceso que se produjo en mayor medida en la segunda corona metropolitana, la cual registró un incremento del 26% en lugares de trabajo entre 1996 y 2002, mientras que en esos mismos años el municipio de Barcelona solo lo hizo en un 18%.

En términos de movilidad, los habitantes de la Región Metropolitana de Barcelona realizaban en 2006 un total de 10.661.899 desplazamientos al día, con una media de 3,52 desplazamientos al día por persona. El promedio de tiempo de desplazamiento es de 20,3 minutos, ligeramente inferior al de la ciudad de Barcelona (23,4), debido principalmente a un mayor uso del medio de transporte privado (figura 33). Dentro de la Región Metropolitana existen importantes diferencias en la elección modal según se resida en la primera o la segunda corona. La primera corona tiene un *modal split* muy similar al de la ciudad de Barcelona exceptuando el bajo peso del transporte público. La baja oferta de transporte público se compensa con un mayor uso de los medios no motorizado y de los medios privados. La realidad de la segunda corona en cambio es claramente favorable al uso del transporte privado[27].

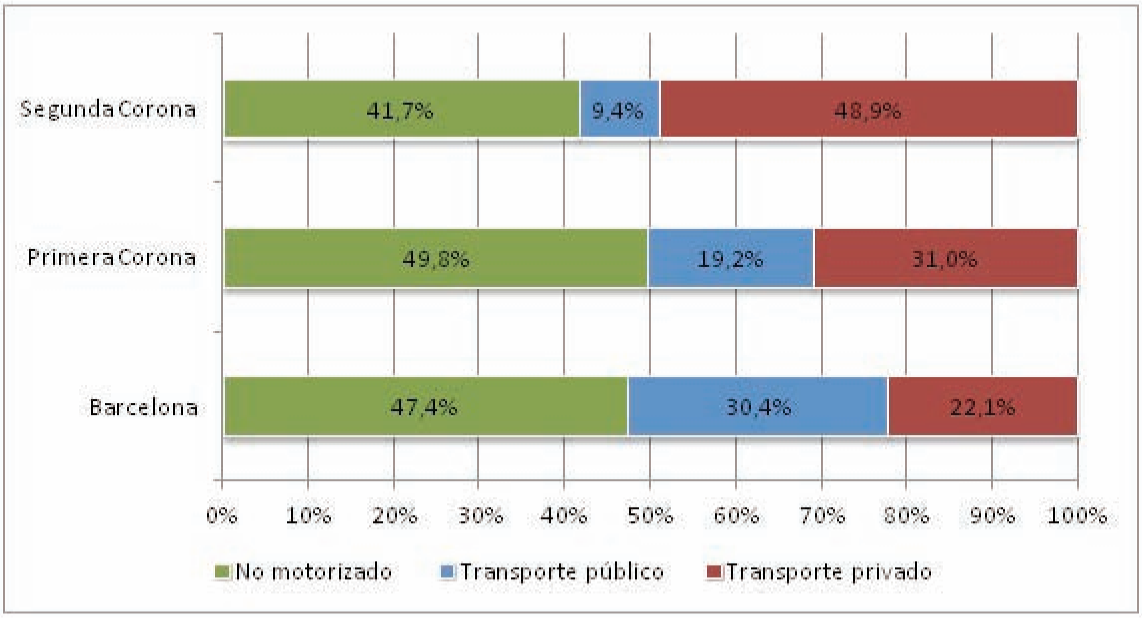

Figura 33: Reparto modal por coronas metropolitanas
Fuente: elaboración propia a partir de datos EMQ06

27 Esto es aún más evidente cuando observamos el 75% de la población de la segunda corona que no vive en ninguno de los 7 municipios estructurantes. Estos más de 700.000 habitantes que viven en municipios pequeños y dispersos de la 2ª corona utilizan el transporte privado para un 54% de sus desplazamientos.

La distribución territorial y el tiempo de tejido urbano existente condicionan pues el uso de los medios de transporte, tanto en su elección modal como en el coste temporal de los desplazamientos. Esto puede verse una vez más si observamos las líneas de tendencia para cada medio de transporte en la Región Metropolitana (Figura 34). Si comparamos las líneas de función *time-decay* de la Región Metropolitana con las del municipio de Barcelona (figura 34) podemos observar como la línea de tendencia correspondiente al coche se acerca mucho más a la de los medios no motorizados incluso para los desplazamientos más cortos de 15 minutos. También observamos como ambas líneas descienden más bruscamente debido a que en la región metropolitana los tiempos de desplazamientos son en general más breves –aunque eso no implique que también sean desplazamientos más cortos en términos de distancia-. Por último, la línea de tendencia correspondiente al transporte público se muestra cuantitativamente más baja que en Barcelona pero igualmente plana.

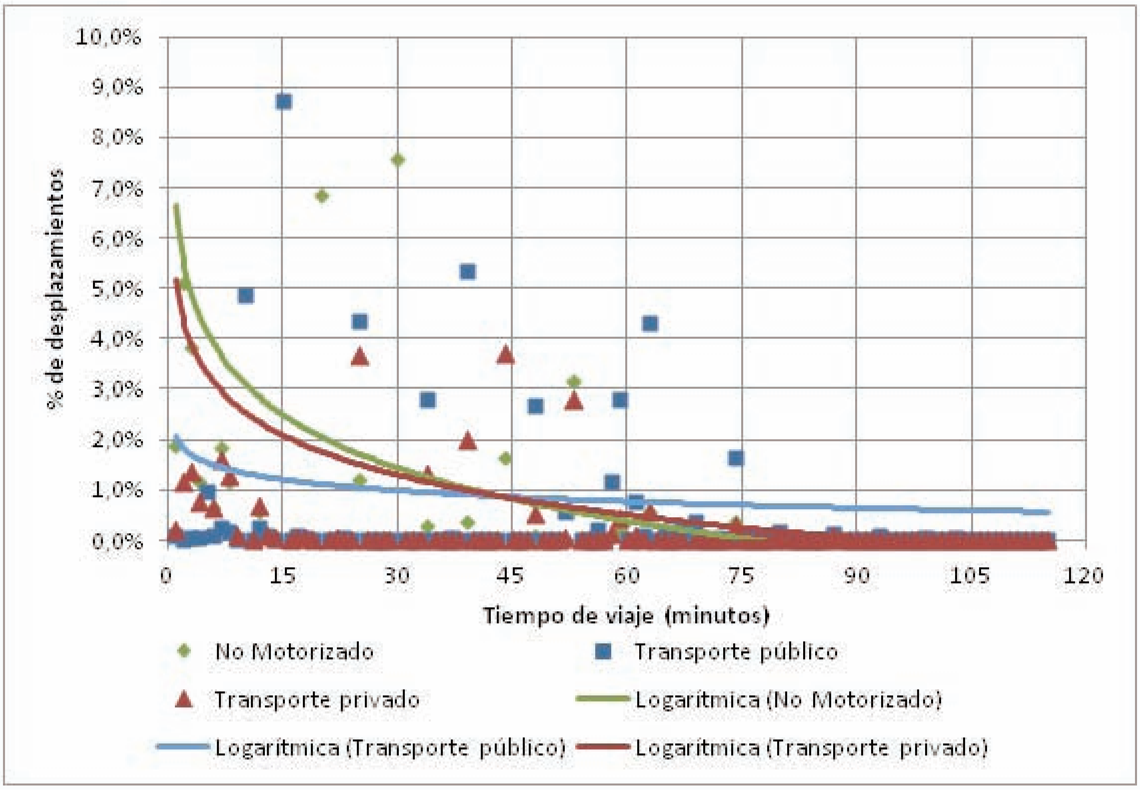

Figura 34: Funciones Time-Decay por modo de transporte en la RMB (sin BCN)

Fuente: elaboración propia a partir de datos EMQ06

La elección de la Región Metropolitana de Barcelona como ámbito de estudio permite observar realidades urbanas que no son tan específicas como el municipio de Barcelona sino mucho más frecuentes a nivel europeo o internacional. La intensa interrelación entre los diversos municipios, el tejido urbano disperso y desestructurado y la variedad de tipologías edificatorias permiten poner a prueba la metodología diseñada para estudiar los desplazamientos de proximidad en entornos menos singulares que la ciudad de Barcelona. Al estudiar un territorio mayor además aumentamos nuestro tamaño poblacional siendo posible aumentar el detalle del análisis hacia poblaciones específicas como la gente mayor o la población infantil. Tal y como explica Monclús (2003) la RMB se corresponde en definitiva con lo que es la ciudad real de Barcelona tanto como el propio municipio de Barcelona.

PARTE IV

Análisis empíricos

CAPÍTULO 7

Casos de estudio

Caso de estudio 1:

The Walkable city and the importance of the proximity environments for Barcelona's everyday mobility[28]

Cities 42 (2015) 258–266

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The Walkable city and the importance of the proximity environments for Barcelona's everyday mobility

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ABSTRACT

To evaluate the importance of walkable environments and neighborhood's vitality in people's everyday life, this paper analyzes proximity travel in Barcelona. Data were taken from one of the major mobility surveys in Spain, which offers the depth required to identify short walking journeys that take place within the neighborhood scale. By analyzing people's mobility patterns, we get a more accurate approach to proximity and inner-neighborhood dynamics. The analysis focuses on the frequency and purpose of these short walking trips, along with the urban settings that foster them. The study also evaluates how proximity trips are unequally distributed throughout the city and how income and population density levels can effectively promote this kind of traveling behavior.

Introduction

Urban proximity has been a predominant theme in the contemporary urban discourses in recent years. Within the complexity of trying to define a more sustainable urban form, and also in the context of the "mobilities turn", the distance traveled to access urban uses and services has been found to be a key factor. Proximity dynamics have a wide array of positive outcomes from vehicle emissions to energetic consumption or the wellbeing of citizens (de Nazelle, Morton, Jerrett, & Crawford-Brown, 2010; OECD, 2012).

Despite this positive assessment of compactness and small-scale dynamics, few academic studies have addressed proximity from the people's perspective. To address this gap, this study explores how citizens of a compact Mediterranean city like Barcelona are using their most-near urban scale, and it does so through the analysis of their daily mobility, bringing a more accurate approach to this proximity dynamics.

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Compact city and urban mobility

In recent years, the Walkable city along with the compact city concepts have gained wide acceptance among academics and urban planners as sustainable urban forms for the future, capable of dealing with negative externalities of both the urban and transport models (Dempsey & Jenks, 2010; Næss, 2005; Næss, 2013). The relationship between urban form and mobility has been analyzed through three main vectors: environmental issues, the social significance of walkability, and the use of time. Variables such as high densities, a public transport supply, and mixed-use development are usually found to be key elements for improving access to local services and to promote fairer transport models (Banister 2008; Banister & Hickman, 2006; Dempsey, Brown, & Bramley, 2012; OECD, 2012).

Environmental considerations have always been at the center of the debate (IPCC, 2007; Loo & Chow, 2006; Muñiz & Garcia-López, 2013) ever since Newman and Kenworthy (1989) stated that the built environment could effectively modify fuel and energy consumption for mobility purposes. Empirical studies have attempted to define the exact effects of urban form on transportation behaviors and modal choice (TRB, 2005, 2009; Miralles-Guasch, Martinez Melo, & Marquet Sarda, 2014).

The recovery of the pedestrian as one of the main urban actors in the city's public space has been another of the most prolific lines of research and has been addressed from different scientific

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[28] Este caso de estudio fue publicado en el número 42 de la revista Cities, y fue primero publicado online el 18-11-2014. La versión completa y formateada del artículo se puede consultar en el anexo. La referencia completa de la publiación es la siguiente: Marquet, O., & Miralles-Guasch, C. (2015). The Walkable city and the importance of the proximity environments for Barcelona's everyday mobility. Cities, 42, 258–266. doi:10.1016/j.cities.2014.10.012

The Walkable city and the importance of the proximity environments for Barcelona's everyday mobility

Abstract:

This paper analyzes proximity travel within Barcelona, in order to evaluate the importance of walkable environments and the vitality of neighbourhood in people's everyday lives. In this respect, we analyzed walking times of less than 10 minutes, a specific kind of trip that takes place on a neighbourhood scale, from one of the major mobility surveys in Spain. By analyzing people's mobility patterns, we obtain a more accurate approach to proximity and inner-neighbourhood dynamics. The analysis focuses on the frequency and purpose of these short walking trips, along with the urban settings that foster them. This study also evaluates how proximity trips are intimately related with personal travel purposes and how they are unequally distributed throughout the city. The data also show how, once a certain minimum level of density is achieved, income and sociodemographic factors ultimately determine the use of proximity.

Keywords: Proximity, Everyday mobility, Pedestrians, Neighbourhood, Walkability.

Introduction

Urban proximity has been a predominant theme in the contemporary urban discourses of recent years. Within the complexity of trying to define a more sustainable urban form and also, in the context of the "mobilities turn", the distance travelled to access urban amenities and services has been found to be a key factor. Proximity dynamics have a wide array of positive outcomes, from vehicle emissions to energetic consumption or the wellbeing of citizens (de Nazelle et al., 2010; OECD, 2012).

Despite this general positive assessment of compactness and small-scale dynamics (Banister, 2011; Boyko & Cooper, 2011; Robert Cervero & Kockelman, 1997; Ewing et al., 2011; Kaido & Kwon, 2008; OECD, 2012), few academic studies have addressed proximity from the people's perspective and their daily uses of the city. To address this gap, this study explores how citizens of a compact Mediterranean city like Barcelona are using their most-near urban scale, and it does so through the analysis of their daily mobility, bringing a more accurate approach to the territorialisation of their daily habits within the city.

1. COMPACT CITY AND URBAN MOBILITY

In a traditional analysis of the compact city, the relationship between urban form and mobility has been expressed through variables such as density, land use and design. High densities, public transport supply and mixed-use developments are, usually, found to be key elements for improving access to local services and to promoting fairer transport models (Banister, 2008; Dempsey et al., 2012; Hickman & Banister, 2007; OECD, 2012).

Environmental considerations have been at the centre of the debate for the compact city (Loo & Chow, 2006; Muñiz & García-López, 2013; Solomon et al., 2007; Transportation Research Board, 2009) ever since Newman and Kenworthy (1989) noted that the built environment could effectively modify fuel and energy consumption for mobility purposes. Compact and proximate developments save fuel consumption and promote walking for transport, helping the recovery of the pedestrian as one of the main urban actors in the city's public spaces (Alshalalfah & Shalaby, 2007). Walking in the city is understood as a guarantee of almost universal accessibility and as people's capacity to reach a certain place with an affordable effort (Ureta, 2008), as everyone can be a pedestrian, regardless of income, skill, gender or ethnicity (Delbosc & Currie, 2011; Hanson, 2010). In addition, walking also is a major source of physical activity which has put the walkability of our cities at the centre of public health policies (Koohsari et al., 2013; Næss, 2013; Sung et al., 2013). Furthermore, small distances between urban functions such as residence, working or shopping also have an impact on travel times and personal schedules (Miralles-Guasch, Martinez-Melo, & Marquet Sarda, 2014; Mückenberger, 2006; Robert, 1992). Within a limited time budget of 24 hours, increasing some travel times requires a reduction in others. The paradox is that, as the functional city expands in size there has been a parallel emergence (or resurgence) of small-scale dynamics (Mendez & Moral, 2010). For example, as individuals travel farther to a place of employment, they are likely to seek shorter travel times, in order to complete other activities (everyday shopping, leisure) (Gimenez-Nadal & Sevilla-Sanz, 2011), which result in an intensified use of neighbourhoods (Timmermans et al., 2002).

Thus, different disciplines point to the fact that the near location of the diverse urban functions, such as residence, work, leisure, commerce, services and equipments, intensifies the use of the neighbourhood. According to Banister (2008), this increases people's accessibility and improves their living environment, as the aim of mobility is not just travelling from one place to another, but also arriving to the right place at the right time, with affordable costs for anyone (Peters, Kloppenburg, & Wyatt, 2010). Urban studies and public policies are also rediscovering the small urban scale and with it, the pioneering work of Jane Jacobs (1961) (Jensen, 2009).

1.2 Proximity and the compact urban form

But, how do we study proximity? Most of the studies have approached it at the territorial level, using different methodologies to measure densities and selected features of the built environment (Boyko & Cooper, 2011; Brownstone & Golob, 2009). They have tried to determine how dense the city must be to have a beneficial impact on mobility patterns, or how mixed the land uses must be in order to achieve the diversity needed to generate proximity travel (Cera, n.d.; Ewing et al., 2011; K. T. Geurs & van Wee, 2004). In most cases, they have analysed existing urban settlements and attempted to estimate the effects that a particular change in those urban spaces would have on people's mobility.

While the territorial dimension of the proximity is undeniable, it is necessary to go beyond the topological distance to incorporate more contextual aspects, such as travel time, the built environment where these mobilities are taking place, or the social characteristics of the population (Brennan & Martin, 2012).

From a mobility point of view, journeys and accessibility can be treated as a temporal attribute defined by travel times, because time is as inherent to proximity as is space (Banister, 2011). In other words, proximity dynamics only appear in those places that gather both nearness between origins and destinations with affordable forms of accessibility for the local population. Because of that, proximity must be understood as a combination of specific spatial and temporal attributes, a double condition that can be observed through mobility analysis.

1.3 Time and space, the defining elements of proximity

One of the difficulties of analysing proximity from the mobility point of view lies in the lack of a linear relationship between space and travel time, due to the different speed of each type of transport (Rodrigue et al., 2006). Therefore, modal choice must also be considered, in addition to travel time. To do so, it is necessary to establish a definition of what a short trip is, in terms of time. Ryley (2008) identified it as a travel that takes 10 minutes or less to be completed. However, to also estimate the covered distance on that same short trip, modal choice must also be taken into account. In this regard, the transport means that are more related to proximity are those that are non-motorised, especially walking, due to its regular speed, which is usually not faster than 4.5 kph (Rietveld, 2000). The combination of short-time trips with slow speeds results in a proximity journey that is certainly located within the neighbourhood scale of the city (Figure 1).

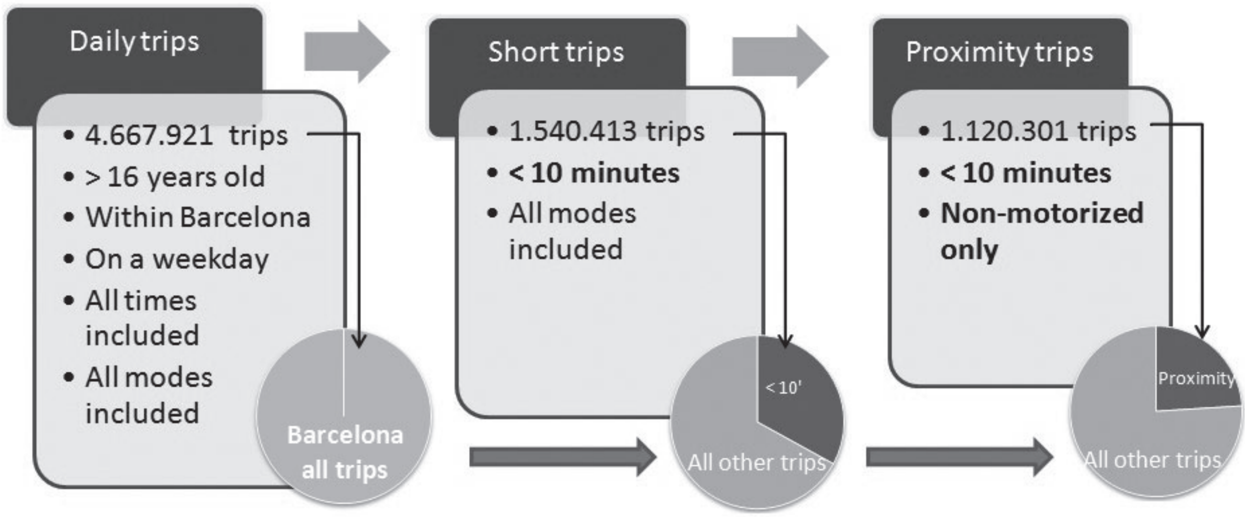

Figure 1: Theoretical framework, from all trips to proximity trips.

Source: Own production

2. METHODOLOGY

Proximity analysis, based on mobility patterns, requires several sequential stages. We first studied how short-time trips (taking no more than periods of 10 minutes) are used in the city, setting out a general view of activities for which people tend to use very little travel time. Next, we focused on short trips involving not only little time, but also being made by walking, which entails covering short distances. These are the trips that have been defined as proximity trips and, once they are isolated, it is possible to examine their frequency, the purposes they serve, and how they are distributed across the city. Finally, this study changes its scale to the neighbourhood level, comparing the spatial distribution of proximity trips and using Chi-square tests to search correlations between the use of proximity and the levels of population density and income.

2.1 Description of Barcelona

The area studied was the city of Barcelona, capital of the Autonomous Community of Catalonia (northeast Spain) and center of the Barcelona Metropolitan Region. In 2006, 1.6

million inhabitants were distributed across 10 administrative districts and 73 "*barris*", or small neighbourhoods. Nearly 90% of the city's 102.2 sq km had been urbanised by 2005 and its population density has not significantly changed over the recent years (Martori Cañas, 2010). Busquets (Busquets Grau, 2005) described the city's morphological characteristics as dominated by a continuous, compact urban area with buildings, generally, not exceeding 8 or 9 floors and mixed land uses, including a commercial structure marked by small retail businesses. Average annual family income was about 17,900 Euros in 2006 with some significant differences on its distribution. Another characteristic of the Compact City, a parameter that is met in Barcelona, is a wide-ranging system of public transport: metro, train, tram, and bus routes.

Finally, the optimal design of street patterns, which is also a significant aspect for active transport and sustainable development, is clearly fulfilled by Eixample, an urban planning development in the centre of Barcelona with a worldwide reputation, created by the Spanish urban planner, Ildefons Cerda (1815-1876) (Dura-Guimera, 2003; Pallares-Barbera, Badia, & Duch, 2011).

2.2 Main data sources

The main data source in this study was the Everyday Mobility Inquiry, a wide-ranging mobility survey taken in 2006 (hereafter, EMQ06) as a joint initiative of the Department of Territorial Policy and Public Works of the Autonomous Community of Catalonia and the Metropolitan Transport Authority of Barcelona (Autoritat del Transport Metropolità & Generalitat de Catalunya, 2006). The aim of this survey was to describe the mobility of the resident population of Catalonia and, as in most international surveys, this study identifies "one trip" as one motivation to move.

The EMQ06 set the entire Autonomous Community of Catalonia as its territorial scope and performed 106,091 computer-assisted telephone interviews (CATI). The EMQ data are segmented into 856 transport zones for the whole of the Catalan territory. Although there is, usually, one zone per municipality, Barcelona contains 63 transport zones, because of its size. Similarly, 24,000 (22.6%) of the interviews were undertaken in Barcelona, permitting in-depth analysis and avoiding the treatment of Barcelona as a monolithic entity.

The EMQ06 provides information on the journeys, their territorial distribution and some socioeconomic characteristics of the people undertake them. Mobility information includes modal choice, time spent on journeys, and degree of access to the different transport modes. Territorial characteristics include transport zone and total population. Furthermore, socioeconomic questions include gender, age, and professional situation.

EMQ06 also provides information about the motivations for each trip. This makes it possible to differentiate occupational mobility (travel to work or study) from personal mobility related to shopping, medical appointments, visiting or accompanying someone, personal business, leisure activities, or just taking a walk. We do not exclude any trip based on its motivation, as neither do we discriminate the specific origin or destination of the trip.

Data analysis was limited to travel by people older than 16 years of age with an origin or destination inside Barcelona, occurring from Monday to Friday (excluding holidays). The confidence level was set at 95.5% with a relative error of +/- 0.67%.

To effectively relate mobility analysis to urban and socioeconomic characteristics, we incorporated some of the vast information gathered by the official statistical service of the City of Barcelona. The two main variables drawn from this data source were population density of each neighbourhood and average family income for year 2006.

2.3 Analytical scales

Two scales of analysis were used: municipal and a sub local scale, similar to the neighbourhood level. The first scale is useful to obtain an overview of near-scale dynamics in Barcelona. The second scale offers the most suitable dimension to study proximity and to explore explanative aspects of neighbourhood dynamics.

At the municipal scale, we measured how many close-scale trips Barcelona residents reported taking, analyzing the time-length of short trips as a precursor to deeper analysis of proximity trips. At the city level, we analyzed the number of trips that took less than 10 minutes (short trips) and the number of trips that took less than 10 minutes and were taken on foot (proximity trips). We also examined the time of day at which those trips were taken and the purposes that triggered them. At the neighbourhood level, we delved more into these mobility patterns to see how they were related to specific urban characteristics, specifically populations density and income distribution.

The EMQ06 divides the city into 63 transport zones and organizes its data according to them (for a complete methodological explanation see IERMB, 2006). In order to have enough sample we had, however, to group transport zones into 15 study areas so that they had enough data to sustain a double disaggregation, such as searching those trips that were made on foot and also that were taking less than 10 minutes. Thus, to downscale the municipal analysis to the neighbourhood level, we designed 15 study areas (Figure 2). The overall criterion for the grouping of transport zones into the study areas was to put together the most similar urban areas, with respect to population density and income levels, making it possible to assess more accurately the weight of each explanatory factor in the intensity of neighbourhood dynamics. We ensured that each study area was clearly defined, provided an appropriate sample size, had similar population density and income levels, and was large enough to produce statistically significant results using the EMQ06 data and municipal statistics. In order to have enough sample size in the analysis, each and every study area had to group a minimum of 950 residents interviewed by the EMQ06. That provided us with a pool of 72,500 trips divided into 15 study areas. As a result, once the mobility data was disaggregated, each study area was comprised of an average of 1,176 proximity trips, there being no area with a minimum of less than 700 proximity trips.

	Sample size			Proximity Trips	
Study Area	Interviews	Number of trips	Number of proximity trips	Proximity trips out of total (%)	Statistical Significance
1	1567	5173	1178	22.8%	-2.3*
2	2597	8809	2160	24.5%	0.35
3	1990	6317	1733	27.4%	4.99**
4	1330	4508	1106	24.5%	0.27
5	1031	3233	699	21.6%	-3.13*
6	1080	3883	1023	26.3%	2.53
7	976	3347	758	22.6%	-1.98*
8	1990	6485	1579	24.3%	0.02
9	1623	5348	1373	25.7%	1.98**
10	1008	3395	1031	30.4%	7.13**
11	1301	4376	849	19.4%	-6.62*
12	1152	4013	1019	25.4%	1.36
13	1898	6388	1366	21.4%	-4.79*
14	1237	4115	1039	25.2%	1.18
15	1025	3109	731	23.5%	-0.93
Total	21803	72499	17644	24.3%	-

Source: own elaboration from EMQ06
Test Chi^2 sig=000 all categories; Adjusted residual test corrected.
** Significantly higher values
*Significantly lower values

Figure 2: Sample sizes and map of study areas
Source: Own production

3. RESULTS

3.1 Quantifying short trips in Barcelona: who, how, where, why.

Mobility data for Barcelona showed that residents older than 16 years make an aggregate of 4,667,921 trips per day, which represents 90% of the total trips made in the city on a weekday. On average, each resident took 3.3 trips per day, investing 79 minutes in mobility. Trips were, usually, taken either by non-motorized means (45%, mainly walking) or by public transport (32%). Privately owned vehicles were used for 23% of trips. If the purpose of the trip is considered, personal mobility was the purpose of 60% of these trips; the rest were related to occupational mobility.

In terms of time travelled, slightly more than a third of all trips (1.5 million journeys) took less than 10 minutes, making the short trip, in terms of time, the most frequent kind of travel. The modal split of these short time trips differed from the city as a whole: non-motorized means (76%) is followed by use of a private vehicle (17%) and public transport (7%).

As a matter of where do those short, close-scale trips take Barcelona residents, and what purposes do they serve, data show that 43% of the personal mobility is completed with these short-time trips, compared to just 26% of all the occupational mobility. Figure 3 shows how people allocate their travel times differently, depending on the purpose of the trip. Personal purposes are more frequent in short journeys (1-5 min and 5-10 min). In the case of trips taking in the range of 11-15 minutes, the distribution between occupational and professional purposes is nearly equal. Furthermore, trips of more than 15 minutes duration are clearly dominated by occupational mobility.

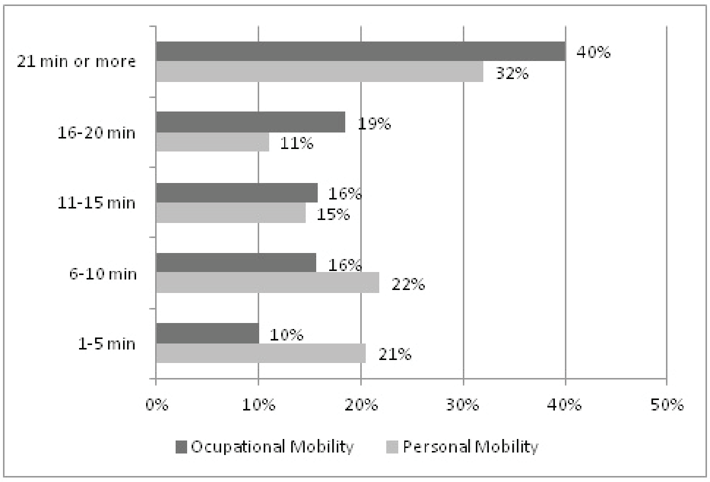

Figure 3: Breakdown of travel time allocation depending on mobility types

Source: Own production based on EMQ06 data

3.2 From time travelled to distance travelled

Time is only one of the variables that define a trip, as the variables can also be explained using covered distance. Thus, travel speed always plays a major role and with it, the means of transport utilized, as each mean of transport provides us with different travel speeds inside the city. The distance travelled on trips that take the same amount of time will differ significantly, depending on what mode of transport was used. In a 10-minute trip, a pedestrian can walk 650 metres, the equivalent of 6 streets in the Eixample district of Barcelona. It is this covered distance that links short-time trips (up to ten minutes in duration) made by walking (with an associated speed of 4 km/h) with proximity dynamics. Other speeds would represent greater covered distances that could, certainly, not be included into these dynamics.

The data indicated that 1.1 million of these proximity trips in Barcelona were made in a single day, which represents 24% of all the daily mobility. These short walking trips represent nearly one quarter of all daily mobility; an evidence of the liveliness of the local dynamics that is indicative of how Barcelona has preserved a high degree of neighbourhood vitality.

An important aspect of this within-neighbourhood mobility is related to the motivations for these journeys. Figure 4 shows the frequency of proximity trips stratified by type of activity. At the local scale, the most frequent activity is shopping, followed by accompanying others: 55% and 38%, respectively, of all such trips in Barcelona, which are proximity trips. On the other end of the spectrum, only 11% of trips to work meet the conditions of being considered as proximity travel.

Data indicate that proximity is more related with personal than professional activities and strongly links neighbourhood utilization with the personal and domestic realm. The lower use of proximity travel for occupational purposes may also reflect some disconnection between the residential and employment spheres (Miralles-Guasch & Domene, 2010; Miralles-Guasch, 2011; Poli, 2009), however, it is also noteworthy that Barcelona has still managed to maintain a large proportion of its labour mobility inside this local scale.

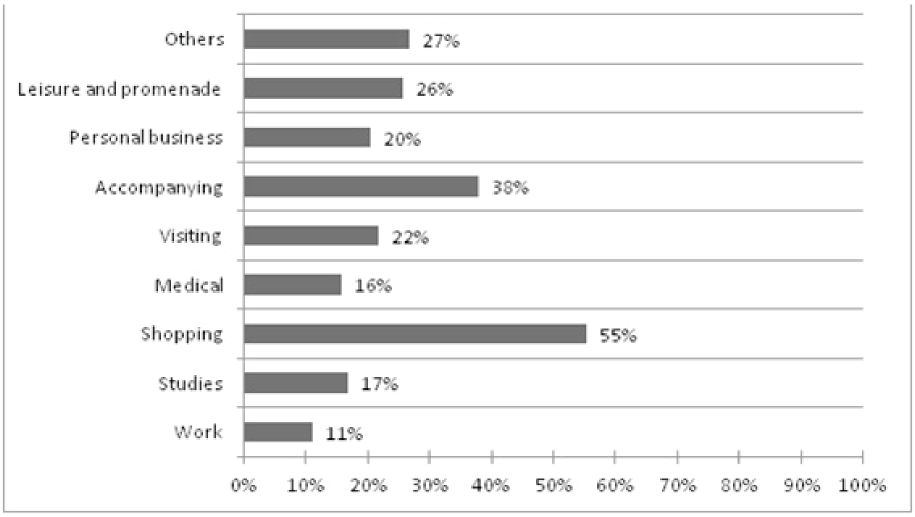

Figure 4: Breakdown of proximity trips by travel purpose

Source: Own production from EMQ06 data

For a deeper analysis of proximity utilization, and given that local scale is comprised of very short distances, it is necessary to change the scale of analysis from the municipal to the neighbourhood level, in order to explain the localization of these dynamics and their relationship with their specific urban environment.

3.3. Proximity by area of study

The scale provided by the 15 study areas (designed to accommodate trips completed by walking 20 minutes or less) made it possible to analyze the spatial distribution of local dynamics. By definition, it also permits the study of proximity trips in their most appropriate territory, as their field of action is equivalent to a 10-minute walk. At the same time, this change of scale enabled comparative analysis between study areas, making it possible to spot some key factors for the presence of close-scale urban dynamics.

Figure 5 shows the distribution of the proximity trips for each area. The most remarkable characteristic is the consistency of these kinds of mobility throughout the city: 11 of the 15 study areas were very close to the city-wide average of 24% of trips made within the city by walking and taking less than 10 minutes, with proximity travel ranging from 22 and 27% of total trips.

This steady use of the local scale can be attributed to the general homogeneity of the city's morphological features. As reported in the municipal data analyzed, public and private services are well distributed throughout Barcelona, averaging 3 schools and 1 primary health care centre per square kilometre. The city's retail structure is characterized by medium- and small-sized businesses (SMEs), and 40 covered markets are distributed across the city. Overall, commercial use occupies 16% of the city's surface area. This distribution of services is combined with very high population density in most of Barcelona: 87% of the population lives in urban environments of more than 15,000 inhabitants per sq km.

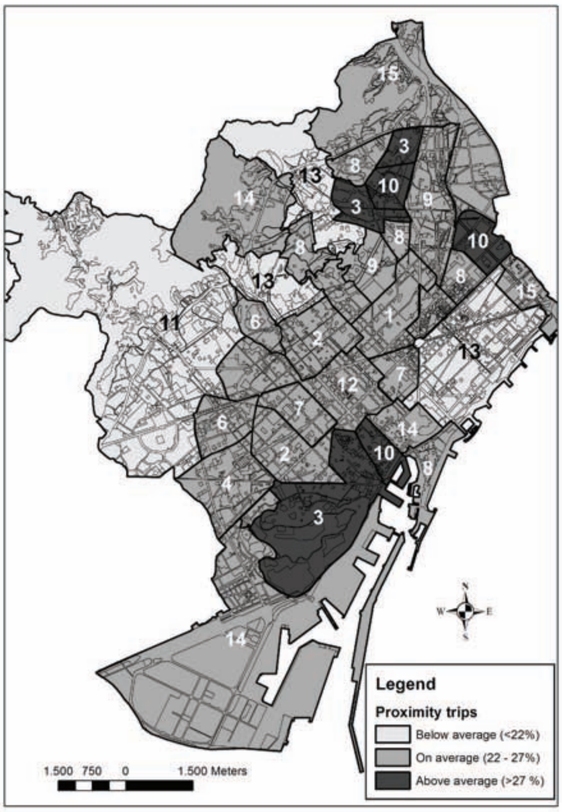

Figure 5: Frequency of Proximity trips in Barcelona

Source: Own production from EMQ06 data.

Beyond the observed similarities, the analysis of areas with extreme values that are showing significantly different intensities of the use of the proximity travelling can also provide interesting insights. Of the four areas with remarkable differences in local-scale uses, two had values statistically significantly higher than the city average and two had lower values (Figure 3). In the two areas where proximity travel was most used (Nºs 10 and 13), these trips constituted 30.4% and 27.4% of total journeys, respectively. In contrast, proximity travel in areas 11 and 13 accounted for 19.3% and 21.4% of trips, respectively.

Areas 10 and 3 comprise the historical core of the city, along with a much more diverse building typology in areas of mixed development, that were mainly urbanized in period 1960-1970. They are neither peripheral nor exclusively centric areas, and are defined by high densities and with buildings which, almost, never surpass 8 or 9 floors. These areas concentrate a high proportion of the aging population, with 23% of the population older than 65 years and more than 40% foreign-born, according to the 2006 municipal statistics.

In contrast, areas 11 and 13 are, indeed, located on the municipal periphery. These are the less dense areas of the city, with more recent urbanization (more than 15% of the urban tissue is post-1980). Finally, they are inhabited by adult (30-64 years old) and young (16-29) populations with higher average incomes.

It is also noteworthy how Ildefons Cerda's Eixample, which is Barcelona's most emblematic urban structure, shows consistent and regular local-scale uses. Its regular grid of vertical and horizontal streets occupies the geographical centre of the city. Its gross density is constantly above 30,000 inhabitants per sq km and, most importantly, its neighbourhood dynamics always generate a proximity travel ratio which is very close to the city's 24% average.

3.4 Explanatory factors

To explain differences in proximity uses, the literature has, generally, identified the built environment and sociological conditions of residents as the key determinants of urban mobility choices and behaviours. Among the many variables used to test this relationship, the most commonly analyzed include population density (Greenwald & Boarnet, 2001; Litman & Steele, 2012) and income per capita (Brownstone & Golob, 2009; Frank et al., 2005; García-Palomares, 2010). Therefore, we chose to test how proximity trips were specifically related with the gross population density values (Figure 6, right side) and income levels (Figure 6, left side).

Population density has long been used as a proxy of the urban environment (Boyko & Cooper, 2011). Mediterranean cities like Barcelona have high population density which, typically, indicates a high concentration of population in a given area, which can lead to an assumption that there is also a high offering of services and retail shops. Furthermore, as a measure of concentration, density is also valuable in distinguishing between compact and disperse urban tissues. Thus, in diverse urban environments, such as Barcelona's, population density identifies areas with the potential to accommodate proximity dynamics.

As can be seen in Figure 6 (left side), a SW-NE swathe crosses the city with constant high densities. 11 out of 15 areas show density levels above 20,000 inhabitants per sq km. Low density is observed only at the periphery. This homogeneous context of built environment grants almost every study area with the potential to develop strong proximity dynamics but, therefore, also decreases the value of density as an explanatory factor for the variation on the frequency of use of proximity trips.

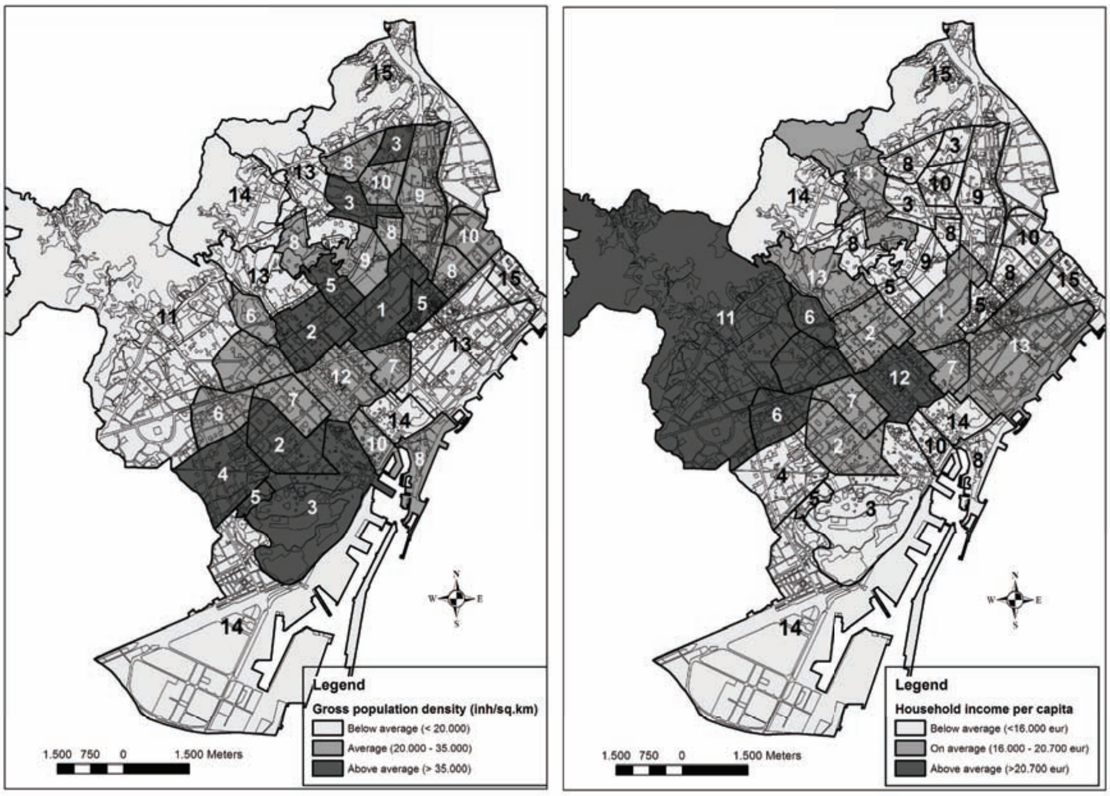

Figure 6: Density and income distribution in Barcelona

Source: Own production from Barcelona Statistical Service data

Nonetheless, although its role may be small, density has some impact on neighbourhood utilization and proximity travelling in Barcelona, as can be seen in Figure 7. First, we can observe that denser areas are more prone to develop local dynamics. Areas with more than 35,000 inhabitants per sq km, tend to have more proximity trips (24.8%) than areas with fewer than 20,000 inhabitants per sq km (22,2%). As density increases from the more dispersed areas to the more dense ones, so the use of the neighbourhood increase. However, once a certain density threshold is surpassed, proximity utilization no longer varies significantly. For areas above the 35,000 inhabitants per sq km, density ceases to be significant for proximity use. In areas with already enough critical mass of people and services, increasing density will no longer cause a major use at the local scale.

In conclusion, density acts both as a precondition and a facilitator of proximity uses; however, in highly homogeneous environments it cannot provide the sole explanation for the intensity of local-scale uses. There are other important factors, some of which may still be related to the built environment. One of them may be the number of services and facilities available to the residents of a certain area. In this sense, areas 11 and 13 have densities similar to areas 14 or 15, but while commerce represents 42% of the cadastral surface for the first pair of zones, for the second pair of zones this figure is 34%. A wider range of near destinations available contributes to areas 11 and 13 having more proximity trips.

The second main variable tested was family income per capita (Figure 6, right side). The spatial distribution of income levels is more differentiated than population density and it follows a very clear pattern. The average income in Barcelona is approximately 17,900 Euros per year. In urban areas on the west side of the city, incomes are much higher (29,000 Euros per year); in areas of the city's historic core and some areas to the north, they are well below the average (11,200 Euros per year). Below average income is found to be significant for proximity utilization, as 25.8% of low income trips are made through a short walking trip. In contrast, this figure is higher in Average and Above Average areas, which suggests a link between income and neighbourhood utilization that is statistically confirmed in Figure 8. Furthermore, income appears as the most relevant variable explaining variance in the use at the local scale in Barcelona ($\chi^2 = 74.774$ $p<0.001$), slightly ahead of density ($\chi^2 = 64.895$ $p<0.001$).

	Use of proximity trips (%)		
	Yes (>10' walking trips) (%)	No (other types of trips) (%)	*Total (%)*
Density (Pearson Chi-Square = 64895)			
Below Average (<20.000)	22.2*	77.8**	100
Average (20.001 – 35.000)	25.4**	74.6*	100
Above Average (>35.000)	24.8	75.2	100
Income (Pearson Chi-Square = 74774)			
Below Average (<16000)	25.8**	74.2*	100
Average (16.000 - 20.700)	22.9*	77.1**	100
Above Average (>27.000)	23.4*	76.6	100
Total	24.3	75.7	*100*

Source: own elaboration from EMQ06
Test: Chi^2 sig=000 all categories; Adjusted residuals test, corrected.
** significantly higher values
* significantly lower values

Figure 7: Use of proximity trips with respect to population density and income

Source: Own production from EMQ06 and Barcelona Statistical Service data

More intense proximity uses in poorer areas appear to be related to access to privately owned vehicles. The close relationship between motorization and income (Scheiner, 2010a) is reflected in 25% higher rates of car ownership in wealthier areas than poorer ones. In the poorer areas, having no car makes it impossible to undertake long trips in an acceptable time range which increases usage of the local scale. Additionally, fewer cars per capita increases general utilization of non-motorized travel, which constitutes part of the definition of proximity travel.

4. SUMMARY AND CONCLUSIONS

Most of the new urban discourses understand that proximity between different functions of the city creates mobility models that are more sustainable and democratic. However, proximity is not only defined as a Euclidian or topological distance, but is also based upon people's capacity to travel from one point to another in an affordable time and means of transport (Brennan & Martin, 2012). Proximity, therefore, encompasses both time invested in travel and distance covered on the trip. While the definition of short-time trips allows examination of the temporal aspect, proximity trips provide the complete temporal and spatial picture. In turn, as proximity trips relate to very short distances, they are useful to examine the everyday functioning of the neighbourhood as a part of the compact city.

Analyzing proximity trips requires a two-scale analysis, combining the study of aggregated data at the municipal level and a detailed scope at the neighbourhood level. This dual analysis of mobility data extracted from the EMQ06 enabled both a global perspective on the use of the local scale and the study of proximity at its most appropriate level: the neighbourhood.

At the speed of the pedestrian, we can impute a distance travelled to every walking trip and, therefore, define proximity trips as those made by non-motorized trips and taking periods of 10 minutes or less. Such trips are very frequent in Barcelona's daily mobility, representing one quarter of all the trips taken in the city on a weekday (2006 data). The most remarkable aspect of the way people use these trips is that they are intimately related with personal mobility. Although citizens tend to report longer travel times for work-related trips, personal needs are being met within the neighbourhood scale. Despite this finding, it is also true that Barcelona's compactness has helped to retain a remarkable number of jobs inside the proximity sphere.

Such intense proximity dynamics are only possible thanks to the morphological characteristics of the built environment, defined by mixed land uses, homogeneous high-density developments, and a planning tradition focused on well-distributed services and facilities (Busquets Grau, 2005). However, when we examined the distribution of proximity trips across the smaller study areas, we still observed some variations in the patterns and intensity of proximity uses. These variations are explained by a combination of density and income factors. In this specific analysis, income was the major factor, as the relevance of density is diminished by the constants that characterize the built environment. Our results suggest that density is a necessary element for the existence of proximity dynamics, but beyond a certain level of density (20,000 inhabitants per sq km) we observed that income and sociological factors gained importance in determining the intensity of local-scale uses. The income level affects every day mobility by determining access to private and public transport means. Thus, lower motorization of the poorer areas drives toward localizing a greater amount of trips inside the neighbourhood that is always reachable within a 10 minute walking trip.

Finding that once the built environment grants the possibility of short walking trips, it is the sociodemographic and economic factors that determine whether people use proximity trips or not, which opens important fields of future research. From an urban planning perspective, the presence or absence of intense proximity dynamics can depend not only on the density or land mix distribution of the neighbourhood, but also on how this built environment is adapted to the specific needs of its population. Examining everyday mobility habits and the use of proximity trips can serve as a proxy of whether the built environment is well adapted, turning the direction of the analysis and making it pertinent from a user perspective.

Overall, studying proximity utilization, from the mobility point of view, responds to a disaggregated approach that allows better insights on daily life mechanisms (Røe, 2000) and contributes to increasing knowledge about short-scale dynamics that take place in every city and that may have passed underrated on traditional transport analysis. These inner neighbourhood dynamics involve a large variety of short journeys, used for a wide array of different motivations. They constitute a myriad of mobility of proximity applications that ultimately form the heartbeat of the city and that have still to be studied, accordingly (Bissell, 2013).

Caso de estudio 2:

Walking short distances. The socioeconomic drivers for the use of proximity in everyday mobility in Barcelona[29]

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Walking short distances. The socioeconomic drivers for the use of proximity in everyday mobility in Barcelona

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ABSTRACT

Many studies have found that cities, with residents that are co-located with jobs and services in compact and diverse urban environments, generate positive outputs for a number of areas of social policy, with issues ranging from environmental to social and including public health. This evidence supports promoting rich and thriving neighbourhoods in order to encourage short distance mobility. In this context, we use a wide travel survey (EMQ06), undertaken in Spain, to measure short-distance travelling within Barcelona and to assess how distinct social groups make use of the local scale for their everyday mobility. The effects of socioeconomics and access to transport are discussed, prior to applying a Chi-squared Automatic Interaction Detection (CHAID) method, in order to explore heterogeneity among the different social groups, in terms of local travelling. We found that nearly a quarter of all daily mobility in Barcelona is performed with a local trip, and that short trips are more frequently undertaken for personal purposes. Also, age, gender and access to private transport appear as significant factors. Overall, our results suggest that a proximity scale is being used by those groups with greater time–space constraints, such as working women or low income people without access to private vehicles, opening important implications on transport policy regarding the design of proximity-prone environments.

1. Introduction

Proximity is a spatial concept with a growing presence in most of the academic literature regarding cities and urban environments. New ways of understanding the city are arising around principles such as sustainability, liveable cities, knowledge economies or rethinking of urban values. Within this new academic debate, proximity appears as a transversal element in many of the arguments. Especially important is the tendency to consider it as a key to achieving increasingly sustainable urban models, in the environmental, social and economic senses. Proximity, in general, facilitates human interaction, economic efficiency and social cohesion (Huriot, 1998). More specifically, reducing distances between housing, jobs and services, makes it possible to reduce the kilometres travelled in motorised vehicles, in conjunction with an improvement in the accessibility for people's everyday mobility. As a result, in recent years, planning policies have, increasingly, focused on favouring shorter travel distances and active transportation, promoting localised and compact urban development (Manaugh and El-Geneidy, 2012). The literature has extensively explored walking as a modal choice (Middleton, 2009;

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Walking short distances. Studying the use of proximity for everyday mobility in Barcelona.

Abstract:

Many studies have found that locating residences, jobs and services together in compact and diverse urban environments generates positive outputs in a wide array of disciplines, ranging from environmental to social and including public health issues. This evidence supports promoting rich and thriving neighbourhoods to encourage short distance mobility. In this context, we use a wide travel survey (EMQ06) taken in Spain to measure short-distance travelling within Barcelona and to assess how distinct social groups make use of the local scale for their everyday mobility. The effect of socioeconomics and access to transport is discussed, prior to applying a CHAID (CHi-squared Automatic Interaction Detection) method in order to explore heterogeneity among the different social groups, in terms of local travelling. We found that nearly a quarter of all daily mobility in Barcelona is performed with a local trip, and that short trips are more frequently for personal purposes. Also, age, gender and access to private transport appear as significant factors. Taken together, our results suggest that proximity scale is being used by those groups with greater time-space constraints, such as working women or low income people without access to private vehicles, opening important implications on transport policy regarding the design of proximity prone environments.

Keywords: proximity, local travel, walking, Barcelona

1. INTRODUCTION

Proximity is a spatial concept with a growing presence in most of the academic literature regarding cities and urban environments. New ways of understanding the city are arising around principles such as sustainability, liveable cities, knowledge economies or rethinking of urban values. Within this new academic debate, proximity appears as a transversal element in many of the arguments. Especially important is the tendency to consider it as a key to achieve increasingly sustainable urban models, in the environmental, social and economic senses. Proximity, in general, facilitates human interaction, economic efficiency and social cohesion (Huriot, 1998). More specifically, reducing distances between housing, jobs and services, makes it possible to reduce the kilometres travelled in motorised vehicles, in conjunction with an improvement on the accessibility for people's everyday mobility. As a result, in recent years planning policies have increasingly focused on favouring shorter travel distances and active transportation, promoting localised and compact urban development (Manaugh & El-Geneidy, 2012). Literature has explored intensely walking as a modal choice (Middleton, 2009; Saelens & Handy, 2008), and also the use of short trips (Litman, 2012; Ory & Mokhtarian, 2009). There have been far less studies that have specifically explored the use of short walking trips, although some examples can be found on Rietveld (2000) and Ryley (2008). Our study comes to fill this research gap at the same time that it introduces some methodological novelties and assumes a new perspective: a short walking trip is not just a matter of travel choice, but a need that has been solved in a short distance, by means of a highly sustainable kind of journey.

Hence, the present paper sets with two major objectives: (1) To introduce a new measure for short-distance travel and local use, and (2) To understand the effects of socioeconomic factors and access to transport on people's activity spaces and their use of proximity. To do so, the rest of the paper is organized as follows: the next section reviews the concept of proximity, along with some of the literature that has explored the determinants of travelled distances. Section 2 discusses a new approach to proximity measuring, through modal choice and travel time. It also introduces some characteristics of the study area, along with data sources and methods of analysis. In Section 4, the empirical findings based on modeling results are presented and discussed. Concluding remarks are presented in the final section. The discussion will be based on Barcelona data, but the results are and policy lessons are easily transferable to other dense and compact urban environments.

1.1 Proximity

Spatial proximity is a long discussed aspect of urban science (Allen, 2000; Gubbini, 1997; Schmid, Sahr, & Urry, 2011). In being defined, simply, as how closely located are the physical elements of a city, it should not be conceived as a simple Euclidian measure (Bissell, 2013; Healey, 2004). Assessing proximity through geometric distance means seeing the city as an isotropic space, an abstract and theoretic concept, very far removed from the anisotropic character of actual urban spaces (Brunet, 2013). Urban space is not homogeneous, as locations and places with different gravitational forces draw more or less attention from the users of the city (P. Healey, 2004; Huriot & Perreur, 1998). At the same time, every individual has a different set of perceptions which shape his own idea of the urban world by modifying the actual use that he makes of the urban environment.

As a result, neither Euclidean nor rectilinear distances serve any purpose in assessing people's use of proximity (Dumolard, 2011).

In defining proximity, more contextual factors such as shape, orientation, size or connectivity are also relevant (Brennan & Martin, 2012), just as the preferences and needs of the population are as important as the neighbourhood's built environment. The spatial use of the city is shaped by the combination of objective and subjective factors (Dumolard, 2011) and, therefore, consistent with Martha Nussbaum's works (2003), proximity should also be addressed from people's capabilities and not only from physical parameters.

What makes local travel desirable for urban planners are its benign environmental and social outputs (Manaugh & El-Geneidy, 2012). With respect to the environmental aspects, compact cities consume less energy and release less pollutants (Owen, 2009). At the same time, the promotion of non-motorised transportation alleviates congestion problems and has a positive impact on public health (Handy & Boarnet, 2002; Kerr et al., 2012). It is through this increased presence of active modes of transport that proximity also entails its main positive outputs on the social aspects. This modal shift from motorised to non-motorised creates more democratic urban spaces, that avoid monetary or skill discrimination and that, finally, are diminishing the social differences caused by diverse access to transport (El-Geneidy & Levinson, 2011; Rubulotta et al. 2012; Talavera-Garcia et al. 2014). The absence of specifically needed abilities, such as having a driving license or monetary costs makes non-motorised travel almost universally accessible (Curtis & Scheurer, 2010). Hence, by making all the facilities in the city equally available to all kinds of people, proximity has the capacity to produce equal and socially sustainable travelling patterns.

1.2 Determinants of distance travelled: socioeconomics, access to transport and built environment.

Each social group has its own travel necessities that are not equal and that are defined by their demographic and socioeconomic status (Cerin et al., 2007). These characteristics determine daily needs, for which people are willing to spend more or less time, depending on their personal schedule. Time is a finite resource that is equal for everyone, regardless of wealth or social status (Madanipour, 2007). Within time, we have to accommodate all of our daily activities (Harvey, 1991). Upon these frameworks, every individual makes his own complex balance between activities, transport needs, and time available, which is shown on its travel behaviour (Miralles-Guasch, 2011).

However, the exact distance that a person can travel in order to fulfil his needs is strongly determined by access to transport (Morency et al. 2011). Uneven access to the different modes of transport clearly affects travel behaviour and, ultimately, people's travelled distances (Carse, et al. 2013; Kenyon 2011). Having access to mechanised transports, either private or public, is a precondition to making long journeys in short time spans, compressing time-space and making more locations available, hence, it has great impact in activity territorialisation, modal choice and travelled distances (Scheiner, 2010a). Together, time availability, personal needs and access to transport shape individual space-time prisms (Ritsema van Eck et al. 2005; Van Acker et al. 2010), a classic time geography concept that depicts the set of all locations that can be potentially reached by an individual, given a starting location and its temporal constraints (Mercado & Páez, 2009).

Overall, every social group has its own range of needs and every need must be satisfied somewhere within its available time-space prism (Chapin 1974; Neutens, et al. 2007). But, as aforementioned, urban spaces are heterogeneous and every neighbourhood offers a different number of opportunities. Built environment and urban structure determine travel behaviour in many well documented ways (Ewing & Cervero, 2010; Guo & Chen, 2007; Sallis et al. 2004), none of which are more important than defining the amount of destinations available within every individual space-time prism. The distance travelled by an individual in his everyday mobility shall be the product of overlapping the potential of his built environment with his available space-time prism. The result is his activity space, usually referred to as potential path area (Justen et al., 2013), a concept created by Horton and Reynolds (1971) to define the geographical area containing all the urban locations with which the individual has direct contact as the result of day-to-day activities (Manaugh & El-Geneidy, 2012).

The number of services, jobs and amenities inside this potential path area is determined by the built environment. In this sense, traditionally, the European city and, particularly, with respect to the Mediterranean city, has been considered as the paradigm of the compact city, in sharing several of its defining features (Beatley, 2012; Rueda Palenzuela, 2002). Being a palimpsest of overlapping developments and sequential urban plans, the Mediterranean city is characterised by aggregated, dense and diverse urban tissue

(Dura-Guimera, 2003), which in many cases has also preserved a high degree of social mixture (Musterd & Zoltán, 2013). Despite the recent suburbanisation and metastatic metropolisation that most of the European cities have suffered (Ascher 1995; Gutiérrez & García-Palomares 2007), the core city, frequently at the centre of dynamic metropolitan areas, still preserves most of its morphological characteristics, providing compact city-like conditions for urban mobility (García-Palomares, 2010). In this, particularly, rich and diverse built environment (Muñiz & García-López, 2013), it is to be expected that a large share of daily mobility can be achieved through proximity trips, as it is possible to reach essential services without having to use motorised transports, thus, avoiding long distances.

However, the fact that the urban environment provides the potential for proximity trips does not mean that every social group uses this local scale with the same frequency. Understanding which are the social factors that foster this specific kind of travel behaviour is a key stage, prior to designing adequate policy measures, in order to encourage proximity dynamics (De Witte et al. 2013; Manaugh & El-Geneidy, 2012; Røe, 2000). At the same time, exploring how different social groups make use of the local scale, will permit identifying whether or not proximity relieves the burden on transport dependency as a well documented social exclusion factor (Metz, 2013; Stanley et al. 2011)

2. METHODOLOGY

We use a two step methodology, upon which we first tested the individual importance of each determining factor upon proximity utilization, and then used a Chi-Squared Automatic Interaction Detector (CHAID) decision tree model to analyse which factors were more important at explaining local travelling. In this methodology section, we explain how we've been able to identify the trips that are covering short distances and we introduce the particular characteristics of the study area. Later, some main details of the data sources along with the basis of the CHAID model.

2.1 Short walking trips

In order to observe the actual use that citizens make of their closest local scale, proximity will be measured through the everyday mobility of the citizens of Barcelona. In attempting to avoid traditional approaches, based exclusively on physical distance, we will measure proximity through both travelling time and speed. As stated by Pulselli & Tiezzi (2009), time alone already expresses both distance and speed, but in order to include the importance of transport in urban life today, speed will also be used to define proximity trips.

Therefore, from the mobility point of view, we define a proximity trip by the following conditions:

1. It has to be of short duration (Time)
2. It has to cover short distance (Distance)
3. It has to be accessible (Transport)

Whereas the first two conditions are somehow obvious, incorporating the access to transport is a paramount condition if we want to achieve, not only the environmental benign outputs of proximity, but also the social ones. Addressing the local use from the point of view of people's everyday mobility requires taking into account the different accessibility provided by each urban transport mode. In this context, the most easily available trips are the ones that can be performed by walking (Preston & Rajé, 2007).

Furthermore, in relatively short distances, walking is a very competitive mode of transport. It is much more accessible than private car and, being an individual mode of transport, is not constrained by predetermined schedules or routes, as is public transport (Lavadinho, 2006).

In terms of time, a short trip, is one that takes less than 10 minutes (Ryley 2006; 2008); these 10 also represent an appropriate walkable distance (McCormack, Giles-Corti, & Bulsara, 2008). Because of the regular pedestrian speed (about 4 km/h) walking trips provide a stable conversion from travel time to distance travelled (Duffy & Crawford 2013; Van Eck et al. 2005; McCormack et al. 2007).

Therefore, proximity trips are identified as those trips that are made by walking and are taking less than 10 minutes. If we were to assume an unlikely constant walking rhythm with no stops or interruptions, this 10 minute trip would allow us to travel 650 metres of linear distance. It is, therefore, a trip that takes place well inside the neighbourhood limits (Li et al., 2005; Sugiyama et al., 2010) and is a clear indicator of local activity, at the same time that it also represents the most basic kind of trip available in any urban environment.

2.2 Barcelona as a European, compact and diverse urban environment

The study area of this research is the municipality of Barcelona, capital of the Autonomous Community of Catalonia, located in the northeast of Spain. In 2012, it had 1.6 million inhabitants, one million of them being of working age (16-64 years old). The city has a compact urban environment characterised by constant high densities (Matas & Raymond, 2008; Muñiz & Galindo, 2005). Mixed land uses are also an important feature, especially with a commercial structure marked by small retail business. Furthermore, the first councils of the democratic era made a great effort to provide with good services and facilities throughout the whole city (Busquets, 2005). On average, every square kilometre has up to five educational institutions, as community facilities and public provisions cover 10% of the total surface area. Only 10 out of 73 neighbourhoods have less than 5% of the total area devoted to public equipments and facilities (Miralles-Guasch & Marquet Sarda, 2013).

The city also has a wide public transport system, consistent on lines of metro, train, tram, and bus with a large distribution throughout the municipality. On average, one can find 34 public transport stops of all kind every square kilometre, making public transport to account for a third of everyday mobility. The rest of the mobility is covered either by walking (47.3% of the trips) or by private transport (22.1%). Finally, the rational design of street patterns, which is also a significant aspect on sustainable development, is plainly fulfilled with the major presence of Eixample Cerdà, (Pallares-Barbera et al., 2011) that provides the necessary connectivity for short walking trips (McCormack, et al. 2007).

Overall, the city provides a homogeneous compact city-like urban environment and, because of its regular physical settings, constitutes a suitable area on which to study spatial behaviours of people. Barcelona, ultimately, shapes a proper urban environment where proximity travelling is potentially possible and, therefore, boosts the importance of the socioeconomic and transport factors with respect to explaining local travelling.

2.3 Data sources

The main data source is a wide mobility survey, Everyday Mobility Inquiry (hereafter, EMQ06), that was performed in 2006 (ATM and GC 2006). This survey is an initiative of the Department of Territorial Policy and Public Works of the Generalitat of Catalonia (Regional Government of Catalonia) and the Metropolitan Transport Authority. It aims to describe the mobility of the resident population of Catalonia and, in the same way as most international surveys, it identifies one trip as one motivation to move (Miralles-Guasch, 2012). The CATI (Computer Assisted Telephone Interview) was used to survey individuals who reported having made any journey on the workday referred to in the interview.

EMQ06 provides travel data of a sample of more than 24.000 people living in the city. This large number enables in-depth analysis, linking mobility data with some of the sociologic characteristics that were also included. Onto the large set of socioeconomic variables available, we chose to test the relevance that five of them had on the configuration of proximity trips. Those five variables were: gender, age, professional status, access to motorised transport and availability of a private vehicle. Although the survey provides data for ages from 4 years, our study only deals with active population (16 to 65 years of age) since they concentrate more travels and have major temporal constraints in their daily mobility.

To complement the survey data we also used some official statistical data provided by IDESCAT[30] and Barcelona Municipality[31]. These were used to create two extra variables: income level and public transport supply. Income has been found to be a relevant factor on most studies regarding travel behaviour (De Witte et al., 2013), and it is important to include the role that public transport has on the mobility patterns in Barcelona (Curtis & Scheurer, 2010). Three income groups were calculated upon Barcelona's average income for the year 2006. High and low income groups were defined as those that were at least 25% higher/lower than the city average. The same criterion was applied to calculate the public transport offer, based on the density of metro, bus and railway stops.

2.4 Methods of analysis

A cross sectional study was performed using descriptive statistics and examining how often each population subgroup made use of the proximity trips. This allowed recognition of the main trends that could be further explored with the CHAID method. The CHAID method of analysis, first described by Kass (1980), is a simple representation of the existing relationship within a dataset in the form of a decision tree. Decision trees split the data to form homogeneous subsets, but they differ from other regression analy-

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[30] Institut d'estadística de Catalunya (Statistics Institute of Catalonia): http://www.idescat.cat/en/
[31] Servei d'estadistica de Barcelona (Statistics Service of Barcelona): http://www.bcn.cat/estadistica/angles/index.htm

ses by making the decision of which predictor comes into play at a more localised level (Sullivan & van Zyl, 2008). At each node, the decision on which an independent variable is most related with the dependent variable is calculated, only within the subpopulation in that node and the relation is measured via chi-squared testing (Horner, Fireman, & Wang, 2010). The result is a hierarchical representation that can be used both for analysis and prediction (Pitombo et al. 2011; Yang et al 2013; Zhang, Yu, & Chikaraishi, 2014) and that is typically used to explore group differences based on categorical predictor variables (Lahmann & Kottner, 2011).

The CHAID method is being increasingly used in transport related studies (Pitombo et al., 2011; Yang et al., 2013; Zhang et al., 2014) to understand group responses in relation to a dependent variable (criterion) according to a combination of variables (predictors) (Kim, Timothy, & Hwang, 2011). In the present case, the CHAID method is especially useful to analyse the travel behaviour of different subpopulations groups, in relation with the amount of local travelling. The model is especially useful at capturing the complexity involved in travel behaviour issues (Zhang et al., 2014). At the same time, tree classification techniques such as CHAID have the advantage of providing simple and clear representation for usually multifaceted relations (Sullivan & van Zyl, 2008). All analysis were conducted on SPSS 19 for Windows (SPSS Inc., Chicago, IL).

3. ANALYSIS

3.1 Proximity and main variables

Our consideration of proximity trips, such as walking trips taking less than 10 minutes, represents 23% of the total mobility performed by citizens between 16 and 64 years of age in Barcelona. Overall, they total 864.857 trips every day, and they are being used for all kind of purposes from going to work to social visiting or going to the doctor. Likewise, these trips are not concentrated on a single social group, but on the contrary are common on most of the social groups that were analyzed.

Trip motivations clearly determine the characteristics of the journey, as 33.8% of all personal trips are covered by a short walk. Behind the category of personal mobility, there is a large variety of different purposes and activities that are covered with short walks, such as “going shopping” (64.4% of trips for this purpose being made by walking in less than 10 minutes) and “accompanying people” (which, basically, refers to taking children to school) (37.9%), being the most significant ones (Table 1). Notwithstanding, figures referring to personal mobility should not overshadow the fact that 12% of the occupational mobility (ie. going to work or to study) is still performed within the local scale of the neighbourhood.

This link between purpose and travel behaviour also impacts on the time of the day when short walking trips are undertaken the most. While proximity trips are fairly scattered throughout the day, they are clearly more intense between time interval of 9am-13pm, in which up to 32.8% of trips that are being made in the city correspond to local travelling (Table 1). In contrast, short walking trips are less frequent in morning peak hours (7am-9am), a time slot where occupational mobility is hegemonic.

Table 1: Proximity trips by social group, and share of proximity trips relative to total amount of travels performed by each group

	Total number of Proximity trips	Proximity trips in relation with total trips (%)
Barcelona	864507	22.9%
Purpose distribution		
Occupational mobility		
Study	28351	16.7%
Work	89318	11.4%
Personal Mobility		
Shopping	123709	64.4%
Going to the doctor	11960	17.6%
Social activities	26162	22.4%
Accompanying people	63188	37.9%
Personal business	23405	19.6%
Leisure	77957	27.9%
Others	18527	26.0%
Temporal distribution		
Morning		
7am - 9am	75745	13.9%
9am - 13pm	228681	32.8%
Midday		
13pm - 15pm	109976	22.7%
Afternoon		
15pm - 18pm	159682	22.0%
18pm - 22pm	366251	23.8%

The utilisation of local travel is socially heterogeneous. Every group relates differently with local travelling, as shown on Table 2, were we can see the frequency on which each group uses short walking trips (column A). We have also taken into account how much of the total mobility taken by a specific group corresponds to personal or occupational purposes (columns B and C) and also specifically how frequently they use short walking trips when attending personal or occupational purposes (columns D and E). We use the additional values in columns B to E, in order to incorporate nuances into the analysis, and to understand how local travelling is not just a matter of the purpose of the trip, but is also socioeconomics and transport related.

Table 2 around here: Proximity trips upon the main studied variables

	Sample profile n	Sample profile (%)	**A. Actual proximity engagement (%)**	B. Personal mobility engagement (%)	C. Professional mobility engagement (%)	D. Proximity engagement on personal mobility (%)	E. Proximity engagement occupational mobility (%)	F. p-value
Gender								<0.01
Male	28647	49%	**19.8%**	43.8%	56.2%	31%	11%	
Female	30099	51%	**25.8%**	59.2%	40.8%	35%	12%	
Age								<0.01
Young (16-29)	15910	27%	**20.4%**	44.4%	55.6%	29%	14%	
Young-adults (30-44)	22264	38%	**22.7%**	49.0%	51.0%	36%	10%	
Adults (45-64)	20572	35%	**24.9%**	60.2%	39.8%	33%	12%	
Professional situation								<0.01
Employed	38783	66%	**19.4%**	39.6%	60.4%	32%	11%	
Unemployed	19963	34%	**29.6%**	75.2%	24.8%	34%	16%	
Income								<0.01
Low income (< 80% BCN)	12514	21%	**24.2%**	51.4%	48.6%	36%	12%	
Average income(80-125% BCN)	35747	61%	**22.7%**	51.8%	48.2%	33%	12%	
High income (>125% BCN)	9860	17%	**21.6%**	52.0%	48.0%	32%	11%	
Access to motorized transport								<0.01
None	23848	41%	**27.1%**	55.7%	44.3%	36%	16%	
Some	34898	59%	**20.0%**	49.0%	51.0%	31%	9%	
Public transport supply								<0.01
Low Public transport supply	10851	18%	**21.2%**	52.9%	47.1%	29%	13%	
Average Public transport supply	33326	57%	**23.5%**	51.4%	48.6%	35%	12%	
High public transport supply	14569	25%	**22.5%**	51.4%	48.6%	33%	11%	

A. % of all trips that are walking and < 10 minutes
B. % of all trips that are invested in personal mobility
C. % of all trips that are invested in occupational Mobility
D. % of personal mobility trips that are walking and < 10 minutes
E. % of occupational mobility trips that are walking and < 10 minutes
F.P-value. Statistical significance (Chi-Square test) of the variable in relation with Actual proximity engagement

3.1.2 Socioeconomic factors

Gender and Age

Gender is, usually, found to cause a major difference in mobility patterns between men and women, as in modal choice (Law, 1999; Polk, 2003). Proximity utilisation is no exception, as women use short walking trips on 25.8% of occasions, compared with 19.8% for men. Not only women take more personal trips (59% of their mobility is devoted to personal reasons compared with 43.8% for men), but the ones they do take are more frequently solved with a short walking trip (35% compared with 31% for men [column D]). Overall, short walks for personal purposes represent one fifth of daily mobility for women, while being only one seventh of mobility for men.

In general terms, as age grows, so does the use of the neighbourhood. While young people tend to make average use of the local trips, in older cohorts this percentage is increased. This is an important factor, because cohorts of 30-44 and 45-64 years of age are the ones that have more obligations, activities and a more compressed time schedule (Lucas, 2012). Social groups with tighter schedules and smaller space-time prisms, as with adult women, tend to rely more on the local scale when possible, especially for the personal trips. In contrast, younger people (16-29 years of age) make fewer personal trips (44.5%) and even fewer of those trips are within the proximity scale (29%); all of which accounts for short walking trips representing only 20% for younger mobility, compared with 25% for older cohorts.

Professional status

Professional status is another key determinant of local travel. Employed and unemployed people seem to have very different mobility patterns, and this is reflected in the frequency of their use of local scale. Trips performed by employed people are within the local scale for 19% of the time, while trips performed by unemployed people, for 30% of the time. While they show similar ratio of use of proximity on their personal trips (32% and 34%), the differences are mainly located on the total amount of these personal trips that they take. In that way, 75% of the trips made by the unemployed are personal related and it is this enhanced role of personal travel that results in using short walking trips more often. Once again, even when considering a trip for the same purpose, unemployed people tend to use short walking trips more often than employed people.

Income

Although there are only 2.6 percentage points difference on the average use of the local scale between high and low income people, income provides a clear pattern on which lower income groups perform more proximity trips than upper income groups. The differences are not found on the professional mobility, as all income levels show nearly 12% of local scale utilisation, but on the personal portion. In this personal dimension of mobility, while lower income groups rely on the proximity scale on 36% of occasions, higher income groups do so on 32% of occasions, and that leads to a slight difference on the global share of the use of proximity. Figure 1 shows this distribution by taking the motivation of the trip into account and helping to visualise these differences. Low incomes (in black) use short walking journeys more often for personal purposes such as *social, personal business, leisure or others*. The wealthiest group, instead (in grey), solves their *work* and *shopping* necessities with a walking short trip, slightly, more often.

It is also interesting to see how high incomes are using short walking trips more often in order to get to work (Figure 1), which may disclose that they live closer to their workplaces. This relationship, however, is reversed in the case of study locations, where low income groups travel with a proximity trip much more often than high income groups. Finally, 30% of the social related trips taken by low income groups are walking journeys resolved in less than ten minutes, in comparison with only 18% of the wealthiest of people.

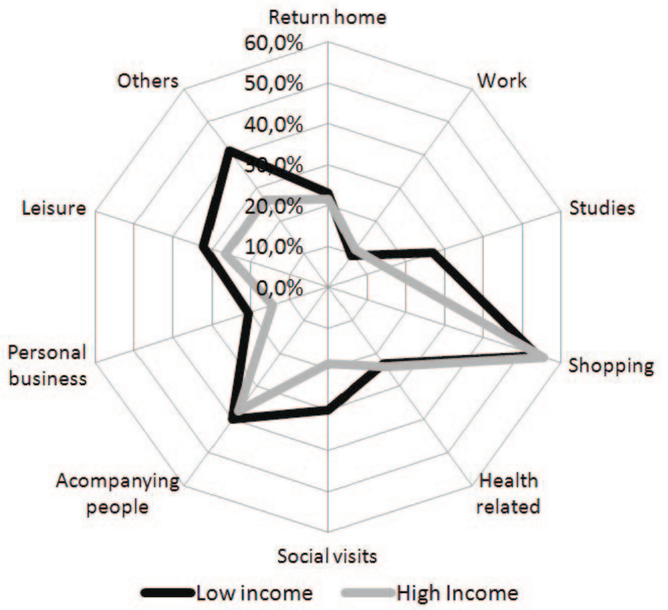

Figure 1: Proximity trips by trip purpose and income

3.1.3 Transport related variables

Access to mechanised transport

Access to the different modes of transport has been consistently found to be a determinant of travel behaviour (Santos et al., 2013). But, how does having access to private or public transport correlate with local travelling? Is the local scale, merely, a resource for those who have no access to a car? How does the supply of public transport modify the use people make of their neighbourhood? The last two variables in Table 2 aim to answer some of these questions.

Significantly, those who have no access to a private car are the ones who use local trips the most (27.1%). In contrast, those who do have access to a car only resort to their near environment for 20% of occasions. There are no significant differences between people living in neighbourhoods with high public transport supply, who are using short walking trips for 22.5% of occasions or with low public transport supply, 21.2%. The balanced offer of public transport throughout the whole city makes access to public transport a variable of low impact in our study. The main differences for local travelling are caused, thus, by the dichotomy of having, or not having, access to a car.

In Barcelona, 353.078 people between the ages 16 and 64 years have no access to a car. This accounts for 37% of the total population in this age range. Depending exclusively on walking, biking and public transport does not make them move less; furthermore, they are responsible for 41% of the total trips made every day. As the potential activity paths of this group of people are marked by lower moving speed, they turn, to a greater extent, to proximate urban scales, in search of near services and facilities.

As shown in Figure 2, people with access to a car (in grey) make use of the local scale, consistently, less than people without access (in black), in all except the one trip purpose. The main differences are found in the *studies* and *accompanying people* categories. The only purpose that people with access to a car tend to engage in more in the proximity environment is trips for medical reasons.

Furthermore, it is also important to note how people with access to a car use a proximity trip to *go to work* on 9% of occasions, while people without access, get to work with a short walking trip on 14% of occasions. Even more noteworthy, are the differences in the *study* category (8.4% versus 20.4%).

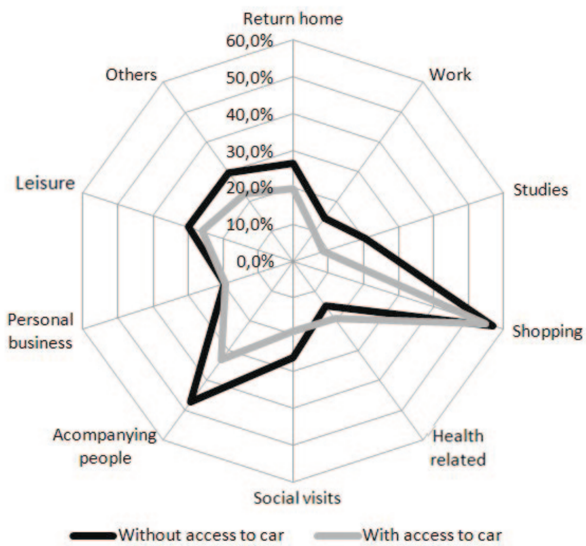

Figure 2: Proximity trips by trip purpose and access to car

3.2 Hierarchy of factors

To see how the combination of different variables played a role in determining proximity, we used two different CHAID answer trees, one for the socioeconomic factors and the other for the transport related ones. The trees sort out the independent variables in order of relevance at explaining the dependant variable. In that case, all variables are set to explain proximity trips. On the final layout of the tree, the upper variables are more relevant at explaining the presence of proximity trips than the lower ones.

3.2.1 Answer tree for socioeconomic factors

The socioeconomic CHAID answer tree was set to calculate the importance of the variables gender, age, professional situation and income at explaining local travelling (Figure 3).

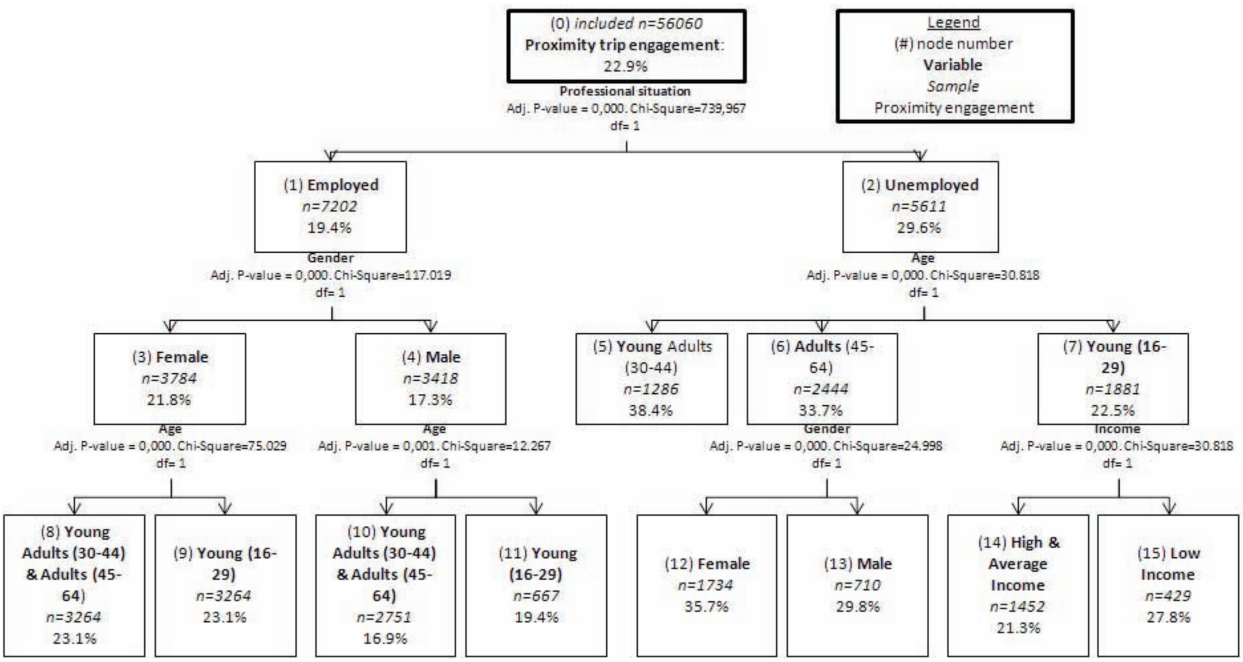

Figure 3: Socioenomic CHAID tree

As we can see by its graphic output, the most important socioeconomic factor at explaining local travel is professional situation. The great differences on the use of these kinds of trips, between employed and unemployed, cause the first major division of the tree. If we focus on the employed branch, who are using proximity on 19.4% (node 1) of their trips, the next main variable is gender, as employed women use proximity on 21.8% of their trips (node 3), against the 17.3% figure for employed men (node 4). Finally, the last variable depicted by the CHAID model for the case of the employed is age. Both for men and women, the younger cohort (nodes 9, 11) behaves differently than the

30-64 years of age ranks (nodes 8, 10). However it is still interesting to see how, while employed young women (node 9) are using the proximity much less than their adult counterparts (node 8), in the case of employed men, younger cohorts (node 11) use the proximity much more than older cohorts (node 10).

On the right side of the tree, depicting the use of short walking trips by unemployed people, the main variable is not gender, but age. In this case, there is a clear break between the unemployed older than 30 years (nodes 5, 6), who are using proximity trips for 38.4 and 33.7% of their trips, and unemployed younger than 30 years of age (node 7), who show a much lower share of local use (22.5%). Finally, the income variable is only found relevant inside the unemployed young category. On this specific social group, average and high incomes tend to use proximity less (node 14.21%) than lower incomes, which use it on 27.8% of their journeys (node 15).

3.2.2 Answer tree for access to transport variables

The second answer tree is restricted only to the variables related with people's access to transport. The specific aim of this tree is to show how access to transport, both private and public, has an impact on people's activity spaces and, therefore, on the way they make use of their nearby urban environment (Figure 4).

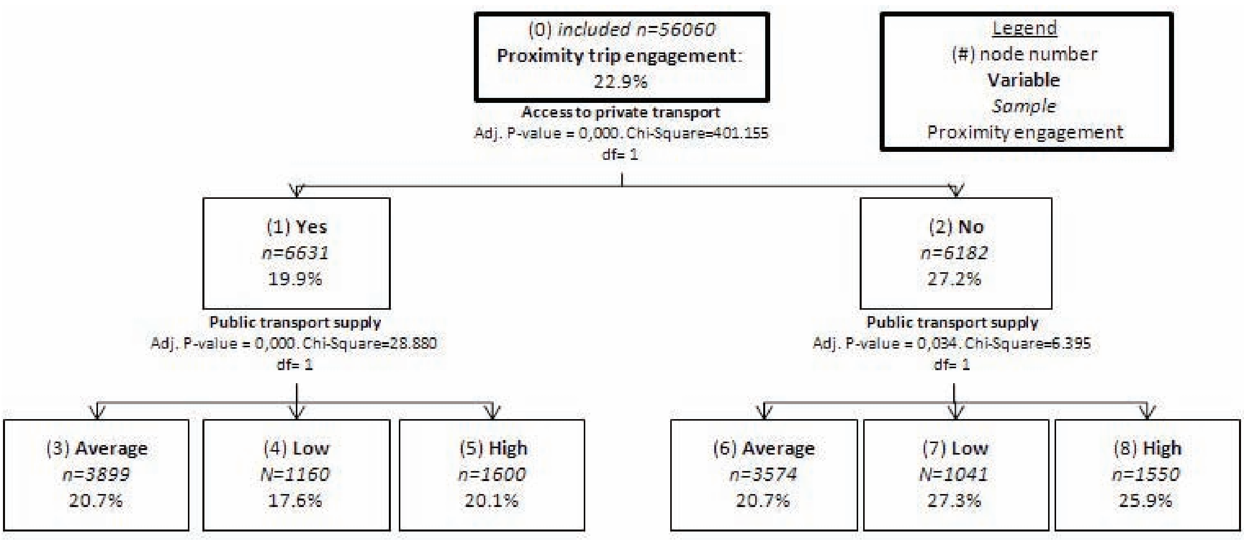

Figure 4: access to transport CHAID tree

The main variable in this tree is having, or not, access to private transport. The first category shows the frequency on which proximity is used by those who have access to a car, or not. As we have already seen, those without access to private vehicle are the ones who rely on the local scale the most (node 2: 27.2%). Among them, the most important variable is the kind of access they have to public transport. The model shows how those who do not have any private vehicle available, but live in a neighbourhood with high public transport supply (node 8) do not use as many proximity trips as people living in areas with low or average public transport supply (nodes 6 & 7).

Car users (node 1), instead, have to deal with congestion and parking problems, hence, their travel behaviour is more sensitive to having, or not, good public transport alternatives. In this sense, car drivers who choose not to drive may not use the local scale when they have good or average public transport facilities (node 5: 20.1%; node 3: 20.7%). In contrast, drivers who live in neighbourhoods with poor public transport possibilities choose to drive to a greater extent and, therefore, proximity utilisation is also scarcer (node 4: 17.6%).

4. DISCUSSION AND CONCLUSIONS

This study aims at advancing understanding of proximity dynamics in the city. We analyse how specific social groups, defined by some key socioeconomic variables, make use of the urban local scale. We identify local trips as walking journeys lasting less than 10 minutes, with specific conditions for a trip that embody being brevity, short distances, and universal accessibility. Departing from a large travel survey on everyday mobility, we use travel time and modal choice to analyze the use that every social group is making of their neighbourhood. Then, a CHAID decision tree technique was used to determine hierarchies between these predictive factors.

Daily, nearly one out of four trips taken by individuals in Barcelona cover less than 650 metres and is made by walking. This speaks of a dense and compact physical morphology with mixed land uses and good provision of services. It is the structure of the city that makes these short trips possible, as other urban morphologies do not provide the necessary mix of services, commerce, jobs or amenities in the adequate range. Notwithstanding, it is the socioeconomic factors which, mostly, determine the frequency by which these proximity trips are finally taken (Van Acker et al. 2010).

Short walking trips appear to be much more frequent on journeys that seek a personal purpose, like shopping, getting children to school or visiting relatives. On a large level, those population subgroups that take more personal trips also use proximity more often. But, going beyond that general observation, factors like age, gender or time availability are also important.

The results show how the use of proximity increases with age. As people grow, so does the complexity of their personal schedules (Lucas, 2012) and, thus, they need to either find closer destinations or travel faster to get to farther ones. Temporal constraints lead people to resort more often to the local scale, in search of easily accessible opportunities available inside their neighbourhood (Camarero & Oliva, 2008).

But, this observable fact is not equal in terms of gender. Our results are fully coincident with Frändberg and Vilhelmson (2011) observation on how gender is determining both the length and the modal choice of most journeys. Results also show that men tend to solve their busier schedules by increasing motorisation -which is largely consistent with what Ryley (2006) found- and, furthermore, reducing the number of proximity trips they take. Women on the other hand tend to solve their schedules by increasing the number of trips within their neighbourhood. The well documented fact that adult women are assuming more tasks (professional and maintenance) (Neutens, Schwanen, & Witlox, 2011; Schwanen, Dijst, & Dieleman, 2002) while having less access to motorisation (Scheiner, 2010a), is solved in the case of Barcelona by a more frequent use of the local facilities. This same pattern can be observed on other social groups, as people with constrained mobility capacities and little time available tend to rely more on the proximity scale than others with more flexible frames.

The travel behaviour for occupational purposes of those without access to a car is particularly interesting, as they solve occupational mobility with a short walk on 16% of occasions, compared to 9% for car users. This speaks both of the land mix of Barcelona that has kept part of the jobs near residential places, but also, and more importantly, it also suggests that having jobs and schools closer to residential areas is an important factor in deciding not to own a private vehicle.

The relationship between transport and local travel can also be appreciated on the income factor. Studies have found that, in general terms, access to cars and travelled distances increases in parallel with income (Santos et al., 2013). Following this trend, what is observed in Barcelona is that lower income groups are using their nearby resources more often. More importantly, income seems to determine the spatial distribution with respect to where the activities are taken. Low income groups tend to locate their social relations closer, an idea previously expressed by Lazo (2012), Lazo & Jouffe (2010) and Ramadier (2002), that has direct implications on local identity, community engagement and social capital.

CHAID analysis has allowed visualizing the relations between the main variables, and how they affect the use of short walking journeys. The significance of the professional situation at determining proximity was an unexpected result that opens relevant public policy implications, especially in a country with a high unemployment rate such as Spain. These results are coincident with what Mercado and Paez (2009) found on unemployed seniors and also with the findings by Forsyth et al. (2009) on how unemployed people were more likely to walk for transport. To the best of our knowledge, however , it is the first time were unemployed people on working age are found as not only more prone to walk but also to prefer short trips.

The use of the CHAID model has also made evident the huge importance of having or not access to private transport on shaping travel behaviours. Even in a compact urban environment like Barcelona's, people with a car are much less prone to take a short walking trip than people without it. Again this is not a new finding, as the association between access to car and travel behaviour has been abundantly explored, but from a policy point of view it fully demonstrates that everyday mobility in Barcelona can be fulfilled without a car, and that most of the motorized trips could actually be converted to proximity short trips. It is thanks to having nearby destinations, that 37% of the population can live without a car without being at risk of social exclusion, as it happens in other urban areas (Lucas & Jones, 2012). In terms of policy, finding that more than a third of the population is using proximity trips to perform daily mobility, should encourage policy makers in Barcelona in its anti car efforts. In our opinion, in dense and compact cities like Barcelona, where proximity makes live without a car completely possible, sustainable ways of moving like short walking trips should be strongly promoted.

Caso de estudio 3:

Neighbourhood vitality and physical activity among the elderly: The role of walkable environments on active ageing in Barcelona, Spain[32]

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Neighbourhood vitality and physical activity among the elderly: The role of walkable environments on active ageing in Barcelona, Spain

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A B S T R A C T

This study investigated whether neighbourhood vitality and walkability were associated with active ageing of the elderly. Immobility, activity engagement and physical activity were explored in relation with age, gender and walkability of the built environment. Number of trips per day and minutes spent on walking by the elderly were extracted from a broad travel survey with more than 12,000 CATI interviews and were compared across vital and non-vital urban environments. Results highlight the importance of vital environments for elderly active mobility as subpopulations residing in highly walkable neighbourhoods undertook more trips and spent more minutes walking than their counterparts. The results also suggest that the built environment has different effects in terms of gender, as elderly men were more susceptible to urban vitality than elderly women.

1. Background

Like many European Countries, Spain faces the challenge of a rapidly ageing population. Having an old age dependency ratio of 26.3, the pace of ageing is much higher in Spain than in other countries, and it is projected that by the year 2050 its old age dependency ratio will be 26% higher than that of the EU28 (EUROSTAT, 2014). Barcelona's Metropolitan Region is no exception to that general dynamic and in 2013 it had 17.4% of its population older than 65 years, with an elder-child ratio of 107 (IDESCAT, 2013). Within the next 15 years, 22% of the population will be above 65 years of age and the elder-child ratio will be 147. The increase of the senior population, not only in Spain but all over Europe, has focused public health policies on the need to promote healthier mobility habits in favour of physical activity (PA) and activity engagement.

PA directly affects several health issues in the general population, all of which become more urgent in the age range of the elderly. The World Health Organization (WHO) identifies the lack of PA as the fourth global risk factor, globally accounting for 6% of deaths (World Health Organization (WHO), 2010). In general terms, more active individuals have lower mortality rates, in comparison with people who remain sedentary (Gregg et al., 2003; Stessman et al., 2009). Other demonstrated effects of the lack of PA are cardiovascular diseases, some types of cancer, arthritis and obesity (Ewing et al., 2014; Jongeneel-Grimen et al., 2014). According to the current recommendations, seniors should perform moderate-intensity PA, for at least 150 min throughout the week, which can be the result of adding shorter PA bouts (WHO, 2010). Over the past few years, there has been a great increase of studies linking PA with general health status (Ewing et al., 2014, 2008; Jongeneel-Grimen et al., 2014), and specifically with elderly mobility (Moniruzzaman et al., 2013; Páez et al., 2007; Hildebrand, 2003).

In terms of transportation, walking has been seen as the key for resolving most elderly problems related with PA. Walking for transport is a major source of physical activity, especially for people over 65 years of age who perceive the options for using other types of transport as being reduced (Balboa-Castillo et al., 2011). Walking is seen as a convenient, safe and adequate activity for seniors as it places the right amount of stress on joints in the human body (Moniruzzaman et al., 2013). The recognition of walking as a means of transport and as a source of moderate PA has led urban planners to focus on creating walkable environments that make active mobility more appealing (Clarke and Nieuwenhuijsen, 2009; Handy and Boarnet, 2002; Lamíquiz and López-Domínguez, 2015; Talavera-Garcia and Soria-Lara, 2015).

Furthermore, urban settings not only determine PA but also psychological wellbeing and mental health (Fujiwara and Kawachi,

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[32] Este caso de estudio fue publicado en el número 135 de la revista Social Science & Medicine. La versión completa y formateada del artículo se puede consultar en el anexo. La referencia completa de la publiación es la siguiente: Marquet, O., & Miralles-Guasch, C. (2015). Neighbourhood vitality and physical activity among the elderly: The role of walkable environments on active ageing in Barcelona, Spain. Social Science & Medicine, 135, 24–30. doi:10.1016/j.socscimed.2015.04.016

Neighbourhood vitality and physical activity among the elderly: The role of walkable environments on active ageing in Barcelona, Spain

Abstract:

This study investigated whether neighbourhood vitality and walkability were associated with active ageing of the elderly. Immobility, activity engagement and physical activity were explored in relation with age, gender and walkability of the built environment. Number of trips per day and minutes spent on walking by the elderly were extracted from a broad travel survey with more than 12,000 CATI interviews and were compared across vital and non-vital urban environments. Results highlight the importance of vital environments for elderly active mobility as subpopulations residing in highly walkable neighbourhoods undertook more trips and spent more minutes walking than their counterparts. The results also suggest that the built environment has different effects in terms of gender, as elderly men were more susceptible to urban vitality than elderly women.

Keywords: Spain; Active ageing; physical activity; active mobility; neighborhood vitality

1. BACKGROUND

Like many European Countries, Spain faces the challenge of a rapidly ageing population. Having an old age dependency ratio of 26.3, the pace of ageing is much higher in Spain than in other countries, and it is projected that by the year 2050 its old age dependency ratio will be 26% higher than that of the EU28 (EUROSTAT, 2014). Barcelona's Metropolitan Region is no exception to that general dynamic and in 2013 it had 17.4% of its population older than 65 years, with an elder-child ratio of 107 (IDESCAT, 2013). Within the next 15 years, 22% of the population will be above 65 years of age and the elder-child ratio will be 147. The increase of the senior population, not only in Spain but all over Europe, has focused public health policies on the need to promote healthier mobility habits in favour of physical activity (PA) and activity engagement.

PA directly affects several health issues in the general population, all of which become more urgent in the age range of the elderly. The World Health Organization (WHO) identifies the lack of PA as the fourth global risk factor, globally accounting for 6% of deaths (WHO, 2010). In general terms, more active individuals have lower mortality rates, in comparison with people who remain sedentary (Gregg et al., 2003; Stessman et al., 2009). Other demonstrated effects of the lack of PA are cardiovascular diseases, some types of cancer, arthritis and obesity (Ewing et al., 2014; Jongeneel-Grimen et al., 2014). According to the current recommendations, seniors should perform moderate-intensity PA, for at least 150 minutes throughout the week, which can be the result of adding shorter PA bouts (WHO, 2010). Over the past few years, there has been a great increase of studies linking PA with general health status (Ewing et al., 2014; Ewing et al., 2008; Jongeneel-Grimen et al., 2014), and specifically with elderly mobility (Moniruzzaman et al., 2013; Páez et al., 2007; Hildebrand, 2003).

In terms of transportation, walking has been seen as the key for resolving most elderly problems related with PA. Walking for transport is a major source of physical activity, especially for people over 65 years of age who perceive the options for using other types of transport as being reduced (Balboa-Castillo et al., 2011). Walking is seen as a convenient, safe and adequate activity for seniors as it places the right amount of stress on joints in the human body (Moniruzzaman et al., 2013). The recognition of walking as a means of transport and as a source of moderate PA has led urban planners to focus on creating walkable environments that make active mobility more appealing (Clarke & Nieuwenhuijsen, 2009; Handy & Boarnet, 2002; Lamíquiz & López-Domínguez, 2015; Talavera-Garcia & Soria-Lara, 2015).

Furthermore, urban settings not only determine PA but also psychological wellbeing and mental health (Fujiwara & Kawachi, 2008; Clark et al., 2007). Studies have demonstrated how mental health depends heavily on social capital (Bowling & Stafford, 2007) and resources that individuals can access through their networks (Fujiwara & Kawachi, 2008). For individuals above the age of 65 years, living in a vital and thriving urban environment may mean undertaking more trips, engaging in more activities (Hildebrand, 2003) and interacting with more people in their everyday life (Kuo et al., 1998; Kweon et al., 1998). All of the aforementioned contributes to increasing their social capital status while avoiding social exclusion processes derived from immobility (Hanibuchi et al., 2012; Richard et al., 2009; Leyden, 2003). The relation between built environment attributes and mental health condition is thus recognised through the number of activities which the elderly can perform within a walking distance.

Currently, there is enough empirical evidence to corroborate that the way neighbourhoods are designed influences walking behaviour (Villanueva et al., 2014). At an age where adults experience a reduction in functional capacities, the settings of the built environment become even more important, as they have the potential to either compensate the deficits in mobility capacity or to exacerbate mobility problems (Dujardin et al., 2014).

There are few articles that try to assess both the physical and mental health of the elderly through their use of active mobility. Most of the research is focused either on PA of seniors (Kerr et al., 2012; Lockett et al., 2005; Michael et al., 2014; Michael et al., 2006; Michael et al., 2010) or on the social capital status of seniors (Bowling & Stafford, 2007; Fujiwara & Kawachi, 2008; Hanibuchi et al., 2012; Leyden, 2003; Richard et al., 2009), without always realising that neighbourhood settings have the potential to determine both the modal choice of the trip (and thus the PA) and the number of trips that the elderly undertake, which relates with activity engagement. Furthermore, and as Sugiyama et al. (2014) suggest, limited variation in environmental attributes may be causing most non-significant or weak associations between neighbourhood environmental attributes with physical activity.

Hence, we believe that the analysis of how the built environment determines the health of seniors, through promoting active mobility, is far from being closed. Our study aims to understand how living in vital or non-vital urban areas can change the travel behaviour of the elderly along with the amount of PA that they are gaining from walking for transport.

Our view of urban vitality takes the seminal works of the American city activist, Jane Jacobs (1961), who measured the vitality of an urban area by using the walking activity on the streets as a reference. For Jacobs, the vitality of the streets was a product of the diversity of the built environment, and the presence of pedestrians served as an indicator of the city liveliness (Sung et al., 2013). We thus understand urban vitality as a synonym of vibrant environments and we measure this vitality, not from a set of morphological indicators (Aditjandra et al., 2012) nor as a personal well-being indicator (Guite et al., 2006; Richard et al., 2009), but through the observation of mobility patterns. Those areas where a large part of daily mobility is performed through short walking trips are labelled as vital areas. The presence of short walking trips characterises not only areas with a high intensity of pedestrians, but also by their proximity to services, amenities, and land use mix (Marquet & Miralles-Guasch, 2015b; Morency, Paez, et al., 2011), forming a particularly suitable urban environment for ageing populations (Marquet & Miralles-Guasch, 2014) and shaping what American urban planner Kevin Lynch understood was a place that supported the biological requirements and capabilities of human beings (Lynch, 1981, p. 118). Having pedestrians on the street increases the appeal of walking (Gehl, 2010) and the potential enjoyment of the trip (Gehl, 2011, p. 68), also making walking more attractive for the elderly. In contrast, areas where short walking trips are scarce often represent low-density built environments that offer neither proximate facilities nor vibrant street life for elderly walkers.

Comparing the health outputs of the elderly populations living in vital or non-vital areas can provide an idea of how much healthy mobility habits can be improved by investing in vital built environments.

2. SOURCES AND METHODOLOGY

In order to understand the determinants of physical activity and activity engagement for the ageing population, we need information sources where all types of daily trips are treated in the same way. Daily travel surveys, such as the one used for the present study are useful because of their homogeneous treatment, including all types of means of transport, trip purposes and journey durations. In this methodological section we intend to address both data sources and the reasons for choosing our population and territorial variables along with the methods of analysis.

2.1 Data Sources and measures

The study took place in Barcelona's Metropolitan Region (RMB), a 3,200 km2 metropolitan area located north-east of Spain, made up of 164 municipalities that gather a total of 4,635,5421 inhabitants. The region is strongly centralised within the Barcelona environment, but it gets polycentric, discontinuous and disperse as one moves away from the core of Barcelona (Muñiz & Galindo, 2005).

The main data source is a broad travel survey, Everyday Mobility Inquiry (ATM and GC 2006), that was performed in 2006 (hereafter, EMQ06) by the regional authorities in Catalonia (Spain). It aims to describe the mobility of the resident population of Catalonia with 106,091 Computer Assisted Telephone Interviews (CATI), out of which 45,184 were located in our area of study, Barcelona Metropolitan Region (RMB). The interviews were used to gather data regarding trips taken in a working day and also included some socioeconomic input about the interviewee.

Mobility data and variables, such as number of trips, modal choice, travel duration or physical activity related to transport per person were extracted from the EMQ06. However, other sources were needed to gather socioeconomic variables at the neighbourhood level, such as income or motorisation levels, and territorial variables like population density or land use distribution. Socioeconomic data were extracted from the official Statistics Institute of Catalonia (IDESCAT) and the official Statistics Service of Barcelona.

Our focus was set on the health-related aspects of travelling for the elderly population, particularly on the rates of change of healthy mobility habits that can be gained from moving from a non-vital area to a vital area. The study represents the built environment on its most local scale, which is consistent with the analysis of a population with low mobility potential (Prins et al., 2014). Health outcome variables are divided into activity engagement measures and physical activity measures. Firstly, immobility is a dichotomous proxy for activity engagement. In that, following a fairly common definition of immobility (Sikder & Pinjari, 2012), when a person claims not to have left the house the day prior to the interview, we consider it a case of immobility. Secondly, activity engagement is a continuous variable: number of trips made on the day prior to the interview. This variable provides the average number of trips in terms of age, gender and urban vitality. PA measures are expressed through two variables: modal choice and number of minutes spent on walking. All the results were stratified by gender (male/female), age (64-75 and >75 years) and urban vitality (vital or non-vital).

2.2 Study areas and population sample

Our target of study was that of the census population of citizens over 65 years of age. This large group was divided into two subgroups, consisting of Seniors (65-74 years of age) and Elderly Seniors (75 years of age and older). This distinction was necessary as travel behaviour changes with respect to the physical possibilities and moving capacities of the studied population (Kerr et al., 2012). Gender was also taken into account as males and females show very different modal choices as well as different allocations of travel times and trip purposes (Hanson, 2010; Miralles-Guasch et al., 2015). Having divided the older population by age and gender, we were able to analyse how the territorial settings and vitality of their built environment determined their travel behaviour and the total amount of physical activity they were gaining from transportation.

The neighbourhoods were sorted between vital and non-vital areas, vitality being measured through the frequency on which the general population of each study area were taking short walking trips. We used a 10 minute threshold to define a short trip, a temporal measure consistently used in previous transport studies (Ryley, 2008; Li et al., 2005). The general assumption was that the way in which the residents of each area were moving was indicative of the physical settings and walkability of the area. Furthermore, we hypothesised that a neighbourhood that enabled short walking mobility for the general population would also be encouraging for the active mobility of the elderly (Moniruzzaman et al., 2013).

On average, people in the Barcelona Metropolitan Region were using short walking trips for 27% of their everyday trips (standard deviation=9.6). We decided to label those study areas that had a use of short walking trips above the 31.8% (+1/2 SD from the average) as vital areas. Those vital areas had 15% more population density than the average, with a building typology consistent with attached dwellings with abundant commercial facilities (see Table 1). Conversely, those areas with less than 22.2% (-1/2 SD) of short walking trips were labelled as non-vital ones. These non-vital zones had lower population density (18% less than the average), higher average incomes and a land-use distribution which is dominated by single dwellings.

Assuming an average walking speed of 4 km/h (Duffy & Crawford 2013; Ritsema van Eck et al., 2005) these 10-minutes-or-less walking trips cover a maximum topological distance of 650 m. This means that urban areas where a great part of the daily mobility is performed through those types of trips are vital areas where the optimum mix of population density, land use distribution, built environment design and connectivity, are offering to its citizens the possibility to reach daily needs inside a proximate area (Marquet & Miralles-Guasch, 2015). The result of this procedure was the selection of the most- and least-walkable urban environments, by observing the travelling behaviour of the overall population, not just the seniors (see Table 1).

Table 1: Descriptive characteristics of vital and non-vital areas

Source: Own elaboration from EMQ06 data

	VITAL AREAS	NON VITAL AREAS	BARCELONA METROPOLITAN REGION
Sample	n (%)	n (%)	n (%)
Male	1420 (33.7%)	928 (22.1%)	4208 (100%)
Female	1387 (35.1%)	892 (22.6%)	3954 (100%)
Kids (4-11)	1877 (34.1%)	1244 (22.6%)	5507 (100%)
Young (12-15)	930 (35%)	576 (21.7%)	2654 (100%
Socioeconomics	Mean (IQR)	Mean (IQR)	Mean (IQR)
Municipality size	17839,9 (9769)	10324,6 (10625)	15678,9 (14405)
Average income	12901,6 (1814)	15469,5 (4638)	14297,7 (5270)
Vehicle/1000 hab	568,1 (333)	728,0 (226)	638,9 (140)
Population density	2456,4 (754)	1737,3 (768)	2133,9 (875)
Land Use distribution	Mean (Std Dev)	Mean (Std Dev)	Mean (Std Dev)
Single dwellings	10.9% (12.3)	36.2% (26.6)	21.1% (21.6)
Attached dwellings	59.4% (18)	24.5% (21.5)	44.2% (24.1)
Industrial land	14.1% (11.9)	24.0% (18.3)	19.1% (15.2)
Business facilities	1.9% (1.7)	3.8% (4.8)	2.8% (3.3)
Commercial facilities	7.4% (2.9)	3.3% (2.7)	5.6% (3.2)
Services facilities	6.4% (4)	7.5% (5.4)	6.7% (4.7)
Rural areas	0.1% (0.1)	0.7% (2.2)	0.2% (1.2)
Total	100 (-)	100 (-)	100 (-)

3. RESULTS

3.1 Trip frequency and activity engagement

The first measure of activity engagement has to be whether the person is mobile or immobile. Immobility is a major concern in ageing populations, when the natural decrease of personal physical capabilities forces the person to stay at home. The immobile person becomes dependant on others to fulfil their daily needs and this also prevents the person from fully participating in community life, increasing the chances of starting a process that moves towards social disadvantage or even social exclusion.

Of the total of 738,064 people older than 65 years of age and living in the metropolitan area, 114,399 (15.5%) declared not having made a single trip on the surveyed working day (see Table 2), when the general immobility ratio for the metropolitan region is set at 6.2%. Logically, this figure is strongly determined by age, because the immobility rate more than doubles itself as the 75 years old threshold (from 10.4% to 21.2%) is approached. Almost the same differences can be spotted in terms of gender, with 19.6% of females suffering from immobility against 9.6% of men.

The importance of the vitality of the area was also found significant, with a positive correlation between urban vitality and immobility (r=0.043, p<0.001). Areas with higher vitality have less immobility in every age and gender category. Also, the figures for the non-vital areas are found to be significantly higher in all but one category. The impact of living in vital or non-vital areas is strongest on the elderly seniors, where it can pose a change of 18% in the number of immobile individuals. The most important differences are found in the case of male elderly seniors where nearly 20% of those who live in non-vital areas are immobile, compared with 13% of those living in vital areas. Furthermore, the population subgroup where immobility is more frequent is that of female elderly seniors, where more than a quarter of the population (25.5%) are not taking a single trip. In this group, the vitality of the neighbourhood is found to be significant at explaining lower values of immobility (23.4%).

Table 2: Percentage of non-mobile population by gender age and area type

Gender	Age group	Area type (%)			
		Vital (a)	Non-Vital (b)	*Total*	Differences (a-b)
Men	Senior 65-74	**6.5**	8.2	6.8	+26.2%
	Elder Senior >75	13.4	19.7	13.5	+47.0%
	Total	**9.1**	13.3	9.6	+46.2%
Women	Senior 65-74	13.8	13.8	13.3	0
	Elder Senior >75	**23.4**	25.6	25.5	+9.4%
	Total	**18.5**	20.3	19.6	+9.7%
Total	Senior 65-74	10.4	11.1	10.4	+6.7%
	Elder Senior >75	**19.8**	23.4	21.2	+18.2%
	Total	**14.6**	17.3	15.5	+18.5%
	Population	*277,954*	*136,047*	*414,001*	

Source: own elaboration from EMQ06
Test: Chi^2 sig=000 all categories; Adjusted residuals test, corrected.
In gray shading: significantly higher values
Bold: significantly lower values
** Non-significant data, insufficient sample frequency per cell

The relation between age and number of trips is significant (χ^2=464.5 p<0.001), as well as the relation between gender and number of trips (χ^2=379.8 p<0.001). After these two main relations, the settings of the built environment are also found to be significant (χ^2=56.320 p<0.001). As shown in Table 3, the average senior on the metropolitan region undertakes 2.99 trips a day, but gender, age and location determine the exact rate of daily trips made by each population subgroup. As a constant, in vital neighbourhoods, people are taking more trips than in other areas. This increase does not change significantly in terms of age, as the differences are very similar when we compare Seniors (1.066 ratio) and Elderly Seniors (1.064 ratio). The significant differences are found for the gender variable. In general, women with more than 65 years of age take 21% less trips than men of the same age, but where a Senior male (65-74 years of age) is making 3.69 trips a day, a Senior female is making only 3.08 trips a day. The same trend is reproduced on the Elderly Senior category (3.02 vs. 2.33, respectively). Even more relevant, the number of total trips taken by Males is more affected by the vitality of the neighbourhood than those taken by women. Men living in a vital and proximate neighbourhood are taking 11.3% more trips than men who live in non-vital areas (1.127 ratio). In contrast, the trip rates for women are steady despite the territorial settings, and living in a vital area entails only making 4.1% more trips than those people who live in non-vital areas.

Table 3: Number of trips by gender age and area type

Gender	Age group	Area type			
		Vital (a)	Non-Vital (b)	*Total*	Differences (a-b)
Men	Senior 65-74	3.84	3.46	3.69	+9.9%
	Elder Senior >75	3.12	2.79	3.02	+10.6%
	Total	3.56	3.16	3.41	+11.3%
Women	Senior 65-74	3.04	2.96	3.08	+2.4%
	Elder Senior >75	2.40	2.32	2.33	+3.0%
	Total	2.72	2.61	2.70	+4.1%
Total	Senior 65-74	3.41	3.20	3.36	+6.2%
	Elder Senior >75	2.66	2.50	2.58	+6.1%
	Total	3.08	2.97	2.99	+7.5%

Source: own elaboration from EMQ06
Test: Chi^2 sig=000 all categories; Adjusted residuals test, corrected.
** Non-significant data, insufficient sample frequency per cell

3.2 Walking as a mode choice

Living in a vital or non-vital area has profound implications on transport behaviour in general, and particularly on modal choice. Table 4 shows the relationship between the characteristics of the urban area where seniors are living and the use of walking, public transport and private transport, with data being stratified by gender ($p < 0.001$). Overall, the senior population in the RMB is walking for transport for nearly 7 out of 10 journeys (69.8%) (χ^2=741.916 p<001). Public transport is used on 17.3% of occasions, leaving private transport to account for 12.9% of trips. The vitality of the urban area appears to be just as relevant in determining all three travel modes. Its effects on walking are particularly strong, as those who live in vital areas are compelled to walk for 76.7% of their trips, 6.9 points higher than the total average. Their counterparts living in non-vital areas are using walking for transportation on only 56.8% of their trips, which means 13 points less than the total average. Also found to be significant, is the utilisation of public and private transport. The use of these means of transport is constantly higher on non-vital areas, to a degree that varies from 13 to 18 percentage points from the total average. The characteristics of the urban area where the trip does take place have nearly identical effects, for either men or women. However, the same gendered differences that can be found throughout other ages are also reproduced in seniors, as men are using private transport more often than women, whether they live in vital or non-vital areas. These gendered differences are slightly stronger in non-vital areas, where women report walking 2 percentage points less than men, but are using private transport 10.2 points less. Also, the effect of the urban environment is stronger in women (χ^2=432.127 $p<0.001$) than in men (χ^2=330.127 $p<0.001$).

Table 4: Modal choice by gender and muncipality type

Gender	Age group	Area type (%)			
		Vital (a)	Non Vital (b)	*Total*	Differences (a-b)
Men	Walking	75.2	**55.8**	67.9	+25.8%
	Public Transport	**10.8**	18.5	14.5	-71.3%
	Private transport	**14.0**	25.7	17.6	-83.6%
	Total	100	100	100	-
Women	Walking	78.1	**57.8**	71.5	+26.0%
	Public Transport	**15.2**	26.7	19.8	-75.7%
	Private transport	**6.6**	15.5	8.8	-134.8%
	Total	100	100	100	-
Total	Walking	76.7	**56.8**	69.8	+25.9%
	Public Transport	**13.1**	22.8	17.3	-74.0%
	Private transport	**10.2**	20.3	12.9	-99.0%
	Total	100	100	100	-

3.3 Physical Activity and WHO recommendations

It is through this increased ratio of walking journeys, that the urban environment expresses its effect on the overall physical activity of the resident senior population. We have seen how seniors choose to walk for transport more often in vital areas. But, how does this correlate with the actual minutes spent on walking and by extension on their physical activity?

Our main hypothesis was that, living in a vital or non-vital environment created a significant difference, not only on the number of walking trips, but also on the number of minutes invested in walking for transport. In order to test the hypothesis, an independent samples t-test was performed, the results of which were the realisation that the relationship actually existed between variables ($t=69.12$; $p<0.001$). Numerically, this relationship can be seen in Table 5. The general trend, as also noted for the number of trips, is that men walk more minutes than women (86.6 vs. 57.7, respectively), and that seniors also do so in comparison with elder seniors (76.4 vs. 63.0, respectively).

Overall, living in a vital environment is equivalent to walking 4.8 more minutes than living in a non-vital environment.. Differences, however, are particularly gendered, as the physical activity of men appears to be highly dependent of the vitality of the neighbourhood. For male Seniors (65-74 years of age) the differences can be up to 16 minutes less a day, although these differences are attenuated on the male Elderly Seniors (>75 years of age) for which there is only a 3 minute difference between vital and non-vital neighbourhoods. In contrast, women appear to draw contradictory results.

Table 5: Average minutes spend on walking by gender, age and area type

GENDER	AGE GROUP	AREA TYPE			
		Vital (a) (Minutes)	Non Vital (b) (Minutes)	Total (Minutes)	Differences (a-b) (Minutes)
Men	Senior 65-74	102.0	86.2	94.0	+15.8
	Elder Senior >75	74.9	71.8	76.4	+3.1
	Total	91.6	80.3	86.6	+11.3
Women	Senior 65-74	61.1	55.5	61.0	+5.6
	Elder Senior >75	51.1	57.6	54.2	-6.5
	Total	56.6	56.6	57.7	0
Total	Senior 65-74	80.8	71.3	76.4	+9.5
	Elder Senior >75	60.7	63.0	63.0	-2.3
	Total	72.1	67.3	70.3	+4.8
	Population	277,954	136,047	414,001	

Source: own elaboration from EMQ06
Test: Chi2 sig=000 all categories; Adjusted residuals test, corrected.
** Non-significant data, insufficient sample frequency per cell

Following the established link between physical activity, urban vitality and walking for transport, one can relate the characteristics of the neighbourhood with how people perform, in accordance with the WHO physical activity standards. In Table 6, we demonstrate how the different sample subgroups get to the recommended threshold of 30 minutes walked per day, which would correspond to 30 minutes of moderate physical activity. As expected, there is a strong statistical significance between achieving the recommended amount of daily physical activity and the area vitality (χ^2=2005.977 p<0.001). Numerically, these differences mean that in all the sample groups, those who lived in vital areas were more prone to achieving the recommendations than their counterparts living in non-vital areas. The higher differences can be found in Males, for whom the area vitality can mean a 35.4% difference. Female differences are lower (25.1%), but they consistently fail to achieve the WHO minimums as, even in vital urban areas, only 37.4% of them are walking more than 30 minutes every day.

Table 6: Percentage of population over 30 min walking by gender, age and area type

Table 6. Percentage of population under > 30 min walking by gender, age and area type

Gender	Age group	Area type (%) Vital (a)	Non Vital (b)	*Total*	Differences (a-b)
Men	Senior 65-74	58.4	**43.6**	51.7	+33.9%
	Elder Senior >75	48.7	**36.4**	48.3	+33.8%
	Total	54.7	**40.4**	49.3	+35.4%
Women	Senior 65-74	41.1	**28.2**	39.5	+45.7%
	Elder Senior >75	33.7	**31.2**	33.6	+8.0%
	Total	37.4	**29.9**	35.6	+25.1%
Total	Senior 65-74	49.2	**35.6**	43.6	+38.2%
	Elder Senior >75	39.1	**33.1**	38.8	+18.1%
	Total	44.7	**34.3**	41.3	+30.3%
	Population	*277,954*	*136,047*	*414,001*	

Source: own elaboration from EMQ06
Test: Chi[2] sig=000 all categories; Adjusted residuals test, corrected.
In gray shading: significantly higher values
Bold: significantly lower values
** Non-significant data, insufficient sample frequency per cell

4. DISCUSSION

This study explored whether urban vitality is associated with PA and activity engagement of the elderly. We found that the elderly living in thriving areas are less immobile, take more trips per day, choose walking as a means of transport more often and also walk for more minutes than those who live in non-vital areas.

In contrast with the results of Forsyth et al. (2009), our results clearly demonstrate how the environment has different effects on different social groups, especially in terms of age and gender. The general trend is that the role of the built environment in modifying PA and travel behaviour is exacerbated as age grows, but most importantly, we found that the results were also gender related, as men were more affected by the settings of the built environment than women. The importance of the gender variable among elderly

PA remains heavily understudied. Only some studies, such as those by Bauer et al. (2003) and Gregg et al. (2003) examined the specific travel patterns of older women, although not specifically the gender differences with men. In contrast, Hakamies-Blomqvist & Siren (2003) did indeed examine gender differences, but only focused on the driving cessation issue.

The results of this study have demonstrated that the lack of urban vitality is consistently found as significant to explain higher immobility cases in the elderly of all ages and gender (see Table 2). Also noteworthy, results have shown that urban vitality does not always mean a low immobility ratio, as there are several other factors at play. As Schwanen & Paez (2010) suggest, the reduction and cessation of driving, as a result of a decrease on the corporeal capacities, has a significant impact on mobility patterns of elderly (Harrison & Ragland, 2003), especially when a non-walkable urban environment offers no alternatives. In the Barcelona Metropolitan Region 49.8% of people between 65-74 years of age still have a driving licence, whereas only 25% of people older than 75 years of age still have one. Besides being a symbol of becoming old, not being able to drive makes elderly become increasingly dependent on the potential of their neighbourhood. That is why the differences between immobility in vital and non-vital environments are exacerbated above the age of 75 years, when car use drops due to age. Our results suggest that immobility numerically affects women more than men, but at the same time reveal that men are more subject to the characteristics of the built environment. These may be in line with the findings of Bauer et al. (2003), as women, who have lived with lower motorisation rates than men, tend to adapt better to life after the car, and are less dependent on the potential of their built environment. Overall, the loss of mobility capacities entails a loss of control over their own lives along with a fear of becoming a burden to families and with losing social capital.

This study has also found that seniors living in vital urban areas are making more trips than those who live in non-vital ones, which means that they are also engaging in more activities (see Table 3). Hence, it can be stated that living in vital urban areas is helping their mental health, as performing more activities has been positively associated by Putnam (2000, p. 328) and Pollack & Knesebeck (2004) with general health and well-being. Results also show that trip frequency decreases with age, both in vital and non-vital areas, as men and women equally reported a drop in their daily trips as they grew older. This findings are in line with those by Giuliano (1999) and, more recently, by Paez et al. (2007) and Petterson and Shmoker (2010). Our results, however, go further and suggest that elderly women take fewer trips than elderly men and also, most importantly, that as in the case of immobility, living in a vital or non-vital area also had a greater effect on trip frequency for men than for women.

The degree upon which these trips are converted onto PA depends on how often the elderly are choosing walking as a means of transport. Walking is 20% more frequent in vital areas than in non-vital areas, which effectively links neighbourhood walkability with actually walking for transport (see Table 4). In all the comparisons between identical seniors (same age and same gender) those who live in vital neighbourhoods report walking more often than those who live in non-walkable neighbourhoods. This is fully consistent with what Villanueva et al. (2014) and McCormack et al. (2014) have recently found in population subgroups of all ages and also what King et al. (2011) found, specifically on population groups above the age of 65 years. This preference for walking in vital environments makes residents in these areas report nearly 5 more minutes of PA every day. In terms of weekly PA, there is a 34-minute difference between residents of vital and non-vital areas, which locates our results on the higher range of the 22-40 minute span reported by King et al. (2011).

Overall, 41.3% of the elderly in the Barcelona Metropolitan Region reach the WHO recommended 30 minutes of PA per day. This figure is far better than the one found by Pucher et al. (2011) with respect to the US and also higher than the 28.2% found by Buehler et al. (2011) with respect to Germany. Living in a vital urban environment improves the chances of reaching the WHO threshold, as 44.7% of the seniors inhabiting these areas walk for more than 30 minutes per day. The fact that urban vitality positively affects PA in all gender and age combinations is encouraging, towards designing public health interventions through urban policy, as actions taken in the urban environment positively affect all mobility habits of the elderly.

Taken globally, these results suggest that the hypothesis upon which urban vitality entails higher physical activity and activity engagement can be fully sustained. Furthermore, these results confirm the hypothesis that living in vital urban environments contributes to building healthy mobility habits, as the proximity to facilities and having people walking on the street encourages the elderly to make more trips which involve walking more often. Finally, it is also interesting to note how gender accounts for more differences than age itself, when most of the literature focuses on the ageing process as the main game changer for elderly mobility. The specific findings on how urban vitality and the settings of the built environment have different effects on men and women, opens future lines of research and may lead to recommending integrating gender on studies of the elderly on a regular basis.

<u>Caso de estudio 4:</u>

Introducing urban vitality as a determinant of children's healthy mobility habits. A focus on activity engagement and physical activity[33]

[33] Este artículo fue entregado a la revista Children's Geographies y actualmente se encuentra en proceso de revisión.

Introducing urban vitality as a determinant of children's healthy mobility habits. A focus on activity engagement and physical activity.

Abstract:

In this study we introduce urban vitality as a determining factor for both physical activity and activity engagement in children living in Barcelona's Metropolitan Region. We compare the physical outcomes of children living in vital and non-vital areas using mobility data taken from a travel survey. Chi-square, and association tests were used to compare the health outcomes of children living in vital and non-vital areas. Specifically, we measured for activity engagement, walking for transport, minutes of physical activity and adequacy to WHO Physical Activity recommendations. Results are stratified by age and gender and reveal how living in a vital area can produce up to 54 minutes more of physical activity per week, with a difference of nearly 20% in the number of outdoor activities undertaken. Neighbourhood vitality promotes healthier mobility habits, as children living in buzzing areas tend to engage in more activities and spend more minutes walking for transport.

1. INTRODUCTION

Over the past years there has been an increase in research concerning the environmental determinants of public health particularly on selected vulnerable social groups such as children (Rothman et al. 2014). While the links between urban environment and the amount of Physical Activity (PA) gained from walking for transport have been intensely studied (Carroll-Scott et al., 2013), other aspects of public health such as activity engagement have yet to be properly explored (Sener et al., 2008).

With respect to physical activity, WHO (2010, p. 19) advises that children between 5-17 years of age should engage in 60 minutes a day of moderate to vigorous intensity PA in order to avoid future health problems related with morbidity, cardiovascular diseases and diabetes (Bringolf-Isler et al., 2015; Galvez, Meghan, & Yen, 2011). Non-motorized transport has been identified as a significant source of such PA in multiple studies (Faulkner,et al,, 2009; Marquet & Miralles-Guasch, 2015a; Mitra, 2013; Sandercock,et al., 2010). Besides PA, activity engagement is also of paramount importance for children's health and early development (Janssen & Leblanc, 2010). Out-of-home activities are crucial to improvement of children's cognitive development and social behaviour (Sener et al., 2008), hence, experts agree that the main enemy of children's public health is sedentary in-home behaviour generally related with long periods spent watching television in a passive mode. Additionally, several studies have also analysed the importance of modal choice in activity engagement, and have found walking to be the best mode of transport for children (Mackett, et al., 2005).

Children's mobility habits are specially dependant towards their built environment (Baylina, Ortiz, & Prats, 2008) as they are attached to their parent's modal choice up to the moment when they become mobility independent when they become exclusively reliant on non-motorized and public means of transport. For this reason, in recent years the study of the built environment as a catalyst of walking for transport has gained momentum (Carver et al., 2013). The general assumption is that closer distances, intense land use mix, optimal connectivity designs and safer streets can promote both children's number of minutes spent on walking for transport (van Loon et al., 2014; Vanhelst et al., 2013) and their independent mobility (Villanueva et al., 2013) concomitant with their being allowed an increasing number of out-of-home activities.

This paper focuses on three main factors of children's public health - physical activity, modal choice and activity engagement - and aims to analyse how the urban vitality of the streets - as a fundamental part of the built environment - affects children's health outcomes. In this case, urban vitality is measured as the number of short walking trips registered in an area. The hypothesis is that, an environment where people perform a large part of their daily mobility through short walking trips may also be a suitable walkable environment for children. In vital areas the built environment allows a high degree of everyday mobility to be conducted through walking, typically through a combination of (I) the proximity of origins and destinations (Grasser, et al., 2013), and (II) the existence of an appealing built environment and the co-presence of other pedestrians and walkers-by (Marquet & Miralles-Guasch, 2014). At the same time, urban vitality in the streets creates safer environments for children to travel on their own, increasing the possibilities not only of increasing the number of activities but also of becoming mobility independent (Brown et al., 2008). The combination of both factors - walkable built environment and walker's co-presence - should promote walking for transport for all ages, but is especially important for children, where walking is a significant source of PA.

Therefore the aims of the study were (1) to assess the importance of neighbourhood vitality in children's mobility habits, and (2) to quantify the influence of urban vitality in terms of physical activity and activity engagement, while contributing to raising awareness on the importance of design and urban planning on public health issues. Furthermore, the present paper is aimed as an answer to the lack of studies on children and young people's PA outside the USA, the UK and Australia, and may provide some answers on how children cope with the specific characteristics of the European Mediterranean cities, characterised by their high densities and proximity dynamics (Dura-Guimera, 2003; Lake et al., 2010, p. 82).

2. METHODS

2.1 Study design

The study took place in the Barcelona Metropolitan Region (RMB), a 3,200 km2 metropolitan area located north-east of Spain, and made up of 164 municipalities that gather a total of 4,635,5421 inhabitants. We use a broad travel survey under the name of EMQ06 as a main data source. The survey was undertaken in year 2006 by the regional authorities in Catalonia (Spain), aiming to describe the mobility of the resident population, and consists of 106,091 Computer Assisted Telephone Interviewing (CATI) procedures, out of which 45,184 were located in the study area, the Barcelona Metropolitan Region (RMB).

2.2 Population and measurements

Our target of study was that of the census population of Children below 16 years of age and the focus was set on the health-related aspects of travelling for Children in the Metropolitan Area. The total sample consisted on 8162 interviews, 5508 of them with children between 4-11 and 2654 with children between 12-15. The number of minutes spent on walking for transport was used as a proxy for PA, whereas the average number of trips taken on a single day represented the number of activities on which they engaged. Acknowledging that walking is not children's only source of PA, we analysed how many children reached 30 minutes (half of the total amount of PA recommended by the WHO) of walking for transport, assuming that the other half might come from other activities. Using a complete travel survey allowed us to gather and examine all the trips performed by children, including all kinds of purposes and destinations.

All the results were stratified by age (4-11 and 12-15 years), gender (male/female) and vitality of the urban environment in which they lived (vital or non-vital). Stratifying children in two age groups (4-11 and 12-15 years) corresponds to the change between primary and secondary school in Catalonia. It is a particularly appropriate division as it represents a major change in a children's life stage that has been found consistently associated with changes in mobility habits, particularly on children's autonomy (Carver et al., 2013). Gender for its part has been consistently found to shape particular mobility differences both on younger children (Brown et al., 2008) and adolescents (Kerr et al., 2007).

2.3 Statistical Analysis

The aim of the study was to quantify the differences in healthy mobility habits in vital and non vital environments. Values are reported as means for continuous variables and percentages for categorical variables. Descriptive analyses of personal characteristics were performed for the whole sample, and were stratified by area vitality. The mobility habits of the inhabitants of vital and non-vital environments were compared by age and gender using the Chi-Square or t-test. Additionally, we use odds ratio as a measure of statistical association between the variables to quantify how strongly the presence or absence of urban vitality is associated with the presence or absence of healthy mobility habits. All statistical analysis were performed using IBM SPSS v19 for Windows.

3. RESULTS

3.1 Study areas

The neighbourhoods were sorted between vital and non-vital areas, vitality being measured through the frequency with which the general population (>17 years of age) of each study area was taking short walking trips inside the area. On average, people in the Barcelona Metropolitan Region were using short walking trips for 27% of their everyday trips (standard deviation=9.6). We decided to label those study areas that had a use of short walking trips above the 31.8% (+1/2 SD from the average) as vital areas. Those vital areas had 15% more population density than the average, with a building typology consistent with attached dwellings with abundant commercial facilities (see Table 1). Conversely, those areas with less than 22.2% (-1/2 SD) of short walking trips were labelled as non-vital ones. These non-vital zones had lower population density (18% less than the average), higher average incomes and a land-use distribution which is dominated by single dwellings. To define a short trip, a 10 minute threshold was established, as has been previously set by other transport studies (Li et al., 2005; Ryley, 2008). The specific socioeconomic and land use characteristics of vital and non-vital areas can be found in Table 1.

The presence/absence of short walking trips was used as a proxy for the built environment's walkability levels as people can only use this kind of proximity trip in urban areas with a good combination of density, land use mix and provision of services (Marquet & Miralles-Guasch, 2015b). These kinds of urban areas are offering their citizens the possibility to reach daily needs inside a proximate area. The result of this procedure was the selection of the most- and least-walkable urban environments, by observing the travelling behaviour of the overall population.

By comparing travel behaviours and PA levels on vital and non-vital areas, this study is able to represent the built environment on its most local scale, which is consistent with the analysis of a population with low mobility potential such as children or older age population (Marquet & Miralles-Guasch, 2014; Prins et al., 2014).

Table 1. Descriptive characteristics of vital and non-vital areas
Source: Own elaboration from EMQ06 data

	VITAL AREAS	NO VITAL AREAS	BARCELONA METRO-POLITAN REGION
Sample	n (%)	n (%)	n (%)
Male	1420 (33.7%)	928 (22.1%)	4208 (100%)
Female	1387 (35.1%)	892 (22.6%)	3954 (100%)
Kids (4-11)	1877 (34.1%)	1244 (22.6%)	5507 (100%)
Young (12-15)	930 (35%)	576 (21.7%)	2654 (100%
Socioeconomics	Mean (IQR)	Mean (IQR)	Mean (IQR)
Municipality size	17839,9 (9769)	10324,6 (10625)	15678,9 (14405)
Average income	12901,6 (1814)	15469,5 (4638)	14297,7 (5270)
Vehicle/1000 hab	568,1 (333)	728,0 (226)	638,9 (140)
Population density	2456,4 (754)	1737,3 (768)	2133,9 (875)
Land Use distribution	Mean (Std Dev)	Mean (Std Dev)	Mean (Std Dev)
Single dwellings	10.9% (12.3)	36.2% (26.6)	21.1% (21.6)
Attached dwellings	59.4% (18)	24.5% (21.5)	44.2% (24.1)
Industrial land	14.1% (11.9)	24.0% (18.3)	19.1% (15.2)
Business facilities	1.9% (1.7)	3.8% (4.8)	2.8% (3.3)
Commercial facilities	7.4% (2.9)	3.3% (2.7)	5.6% (3.2)
Services facilities	6.4% (4)	7.5% (5.4)	6.7% (4.7)
Rural areas	0.1% (0.1)	0.7% (2.2)	0.2% (1.2)
Total	100 (-)	100 (-)	100 (-)

3.2 Activity engagement and number of trips

On average, children under 16 years of age are making 4.12 trips per day, but there are important differences depending on where they live (Table 2). Those living in vital areas are making up to 18.6% more trips that those who live in non-vital neighbourhoods. In terms of age, differences caused by the vitality of the built environment are stronger in younger kids (4-11 years; 19.8%) than on the 12-15 age range (16.2%).

The fact that from 11 years of age children start to become mobility independent is expressed by the 8.5% difference on daily trips between kids (4-11 years) and youngsters (12-15 years). As they become increasingly independent the role of the built environment changes from determining the modal choice of their parents to determining their own possibilities of mobility. That is why vital areas consistently foster a higher number of out-of-home activities, either on kids between 4-11 years of age and youngsters between 12-15 years of age, even when their mobility capacities are different.

Finally, the gender factor starts to be an important behaviour changer in the Young (12-15 years) age group. Girls of this age appear to be less susceptible to the area's vitality, with only 13.1% difference on the number of trips that vital and non-vital residents are taking, but in contrast, the difference with male data is consistently close to 19.6%.

Table 2. Average number of trips by gender, age and area type
Source: own elaboration from EMQ06

GENDER	AGE GROUP	AREA TYPE			
		Vital (a)	**Non-Vital** (b)	***Total***	**Ratio** (a/b) (%)
Male	Kids 4-11	4.34	3.62	3.98	1,199
	Young 12-15	4.63	3.87	4.47	1,196
	Total	4.43	3.70	4.14	1,197
Female	Kids 4-11	4.26	3.56	3.99	1,197
	Young 12-15	4.57	4.04	4.33	1,131
	Total	4.37	3.72	4.09	1,175
Total	Kids 4-11	4.30	3.59	3.98	1,198
	Young 12-15	4.60	3.96	4.41	1,162
	Total	4.40	3.71	4.12	1,186

Test: Chi2 sig=000 all categories; Adjusted residuals test, corrected.

** Non-significant data, insufficient sample frequency per cell

3.3 Modal choice

The area vitality deeply determines the modal choice kids and youngsters are using for their daily mobility as not only determines their own modal choice but also that of their parents from which they are heavily dependent. Table 3 shows the relationship between the vitality of the urban area where children are living and the use of walking, public transport and private transport with data being stratified by age ($p < 0.001$). Overall in the metropolitan area, children are walking for the 65.7% of their trips, but in this case, walking is found consistently linked with vital areas in both age groups analysed (χ^2=2225.997; Cramer's V=0.195; $p<0.001$). Having a walkable environment is making children walk for nearly 8 out 10 of their trips on vital areas, which is a 13% higher frequency than the metropolitan average and 36% higher than the average on the non-vital areas. Living in a walkable environment also lowers the use of public transport and most importantly, the use of private transport. In contrast, on non-vital areas walking is not even the most common mode of transport for kids between 4-11 years of age, whereas for youngsters between 12-15 years of age it retains the first position despite being 23 percentage points below the metropolitan usage average.

Table 3. Modal choice by gender and municipality type
Source: own elaboration from EMQ06

AGE	MODAL CHOICE	AREA TYPE (%)			
		Vital (a)	**Non-Vital** (b)	**Total**	**Ratio** (a/b) (%)
Kids 4-11	Walking	*77.9*	**40.8**	64.1	1,909
	Public Transport	**5.0**	*10.6*	7.5	0,472
	Private transport	**17.1**	*48.6*	28.3	0,352
	Total	100	100	100	1,000
Young 12-15	Walking	*80.1*	**45.2**	68.5	1,772
	Public Transport	**6.8**	*21.9*	11.5	0,311
	Private transport	**13.1**	*32.9*	20.0	0,398
	Total	100	100	100	1,000
Total	Walking	*78.7*	**42.3**	65.7	1,861
	Public Transport	**5.6**	*14.4*	9.0	0,389
	Private transport	**15.7**	*43.3*	25.4	0,363
	Total	100	100	100	1,000

Test: Chi2 sig=000 all categories; Adjusted residuals test, corrected.
italics: significantly higher values
Bold: significantly lower values

** Non-significant data, insufficient sample frequency per cell

This distinct use of walking for transport also affects the use of public and private transports. Kids (4-11 years of age) living in non-vital areas tend to compensate their lower use of walking by increasing their use of private transport to the point that nearly half of all their trips have to be made by car. For youngsters (12-15 years of age), these differences are attenuated through the use of public transport. As kids become increasingly independent on their parents they diminish their use of private transport and increase the use of public transport. In vital areas, the drop in the use of private vehicles that comes from becoming mobility independent is mainly being assumed by walking for transport, as public transport increases only by 1.8 percentage points. In contrast, in non vital areas, where walking is not always available, the 15 point drop in the use of private transport is being assumed nearly exclusively by public transport with an increase of 11.3 points.

The vitality of the urban areas is thus affecting the modal choice by making walking available for children of all ages. The deficit of walking facilities in non-vital environments is solved by an increased use of private transport by kids between 4-11 years of age, whose mobility is dependent of their parents, and with an increase in the use of public transport in youngsters between 12-15 years of age, when they progressively become mobility independent. Overall, the effect of the urban vitality on modal choice appears to be stronger in 4 to 11 year kids (χ^2 =1518.147; Cramer's V=0.201 $p<0.001$) than in 12 to 15 year youngsters (χ^2=742.837; Cramer's V=0.190; $p<0.001$).

When the odds ratio of walking are calculated (Table 4) we can see that walking in a vital areas is 1.9 times more probable than any other forms of transport, this relationship being slightly higher in youngsters of 12-15 years of age. In contrast, in non-vital areas, the odds of walking are 0.379 where compared with the odds of non-walking for any given trip.

Table 4. Odds ratio modelling the probability of walking on a trip

Source: own elaboration from EMQ06

AREA TYPE	AGE	OR	95% IC
Vital Areas		1.911	(1.849;1.976)
	4-11 years	1.928	(1.851;2.008)
	12-15 years	1.879	(1.774;1.989)
Non-vital Areas		0.379	(0.364;0.395)
	4-11 years	0.376	(0.357;0.396)
	12-15 years	0.386	(0.360;0.414)

3.4 Physical activity

When we transform the role of walking in the overall daily mobility into actual physical activity gained from transport in Table 5, we can see how living in vital and non-vital areas modifies the total number of minutes that children spend on walking. Additionally, in Table 4 we have added the proportion that these minutes represent in relation to the overall minutes spent on travelling.

Table 5. Average minutes spent on walking by gender, age and area type

Source: own elaboration from EMQ06

		AREA TYPE (%)					
		Vital (a)		**Non-Vital** (b)		**Total**	
AGE	GENDER	Min walking	% of min travelling	Min walking	% of min travelling	Min walking	% of min travelling
Kids 4-11	Male	36.3	67.8%	30.7	54.6%	33.9	63.0%
	Female	43.0	74.3%	29.4	57.9%	37.2	67.4%
	Total	39.6	71.1%	30.0	56.1%	35.5	65.2%
Young 12-15	Male	48.1	72.9%	42.6	59.6%	47.2	67.3%
	Female	49.8	76.5%	47.7	65.3%	48.3	71.2%
	Total	48.6	74.7%	45.3	62.7%	47.8	69.2%
Total	Male	40.2	69.9%	34.4	56.4%	38.5	65.1%
	Female	45.4	75.2%	35.5	61.3%	41.0	69.0%
	Total	42.8	72.6%	35.0	58.8%	39.7	67.0%
Population		*277,954*		*136,047*		*738,064*	

Test: Chi2 sig=000 all categories; Adjusted residuals test, corrected.

** Non-significant data, insufficient sample frequency per cell

What clearly stands out from Table 5 is that whatever the age of the children, their gender or the vitality of the area in which they live, they are being pedestrians for most of their travelling times. The average child invests 67% of his/her travel time in walking, and even the group with less prevalence of walking (i.e. male kids between 4-11 years of age and living in non-vital areas) is spending more than half of their travelling time on walking (54,6%). Despite that, living in a vital/non-vital area entails a 13.8 point differential on the travel time spent on walking.

In terms of actual minutes, the average time of physical activity gained from walking in the Barcelona Metropolitan Region is 39.7 minutes per day, which covers 67% of the total PA recommended by the WHO. The consistent fact on Table 4 is that children on vital areas walk more minutes (42.8) than those who live in non-vital areas (35). Also, their share of travelling time that is invested in walking is always bigger in vital areas than in non-vital ones. The difference between an average kid living in a vital area and one living in a non-vital one is equivalent to 7.8 walking minutes a day, and equals to 54.6 more minutes of physical activity every week.

Walking time, however, is significantly different between kids from 4 to 11 years of age and youngsters from 12 to 15 years of age. Rather obviously, little kids walk less minutes (35.5) than young ones (47.8), but most importantly, data show that they also spend less of their travelling time on walking (65,2%) than the Young (69.2%).

In terms of gender, the built environment vitality appears to be especially important for female travel patterns. Females between 4 and 11 years of age can experience a 13.6 minute difference depending on the vitality of their residential area when boys of the same age only show a 5.6 minute difference. However, these gender differences are attenuated on the youngsters, where the behaviour of males and females towards walking for transport is much more similar.

3.5 WHO recommendations

If we were to compare the minutes of physical activity that children gain from their walking for transport, with the standards set by the WHO recommendations we can get a clear picture of how the built environment can seriously affect children's health. Table 6 displays the share of children that achieve 30 minutes of moderate physical activity, which is half of what is recommended by the WHO.

Table 6. Percentage of population > 30 min walking by gender, age and area type
Source: own elaboration from EMQ06

AGE	AGE GROUP	AREA TYPE (%)			
		Vital (a)	**Non-Vital** (b)	**Total**	**Ratio** (a/b) (%)
Kids 4-11	Male	*44.3*	**30.3**	38.9	14
	Female	*57.7*	**25.6**	41.8	32.1
	Total	*47.7*	**25.6**	41.8	22.1
Young 12-15	Male	*64.7*	**48.6**	60.2	16.1
	Female	*63.3*	**51.2**	58.8	12.1
	Total	*64.0*	**50.0**	59.5	14
Total	Male	*51.1*	**35.9**	46.2	15.2
	Female	*53.3*	**34.2**	47.5	19.1
	Total	*52.2*	**35.1**	46.8	17.1
Population		*277,954*	*136,047*	*738,064*	

Test: Chi2 sig=000 all categories; Adjusted residuals test, corrected.
Italics: significantly higher values
Bold: significantly lower values
** Non-significant data, insufficient sample frequency per cell

As can be seen, 46.8% of the children living in the Metropolitan Region of Barcelona are getting half of the minutes of PA recommended by WHO from walking for transport. Once again age, and its relationship with becoming mobility independent, is found to be a significant factor, as 60.0% of Youngsters are getting to the 30 minute threshold, compared with 41.8% of kids. Living in a Vital urban area clearly affects the total amount of PA kids are gaining from walking, as there is 17% difference between vital and non-vital areas. This relationship appears to be stronger in the kid's category, both numerically and statistically. Chi-square values, however, show a more significant relation between PA and Urban Vitality on females (X2= 46.452) than on boys (X2= 21.212).

With respect to Youngsters, the statistical significance is lower, but the pattern is still clear whether both males and females living in vital environments are more prone to fulfil 30 minutes of PA than their counterparts. It is interesting how in this age range the gender factor is reversed with boys being more susceptible to environment vitality than females (X2=11.777 vs X2=79.54). The odds ratio analysis in Table 7 actually confirms this analysis making females aged 4-11 the group that is most affected but the vitality or lack of vitality of the neighbourhood.

Table 7: Odds of reaching the 30 recommended minutes of Physical Activity from

Source: own elaboration from EMQ06

		VITAL		NON-VITAL	
AGE	**GENDER**	**OR**	**95%CI**	**OR**	**95%CI**
4-11 years		1.243	(1.180;1.310)	0.567	(0.489;0.658)
	Male	1.182	(1.099;1.271)	0.645	(0.526;0.790)
	Female	1.312	(1.216;1.416)	0.496	(0.399;0.616)
12-15 years		1.178	(1.089;1.274)	0.663	(0.550;0.800)
	Male	1.201	(1.073;1.344)	0.622	(0472;0.819)
	Female	1.156	(1.036;1.291)	0.703	(0.544;0.907)
Total		1.219	(1.168;1.273)	0.603	(0.539;0.676)

4. DISCUSSION

We studied how the urban vitality affects the physical activity of Children in the Barcelona Metropolitan Region. This paper analyses a wide age range of 4-16 years that covers the whole childhood years, stratifying by primary school and secondary school. The use of a large travel survey and not an ad hoc survey has allowed studying very different territories that pose significant challenges to children's mobilities. Also, we have been able to integrate all kinds of trips into our analysis, not only travel to school, a major flaw that is most current on many child related transport studies. In the same way as Hillman (2006) and Lin & Yu (2011), we feel that childhood mobility analyses are still excessively centred on school mobility, often forgetting to pay adequate attention to those two-thirds of non-school related mobility.

Our findings show that children living in vital areas take almost 20% more trips than those living in non-vital areas. As Mackett et al. (2005) established, taking a trip is always better in terms of PA than staying at home, regardless of the mode of transport. But most importantly, in terms of activity engagement, it means that living in a vital area is allowing children to engage in more out-of-home activities which is important for their social and cognitive development (Sener et al., 2008). These trips and activities, which are extensive in number, are fostered by areas where short walking trips are possible, areas with bigger population densities and intense land use mix, which is consistent with the findings of Lin & Yu (2011) on how travel distances, mixed land uses and density of leisure facilities are indicative of the greater amount of travel undertaken by children.

In terms of walking as a modal choice, the intense urbanisation on the metropolitan area and the population weight of a compact and dense city such as Barcelona, makes walking the most popular mode of transport among people between 4-16 years of age. The 65.7% frequency of walking trips more than doubles the 32% frequency of walking trips taken in Great Britain (Mackett et al., 2005). However, there is a very significant variation among the frequency of walking and the number of minutes walked between vital areas and non-vital ones. Children living in a vital area are walking for transport 36.4% more often than children living in a non-vital area. Vital areas not only promote more walking trips, but most importantly, they discourage trips made by car, which in turn contributes to attenuate one of the major fears of parents on letting children walk: intense traffic. Thus, vital areas not only grant a constant co-presence of walkers on the streets, but they also have less traffic and consequently reduce parents' fears, also promoting independent mobility (Lin & Yu, 2011).

Becoming mobility independent is not only important for its PA implications but also, as Brown et al. (2008) have pointed out, because it opens the recreational and social opportunities available to the child. As reported by Carver et al. (2013), becoming mobility independent means that in almost all cases there is walking for more minutes, not only because children cannot drive, but because accompanied travelling is strongly related to travelling by car, even for short trips. In our specific context, the change between primary school (4-11 years of age) and secondary school (12-15 years of age) entails a progressive transition from dependent to independent mobility that results in a decrease of 30% in relative use of the car, which is translated in almost equal parts into an increasing of walking and public transport use.

Our data suggest an important variance in the effect of urban vitality dependence on age and gender factors. Between 4 and 11 years of age, living in a vital/non-vital urban environment produces greater PA differences in females (i.e. 13.6 minute difference) than males (i.e. 5.6 minutes difference). Given that PA is intimately related with mobile independence (Evenson et al., 2006), the explanation for this could be that parents are more susceptible to the settings of the built environment when it comes to allowing females to become mobility independent. These findings are consistent with those of Van Loon et al. (2014) for children between 8 and 11 years of age. Our study, however, shows how these gender differences are almost eliminated (if not reversed) in the youngsters category (12-15 years of age). A plausible explanation for these findings is that, as age increases the role of parents as gatekeepers is diminished (Teedon et al., 2014) and, therefore, the differences between the travel patterns of males and females are normalised. Thus, the gender differences found in the Young category are more similar to those found in adults (Miralles-Guasch, Martinez Melo, & Marquet, 2014).

Strength of the present study is the novelty of approaching urban vitality as a quantifiable mobility changer for children. At the same time, the large data set allows a deep level of disaggregation adding nuances to the results. However there are also some limitations, as other socioeconomic factors beyond age and gender should be included to have a more complete vision of children mobility habits. Also, the issue of becoming mobility independent should draw additional attention as it constitutes a game changer for children mobility potential and thus it has also a great impact on the health related issues of mobility.

In our opinion, this paper represents a step towards an increasing knowledge on the environmental drivers of PA on Mediterranean cities. It is important to develop a European knowledge of the patterns of children's physical activity because the results from the US and Australia cannot be adapted in a straightforward manner due to the different characteristics of the urban areas (Buck et al., 2011) and because each country and culture has different PA drivers (Owen et al., 2007; Sallis et al., 2009). Overall, urban vitality proves to be a strong determinant of children PA, with children living in urban areas making nearly 8 more minutes a day of walking for transport than their counterparts and also engaging in 20% more activities. This confirms both the hypothesis that a diverse and lively built environment can promote healthy lifestyles for children and that the co-presence of pedestrians on the street also contributes to making walking the main modal choice for Children.