UNIVERSIDAD DE CANTABRIA

Universidad de Cantabria, Universidad de Oviedo y Universidad del País Vasco

PROGRAMA DE DOCTORADO EN ECONOMÍA: INSTRUMENTOS DEL ANÁLISIS ECONÓMICO

TESIS DOCTORAL

ENSAYOS SOBRE ECONOMÍA DE LA SALUD: DESIGUALDAD, POBREZA Y POLARIZACIÓN

PHD THESIS

ESSAYS ABOUT HEALTH ECONOMICS: INEQUALITY, POVERTY AND POLARIZATION

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Escuela de Doctorado de la Universidad de Cantabria

Santander, noviembre 2019

UNIVERSITY OF CANTABRIA

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Santander, November 2019

Agradecimientos

Quiero expresar mi más sincero agradecimiento a todas aquellas personas que, de algún modo, me han ayudado en la elaboración de esta Tesis Doctoral.

En primer lugar, mi mayor agradecimiento va dirigido a mis directores, Prof. Dra. Dª. Marta Pascual Sáez y Prof. Dr. D. David Cantarero Prieto por la confianza que han depositado en mí desde que comencé a trabajar con ellos. Gracias por su gran experiencia y profesionalidad en todo momento. Sin su dedicación y consejos, no habría sido posible llevar a cabo con éxito esta tesis doctoral.

En segundo lugar, agradecer el apoyo recibido a mis compañeros del Grupo de Investigación en Economía Publica y de la Salud (GIECONPSALUD) y del Grupo de Investigación en Economía de la Salud y Gestión de Servicios Sanitarios del Instituto de Investigación Marqués de Valdecilla (IDIVAL). En concreto, a mi compañera Carla Blázquez, por estar ahí, tanto en los buenos como en los malos momentos, siempre de manera desinteresada.

Asimismo, a mis compañeros del Área de Economía Aplicada y Hacienda Pública, por los consejos, profesionales y académicos, que me han dado y, en general, a todos los miembros del Departamento de Economía de la Universidad de Cantabria que me han ayudado durante este tiempo, especialmente a Carmen Murillo, Natividad Fernández, Ana Carrera y Alexandra Soberón. También quiero destacar a Daniel Díaz, coordinador del programa de Doctorado en Economía, por su total disponibilidad.

Quiero expresar mi gratitud a la profesora Victoria Serra-Sastre por brindarme la oportunidad de realizar una estancia de investigación, bajo su tutela, en City, University of London (Reino Unido). Asimismo, resaltar la gran acogida por parte de todo el Departamento de Economía de dicha Universidad, desde el primer hasta el último día.

Por último, destacar el agradecimiento a mi familia y amigos. Sin duda, reservo el más especial para mis padres, Pablo y Gloria, por quererme y apoyarme siempre, y hacer de mí la persona que soy ahora. A mi hermana, Elena, quien a pesar de la distancia física me ha mostrado su ayuda sin dudarlo y, quien fue mi mayor apoyo el tiempo que viví en Londres.

Y, por supuesto, no puedo terminar sin dedicarle unas palabras a Víctor. Gracias por tu apoyo incondicional a lo largo de este camino. Gracias por estar siempre a mi lado a pesar del tiempo que nos ha robado esta tesis. Gracias por compartir mis logros como si fueran tuyos porque, en cierto modo, lo son. Gracias por animarme siempre a continuar, no rendirme y llegar un poco más lejos cada día. Gracias por confiar en mí más de lo que yo misma lo hacía.

A todos, muchas gracias.

A mi familia

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Introducción

La Gran Recesión ha generado efectos notables a la vez que negativos no sólo en el ámbito económico, sino también en otros muchos como el sanitario, educativo y laboral. Desde el comienzo de dicho suceso en 2008, ha tenido lugar un aumento de las tasas de desempleo junto con una reducción del crecimiento económico en determinados países europeos. Ante esta situación, los gobiernos se han visto obligados a adoptar serias medidas de austeridad, estableciendo recortes en determinadas partidas presupuestarias, siendo la correspondiente a sanidad una de las más afectadas (Escolar-Pujolar, Bacigalupe y San Sebastian, 2014; Cervero-Liceras, McKee y Legido-Quigley, 2015; Córdoba-Doña *et al.*, 2016; Coveney *et al.*, 2016).

En lo que al ámbito de salud se refiere, la Gran Recesión ha tenido una importante influencia en los países mediterráneos como Grecia, Italia o España, así como en Europa en general (Karanikolos *et al.*, 2013). Factores como la riqueza, la educación, la ocupación o las condiciones sociales del lugar de residencia tienen efectos tanto sobre la salud como sobre la enfermedad, lo cual se agrava en periodos de crisis económica, dando lugar a grandes desigualdades entre la población. Más concretamente, las desigualdades en salud son consecuencia de las desigualdades políticas, económicas y sociales que están

presentes en las sociedades de todos los países del mundo. Así, se pueden observar en variables relacionadas con la salud como son la salud mental, la salud autopercibida o la calidad de vida relacionada con la salud, entre otras (Bacigalupe y Escolar-Pujolar, 2014). Y es que está demostrado que, durante épocas de crisis económica, por ejemplo, el estado de salud mental empeora y, por tanto, el consumo de medicamentos aumenta (Córdoba-Doña *et al.*, 2016; Pruchno, Heid y Wilson-Genderson, 2017).

Por tanto, es posible afirmar que los impactos que generan determinados factores sobre la salud de la población tienen como consecuencia que los grupos sociales más favorecidos experimentan mejoras de salud y, todo lo contrario, sucede con la población menos favorecida, la cual presenta una peor salud (Benach, 1997; Borrell *et al.*, 2005; Gumà, Treviño y Cámara, 2015; Gumà, Arpino y Solé-Auró, 2019).

Ante la situación recién descrita, la tesis que se presenta busca analizar en detalle las desigualdades socioeconómicas existentes en la población en términos de salud. Más concretamente, se investigan las diferentes consecuencias que la Gran Recesión ha provocado sobre determinadas variables asociadas con la salud tanto en España como en Europa.

Sin embargo, como se ha mencionado previamente, el campo de la sanidad no ha sido el único que se ha visto afectado por la reciente crisis económica. Otra área sobre la que este fenómeno ha tenido un importante impacto negativo ha sido la educación. Más concretamente, aquella población perteneciente a hogares con un número de recursos limitado se ha visto afectada en mayor medida ante periodos de recesión económica en comparación con aquellos hogares con más recursos en términos de nivel de educación (Bambra, Netuveli y Eikemo, 2010; Barroso, Abásolo y Cáceres, 2016; Arpino y Solé-Auró, 2019).

Por consiguiente, el objetivo concreto de esta tesis doctoral es analizar determinados factores socioeconómicos para saber cómo afectan a la salud autopercibida de la población, así como a las tasas de cobertura de vacunación, a la salud mental y a la obesidad, y si existe o no cierto grado de desigualdad.

En cuanto a la literatura existente que analiza las desigualdades en salud, cabe destacar que es bastante amplia en lo que a contenidos y enfoques se refiere, independientemente del ámbito geográfico al que queramos hacer referencia. Por ejemplo, Madureira-Lima *et al.* (2017) investigan si estar desempleado incrementa la probabilidad de necesidad médica insatisfecha durante la Gran Recesión. Además, Henares-Montiel, Ruiz-Pérez y Mendoza-García (2018) examinan las desigualdades en salud entre la población nativa e inmigrante en España. Más recientemente, Trujillo-Alemán *et al.* (2019) analizan la existencia de desigualdades y los comportamientos de salud entre parejas y madres solteras en España por clase social ocupacional y situación laboral.

Igualmente, otro tema de especial interés y, por ello, bastante utilizado como variable de estudio en investigaciones empíricas del ámbito de Economía de la Salud es la autovaloración de la salud por parte de los individuos. Esta variable resulta ser un indicador de salud subjetivo y, normalmente, cambia a lo largo del tiempo debido a que las personas no perciben el mismo estado de salud a lo largo de toda su vida. Asimismo, cabe destacar, que esta variable se recoge en numerosas encuestas de salud, tanto a nivel nacional como internacional. En este caso, ante la idea de ser aplicada como variable principal de estudio de esta tesis doctoral, se tiene en cuenta que la salud autopercibida capta el concepto de salud como bienestar general y no únicamente como ausencia de enfermedad.

Algunos autores consideran que los datos provistos por esta variable son apropiados para las investigaciones en el área recién mencionada. Así, destacan Hernández-Quevedo, Jones y Rice (2004), quienes muestran que la autovaloración de la salud tiene una gran capacidad de recoger y sintetizar gran parte de las características de la salud de los individuos. Además, Johnston, Propper y Shields (2009) muestran que esta variable es un predictor adecuado tanto para la mortalidad como para la morbilidad. De esta manera, la autovaloración de la salud provee información relevante acerca del bienestar de los individuos (Apouey, 2007; Fusco y Silber, 2014).

Entre algunos de los estudios que tratan este tema en España podemos destacar el desarrollado por Daponte-Codina *et al.* (2008), quienes analizan el impacto de la clase social y los niveles de privación del área de residencia sobre las desigualdades en la salud autopercibida. Por un lado, Urbanos-Garrido (2012) investiga qué factores provocan desigualdades socioeconómicas en salud, incluyendo la privación de vivienda y las interacciones sociales como determinantes de salud autopercibida. Por otro lado, Machón *et al.* (2016) busca los principales factores que afectan la salud autoevaluada en los adultos mayores funcionalmente independientes.

Mientras, otros tantos artículos presentan un enfoque bastante similar al recién descrito, pero centrándose en diversos países europeos. Entre ellos, se puede distinguir el elaborado por Kunst *et al.* (2004), quienes analizan las desigualdades en la salud autoevaluada en la población de diez países europeos, haciendo especial énfasis en la tendencia seguida en las décadas de los ochenta y noventa, además de las diferencias entre países. Además, Torsheim *et al.* (2018) estudian el nivel de desigualdad socioeconómica en la salud autoevaluada entre los adolescentes nórdicos. Más recientemente, Moor *et al.*

(2019) muestran la relación entre cinco indicadores de estatus socioeconómico con la salud autoevaluada y el tabaquismo.

Sin embargo, otros autores no están de acuerdo con el uso de esta variable en el análisis empírico debido a su carácter subjetivo, lo que significa que las personas evalúan su propio estado de salud. Además, insisten en el hecho de que el estado de salud autoinformado y el estado de salud actual podrían no ser necesariamente los mismos (Le Grand, 1987; Sen, 2002).

En base a lo descrito previamente, se justifica el interés práctico del análisis correspondiente a los diversos estudios que examinan las desigualdades de salud en la población de acuerdo a sus condiciones socioeconómicas, intentando este trabajo aportar nueva evidencia empírica a la literatura ya existente.

A lo largo de esta tesis doctoral, se desarrollan numerosos métodos cuantitativos con el fin último de lograr el objetivo especificado en cada uno de los capítulos. Más concretamente, se llevan a cabo dichos métodos junto con la descripción correspondiente de los fundamentos teóricos asociados al ámbito de Economía de la Salud. De este modo, se utilizan diferentes técnicas estadísticas y econométricas tales como índices de desigualdad, pobreza, polarización; modelos dinámicos o de convergencia condicionada, entre otras. Asimismo, se realiza una revisión sistemática de la literatura para conocer el estado actual del tema.

Para ello, es necesario destacar que en todos los capítulos se ha tratado de abarcar el mayor número de variables posible, al igual que ha sucedido con el periodo analizado. No obstante, en este sentido, esta tesis se ha visto limitada en base a la disponibilidad de los datos en función de las diferentes fuentes de datos consideradas a lo largo de ella.

De modo que, para la elaboración de la revisión de literatura se han utilizado tres fuentes de datos tales como PubMed, Cochrane Library y Web of Science, limitándose la búsqueda al periodo desde el año 2000, aproximadamente, hasta la actualidad (2019). Por su parte, en lo que concierne a cada uno de los capítulos empíricos de los que se compone esta tesis, se emplean varias fuentes al considerar, en unos casos el nivel nacional, y en otros en el nivel internacional e, incluso, mundial. Más concretamente, se utilizan microdatos de distintas encuestas de salud, así como otras fuentes de información asociadas al objetivo que corresponda. Las principales fuentes de datos empleadas en esta tesis doctoral son el Instituto Nacional de Estadística (INE) para la información requerida a nivel nacional, y Eurostat para los datos necesarios a nivel internacional. A su vez, el Banco Mundial y la Organización Mundial de la Salud (OMS) también proporcionan datos de gran utilidad para la elaboración de un capítulo de esta tesis, específicamente, para aquel que realiza la investigación a nivel mundial. Finalmente, el software utilizado es STATA 15.0.

Continuando y describiendo más en detalle las distintas fuentes de datos consideradas de los artículos empíricos, cabe destacar que los capítulos 2 y 3 utilizan como datos aquellos provistos por Eurostat, especialmente, a través de dos encuestas, tal y como son *European Health Interview Survey* (*EHIS*) y *European Union Statistics on Income and Living Conditions* (*EU-SILC*). Por un lado, *EHIS* está formada por cuatro módulos distintos que tratan aspectos relacionados con el estado de salud, la utilización de la atención médica, los determinantes de salud y los antecedentes socioeconómicos. Asimismo, consta de dos olas, la primera se basa en el periodo de tiempo entre 2006 y 2009, y la segunda entre 2013 y 2015. Por otro lado, *EU-SILC* proporciona microdatos multidimensionales, transversales y longitudinales, relevantes y comparables acerca de

ingresos, pobreza, exclusión social y condiciones de vida. Dichos datos se recogen desde el año 2003 hasta la actualidad. Además, los capítulos 5 y 6, los cuales se centran fundamentalmente en el análisis de España, se basan en microdatos obtenidos de las últimas encuestas de salud a través del INE, entidad que junto al Ministerio de Sanidad, Consumo y Bienestar Social se encarga de recopilar toda la información tanto a nivel nacional como regional. No obstante, a pesar de que esta tesis se centra en el ámbito de la salud y, por tanto, en las encuestas relativas a ella disponibles en esta fuente de datos, el INE también provee otro tipo de información estadística centrada en campos tales como la economía, la sociedad o el medio ambiente, entre otros.

Tal y como se ha mencionado previamente, el objetivo concreto de la presente tesis doctoral es analizar determinados factores socioeconómicos de la población para conocer cómo afectan a su salud tanto en términos generales como focalizando en inmunización, salud mental y obesidad. Además, será posible observar si existe o no cierto grado de desigualdad entre la población considerada. De esta manera, se busca realizar una aportación original a la evidencia empírica ya existente en la literatura relativa a Economía de la Salud, a la vez que actualizada, ya que se utilizan los datos más recientes posibles.

Esta tesis doctoral se divide en seis secciones (artículos/capítulos). Cada uno de los capítulos contribuye a analizar determinados aspectos de la desigualdad en la salud a través de diferentes enfoques. No obstante, a pesar de ser independientes, los capítulos están relacionados entre sí a través de la desigualdad en salud. Más concretamente, cada uno de ellos aborda un tema diferente del campo de Economía de la Salud, utilizando distinta metodología y datos.

Así, el primer capítulo de esta tesis doctoral realiza una revisión sistemática de literatura acerca de la desigualdad, pobreza y polarización de la salud autopercibida de la población. Mientras, el segundo capítulo analiza la polarización y las desigualdades en la autoevaluación de la salud de los individuos. Similar, el tercer capítulo se centra en la pobreza de la autovaloración de la salud, considerando esta cuando los individuos reportan que su salud es mala o muy mala. Finalmente, los tres últimos capítulos versan sobre determinados aspectos o características sanitarias como son las tasas de vacunación infantil, la salud mental y la obesidad, y se analiza su relación con la renta, así como con otros factores socioeconómicos.

A continuación, se describe más en detalle cada uno de los capítulos. El Capítulo 1 es un artículo de revisión sistemática de literatura. El objetivo principal de este estudio es hacer una comparación internacional a la vez que describir aquellos artículos existentes que analizan la desigualdad, pobreza y polarización en salud. Más específicamente, aquellos documentos recientes que examinan un término tan relevante como es la salud autopercibida de la población, considerando un horizonte retrospectivo. Los hallazgos obtenidos revelan que ser mujer, de edad avanzada y tener un bajo nivel de educación implica reportar una mala salud. Además, las personas con bajos ingresos presentan un mayor riesgo de mala salud autopercibida. Todos estos problemas implican desigualdades tanto en ingresos como en salud. Por un lado, convivir con alguien, vivir sin hijos, la raza, el nivel educativo o la situación laboral, entre otros, son determinantes de pobreza en salud. Por otro lado, la edad o las áreas geográficas son factores que implican polarización, teniendo las áreas rurales ingresos más bajos junto a un mayor nivel de polarización.

Por otro lado, el Capítulo 2 examina la desigualdad, así como la polarización del estado de salud autoevaluado por los propios individuos, contribuyendo, de esta manera, a la escasa literatura existente sobre este tema en el campo de Economía de la Salud. Para ello, se utilizan datos de *EHIS*. Así, como principal objetivo de este análisis, se establece la relación entre la desigualdad y la polarización de la salud para 27 países de la Unión Europea. En cuanto al periodo temporal considerado, se tienen en cuenta las dos olas disponibles en dicha encuesta, correspondientes a 2006-2009 y 2013-2015. La variable dependiente del estudio es la autovaloración de la salud por parte de los individuos, de modo que los datos reportados por la encuesta informan que un individuo evalúa su estado de salud como muy malo cuando selecciona un valor igual a 1, mientras dicho valor aumenta hasta 5 si considera que su estado de salud es muy bueno. Así, ante la naturaleza de carácter ordinal que presenta la variable explicada, se emplean medidas basadas en la mediana, tanto para medir el nivel de polarización como el grado de desigualdad. Los resultados obtenidos informan que, cuando se considera que la categoría de la mediana es "muy buena salud", Grecia es el país con mayor grado de polarización de la salud durante los dos periodos analizados. Por el contrario, se observa que Irlanda es el país con menor nivel de polarización. Cabe destacar que los resultados para el índice de polarización coinciden con aquellos obtenidos para el índice de desigualdad. Por otro lado, si se tiene en cuenta que la categoría de la mediana es "buena salud", Estonia, Hungría y Lituania tienen el mayor grado de polarización de la salud en 2006-2009 y 2013-2015, siendo Malta, los Países Bajos y España los países con los niveles más bajos.

El Capítulo 3 analiza los cambios que se han producido en la pobreza de la salud de la población española durante el periodo de crisis económica vivido recientemente en nuestro país. Asimismo, también se establece como objetivo la descomposición de

determinados factores socioeconómicos, tales como el género, la edad y el nivel educativo, para comprobar de qué manera afectan estos determinantes a la salud de la población durante épocas de recesión. Para lograr ambos objetivos, se utilizan microdatos proporcionados por *EU-SILC*. En cuanto al periodo de tiempo estudiado, como se ha mencionado, se hace referencia a la crisis económica, más concretamente, se tiene en cuenta un periodo que abarca desde 2008 hasta 2016. Como metodología, se utiliza el índice de Foster-Greer-Thorbecke. La pobreza de la salud se mide a través de una variable de carácter subjetivo tal y como es el estado de salud autopercibido por parte de los individuos. Los resultados indican un crecimiento negativo cuando se considera que el umbral de pobreza de salud es una "mala salud". Por el contrario, si se selecciona un umbral de pobreza de salud tal que una salud autopercibida "normal", se observa un crecimiento positivo. Asimismo, al realizar la descomposición de subgrupos de los factores socioeconómicos recién mencionados, estos hallazgos sugieren un aumento de la pobreza de salud en España, favoreciendo a los hombres, a los jóvenes y a los individuos con alto nivel educativo.

Por su parte, el Capítulo 4 estudia la relación entre el ingreso per cápita y las tasas de vacunación infantil. Asimismo, como objetivo secundario, se examina la existencia de convergencia entre ambas variables. Para ello, examinamos el ingreso per cápita utilizando datos del Banco Mundial y las tasas de cobertura de vacunación a través de la OMS. Cabe destacar que se ha intentado analizar, en la medida de lo posible, el mayor número de países, del mismo modo que ha sucedido con las vacunas consideradas. Asimismo, en base a la disponibilidad de los datos de las dos fuentes de información utilizadas en este capítulo, se estudia un periodo de tiempo que abarca diecisiete años, más concretamente, se analiza desde el año 2000 hasta 2016. De manera que, teniendo en

cuenta lo recién mencionado, la muestra consta finalmente de 135 países, los cuales se dividen en función del nivel de ingresos (bajos, medios-bajos, medios-altos y altos ingresos). En el caso de las vacunas, se tienen en cuenta ocho diferentes, como son la Bacillus Calmette–Guérin (BCG); la primera y tercera dosis de la vacuna contra la Difteria, Tétanos y Tos Ferina; la tercera dosis de la vacuna frente a la Hepatitis B; la primera y segunda dosis frente al Sarampión; la tercera dosis de la Polio y la Toxoide Tetánica. Como metodología, se lleva a cabo un modelo de efectos fijos (tanto lineal como dinámico) además de un modelo de convergencia condicionada. Los resultados obtenidos muestran una correlación positiva entre el ingreso per cápita y la mayoría de las vacunas, excepto en el caso de la segunda dosis frente al Sarampión. Además, se demuestra la existencia de convergencia condicionada para todas las vacunas, mostrando que los países convergen hacia diferentes estados estacionarios.

En los últimos dos capítulos de esta tesis doctoral, se analizan los factores que influyen, por un lado, a la salud mental y, por otro lado, a la obesidad. En ambos capítulos, se considera la perspectiva de la población española. Más concretamente, se analizan determinados factores socioeconómicos y de estilo de vida para comprobar cómo influyen en las dos variables de salud mencionadas.

El Capítulo 5 muestra la evolución de los problemas de salud mental en España antes, durante y después de la Gran Recesión. El principal objetivo de este capítulo es examinar la relación que existe entre una mala salud mental y la pobreza, midiendo esta última a través del ingreso per cápita de los hogares. Asimismo, se consideran otras características socioeconómicas (edad, género, estado civil, nivel educativo, situación laboral o salud autopercibida, entre otros) y de estilo de vida (tabaquismo e índice de masa corporal) que pueden influir en la salud mental de los individuos. En concreto, se

utilizan datos de la Encuesta Nacional de Salud española. Como metodología, se lleva a cabo una regresión logística multinivel con efectos aleatorios. La variable dependiente (mala salud mental) se basa en el *General Health Questionnaire*, que mide los problemas de salud mental y considera mala salud mental cuando se obtiene un valor entre 3 y 12 (ambos inclusive). Los hallazgos muestran que la tasa de prevalencia de mala salud mental disminuye de 2006 a 2017. Por un lado, los resultados señalan que existe una relación entre un menor ingreso y una mayor probabilidad de mala salud mental. Por otro lado, tener un nivel educativo bajo, así como estar desempleado, supone un mayor riesgo de mala salud mental para la población en general. Cuando se distingue por género, en el caso de las mujeres, estar separada o divorciada implica una mayor probabilidad de mala salud mental. Por el contrario, para los hombres, ser viudo supone un mayor riesgo de mala salud mental.

El Capítulo 6 se centra en la influencia que tienen los diferentes niveles socioeconómicos sobre la obesidad de la población española. Asimismo, entre los objetivos contemplados en este capítulo, se establece analizar la asociación entre obesidad y determinadas características socioeconómicas y de estilo de vida, tanto a nivel nacional como regional. Para ello, se utilizan microdatos proporcionados por la Encuesta Nacional de Salud. Al querer aportar una evidencia lo más actualizada posible, se utilizan los datos de la última ola disponible, correspondientes a 2017. De modo que, para medir la desigualdad, calculamos el Índice de Concentración, el Índice de Concentración Corregido y el índice de Entropía Generalizada. Asimismo, para comprobar qué determinantes y de qué manera afectan a la obesidad de los españoles, desarrollamos un modelo de regresión logística multivariable. De modo que, como variable dependiente se tiene el Índice de Masa Corporal. Como variables explicativas se distinguen el ingreso,

el nivel de educación, la actividad física o los patrones de alimentación, entre otros. Los resultados obtenidos indican que el grado de desigualdad de la obesidad varía entre las distintas regiones españolas. El Índice de Concentración Corregido muestra un mayor nivel de desigualdad entre la población pobre en Melilla y un menor grado en Canarias. Además, nuestros hallazgos indican que las mujeres con bajos ingresos (quintil 1), bajo nivel educativo y que no practican ninguna actividad física presentan mayor riesgo de obesidad, tal y como sucede con los hombres de Quintil 4, con bajo nivel educativo y que no practican ninguna actividad física.

Finalmente, cabe destacar que distintas versiones de los seis capítulos que componen esta tesis doctoral han sido presentadas en varios seminarios, jornadas, congresos y encuentros durante estos años. Tanto el Capítulo 2 como el Capítulo 3 han sido presentados en un reciente Seminario de investigación organizado por el Departamento de Economía de la Universidad de Cantabria (Santander, noviembre 2019). Asimismo, el Capítulo 3 también ha sido expuesto en el III *Workshop Health Economics* (Zaragoza, noviembre 2017) y en el XXV Encuentro de Economía Pública (Valencia, enero 2018). Mientras, el Capítulo 4 ha dado lugar a una comunicación en el IV *Workshop Health Economics* (Zaragoza, mayo 2019). De igual forma, el Capítulo 5 ha sido presentado en el XXVI Encuentro de Economía Pública (Oviedo, enero 2019). El Capítulo 6 ha sido expuesto en las XXXIX Jornadas de Economía de la Salud (Albacete, junio 2019). Asimismo, este capítulo ha sido finalizado gracias a realización de una estancia pre-doctoral de tres meses en el Departamento de Economía de la *City, University of London* (Londres, 2019), bajo la supervisión de la Profesora Victoria Serra-Sastre. Cabe destacar que, en todos los seminarios, jornadas, congresos y encuentros, se

recibieron aportaciones de gran relevancia para la mejora de cada uno de los capítulos presentados.

Asimismo, algunos de los principales resultados obtenidos en estos capítulos ya han sido publicados, aceptados para su publicación o han pasado la primera etapa del proceso de revisión en diferentes revistas de tipo académico. En concreto, distintas versiones tanto del Capítulo 2 como del Capítulo 3 han sido ya publicadas en *The European Journal of Health Economics*, así como en *Health Policy*, respectivamente:

- Pascual, M., Cantarero, D., & Lanza, P. (2018). Health polarization and inequalities across Europe: an empirical approach. *The European Journal of Health Economics*, **19(8)**, 1039-1051.
- Pascual-Sáez, M., Cantarero-Prieto, D., & Lanza-León, P. (2019). The dynamics of health poverty in Spain during the economic crisis (2008-2016). *Health Policy*.

Por último, cabe señalar que una versión de los Capítulos 1, 4, 5 y 6 se encuentra actualmente en proceso de revisión en cuatro *journals* de impacto *JCR* en Economía.

Introduction

The Great Recession has led to significant and negative effects in the economic field, but also in other areas such as health or education ones as well as in the labour market. Since the beginning of this phenomenon in 2008, there has been an increase in unemployment rates along with a decrease in economic growth in several European countries. In view of this situation, governments had been obliged to take serious austerity measures, establishing cuts in several budget lines and being health allocation one of the most affected (Escolar-Pujolar, Bacigalupe and San Sebastian, 2014; Cervero-Liceras, McKee and Legido-Quigley, 2015; Córdoba-Doña *et al.*, 2016; Coveney *et al.*, 2016).

According to health field, the Great Recession has had a deep impact in Mediterranean countries such as Greece, Italy or Spain, as well as in Europe in general (Karanikolos *et al.*, 2013). Several social conditions such as wealth, education, occupation or place of residence present effects on both health and disease, which get worse with economic crisis. As a consequence, most advantaged social groups experience health improvements and, by contrast, most disadvantaged ones tend to have worse general health (Benach, 1997; Borrell *et al.*, 2005; Gumà, Treviño and Chamber, 2015;

Gumà, Arpino and Solé-Auró, 2019). In other words, this situation implies huge inequalities among population.

More specifically, health inequalities are a consequence of political, economic and social inequalities which run through societies around the world. Thus, they can be shown in variables associated with health such as mental health, self-assessed health status or health-related quality of life, among others (Bacigalupe and Escolar-Pujolar, 2014). Evidence shows that, for example, mental health status worsens and, therefore, drug consumption increases in times of economic crisis (Córdoba-Doña *et al.*, 2016; Pruchno, Heid and Wilson-Genderson, 2017).

Against the above background, this thesis aims to analyse in detail the socio-economic inequalities among population in terms of health. In addition, the study of different consequences caused by the Great Recession in Spain and in Europe is investigated.

Nevertheless, as mentioned previously, health field has not been the only one which has been affected by the recent economic crisis. Another area on which this phenomenon has had a relevant and negative effect has been education field. More specifically, individuals who live in households with a limited number of resources have suffered to a greater extent the changes produced by the periods of economic recession in terms of education level (Bambra, Netuveli and Eikemo, 2010; Barroso, Abásolo and Cáceres, 2016; Arpino and Solé-Auró, 2019).

Therefore, the main objective of this thesis is to examine several socio-economic characteristics to know how they affect population's self-perceived health status as well as vaccination coverage rates, mental health status and obesity. In addition, it is shown whether these factors imply health inequality.

According to the existing literature focused on health inequalities, it is important to emphasize that it covers a wide range of contents and approaches, regardless of the geographical area considered. For example, Madureira-Lima *et al.* (2017) investigate whether being unemployed increases the probability of unmet medical need during the Great Recession. Besides, Henares-Montiel, Ruiz-Pérez and Mendoza-García (2018) examine health inequalities among both native and immigrant population in Spain. More recently, Trujillo-Alemán *et al.* (2019) analyse the existence of inequalities and health behaviours between couples and single mothers in Spain, distinguishing among occupation class and employment status.

Likewise, self-assessment health status is another interesting topic and, therefore, it has been extensively used as a study variable in empirical research in Health Economics. This variable acts as a subjective health indicator and, usually, it changes over time due to individuals do not perceive the same health status throughout their lives. In addition, it is included in several health surveys, at both national and international levels. In this thesis, self-assessment health status is considered in most of the chapters because it captures the concept of health as overall well-being and not only as the absence of disease.

Some authors claim that data provided by self-reported health variable are adequate for Health Economics research. Hernández-Quevedo, Jones and Rice (2004) show that self-rated health variable collects and synthesizes a large part of individuals' health characteristics. Besides, Johnston, Propper and Shields (2009) demonstrate that it is a good predictor of both mortality and morbidity. Thus, self-perceived health status provides relevant information about people's general well-being (Apouey, 2007; Fusco and Silber, 2014).

Looking at the literature focused on this variable in Spain, it should be emphasized the research developed by Daponte-Codina *et al.* (2008), who analyse the impact of social class and deprivation levels of the area of residence on self-rated health inequalities. On the one hand, Urbanos-Garrido (2012) looks into what factors imply health-related socio-economic inequalities, including deprivation of housing and social interactions as determinants of self-assessed health. On the other hand, Machón *et al.* (2016) look for the main factors that affect self-reported health among functionally independent older adults.

In addition, other articles present a similar approach but focused on European countries. Among these papers, it can be distinguished the one developed by Kunst *et al.* (2004), who analyse self-perceived health inequalities in ten countries across Europe, with special emphasis on the trend followed in the 80's and 90's decades as well as on the differences founded in the countries considered. Besides, Torsheim *et al.* (2018) study if there is inequality between socio-economic characteristics and self-assessed health among Nordic teenagers. More recently, Moor *et al.* (2019) show the relationship between five socio-economic status indicators and self-rated health and smoking status.

Nevertheless, other authors do not agree with the use of this variable in empirical analysis due to it is subjective, which means that individuals evaluate their own health status. Besides, they insist on the fact that self-reported health status and current health status might not necessarily be the same (Le Grand, 1987; Sen, 2002).

Based on the foregoing, the practical interest of the analysis of the different studies examining health inequalities according to several socio-economic conditions of European and Spanish population is justified, trying to provide new empirical evidence to the existing literature.

Throughout this thesis, several quantitative methods are developed with the aim of achieving the objective specified in each chapter. More specifically, these methodologies are carried out along with theoretical foundations in the field of Health Economics. Thus, different statistical and econometric techniques such as inequality, poverty or polarization indices; and dynamic or conditional convergence models, among others, are used. Furthermore, we carry out a systematic literature review to know the current state of the topic.

To do this, it is necessary to highlight that in all the following chapters, it has been tried to cover as many variables as possible. The same happens with the period considered. Nevertheless, this thesis has been limited by the availability of data according to the different databases considered.

Therefore, when we carry out the literature review, we use three data sources such as PubMed, Cochrane Library and Web of Science, limiting the research to the period between 2000 and 2019. Looking at the empirical chapters, several data sources are used, considering both national and international level and, even, worldwide. More specifically, microdata from different health surveys as well as other information sources are considered, according to the objective specified. The main data sources used in this thesis are the Spanish National Statistics Institute, which is used for the chapters based on national level; and Eurostat, that is used for the chapters focused on an international approach. Likewise, the World Bank and the World Health Organization (WHO) provide very useful information for the chapter which carries out a global research. Finally, the software used is STATA 15.0.

A brief description of the different data sources considered in the empirical chapters are as follows. The first two chapters use data provided by Eurostat throughout

two surveys such as European Health Interview Survey (EHIS) and European Union Statistics on Income and Living Conditions (EU-SILC). On the one hand, EHIS consists of four different modules associated with general health status, medical care utilization, health determinants as well as socio-economic backgrounds. In addition, it includes two waves, the first one collects data from 2006 to 2009 and the second one from 2013 to 2015. On the other hand, EU-SILC provides multidimensional, cross-sectional and longitudinal microdata related to income, poverty, social exclusion and living conditions. These data are collected since 2003 until now. Besides, the two chapters which focus on the analysis of Spain (Chapter 4 and Chapter 5) use microdata from the latest health surveys provided by the National Statistics Institute, that collects all the information at national and regional level along with the Ministry of Health, Consumption and Social Welfare. Despite the fact that this thesis is focused on Health Economics field, the Spanish National Statistics Institute also reports statistical information related to economics, society or environmental areas, among others.

As mentioned above, the main objective of this thesis is to study several socio-economic characteristics to show how they affect people's general health status, focusing on selected aspects of their health such as immunization, mental health and obesity. In addition, it can be shown whether there is some inequality degree among population considered. Thus, it is intended to make an original and current contribution to the empirical evidence in existing literature related to Health Economics.

This thesis is divided into six sections (articles/chapters). Each helps to examine some health characteristics throughout different approaches. However, the chapters are related to each other through health inequality, but they are totally independent between

them. More specifically, each section deals with a different issue of the Heath Economics field, using different methodologies as well as data.

Therefore, the first chapter of this thesis makes a literature review of inequality, poverty and polarization related to health. Meanwhile, Chapter 2 analyses inequality and polarization related to self-assessed health status. Similarly, the third one examines health poverty focused on self-reported health, considering this status when individuals rate their health as bad or very bad. Finally, the last three chapters are about specified health characteristics such as childhood vaccination rates, mental health and obesity; studying their relationship with income as well as other socio-economic factors.

Next, it is described in detail each article. Chapter 1 is a systematic literature review article. The main objective is to make an international comparison between health inequality, poverty and polarization studies. More specifically, those papers which are focused on self-perceived health status, considering a retrospective horizon until 2019. The findings obtained reveal that being a woman, older as well as having a low-education level imply poor self-reported health. Besides, individuals with low-income presents greater risk of very poor self-rated health. All these issues imply income and health inequalities. On the one hand, cohabiting and living without children, race, education level or employment status, among others, are determinants of health poverty. On the other hand, age or geographical areas are factors that imply polarization, having rural areas lower income as well as larger polarization level.

In addition, Chapter 2 examines inequality as well as polarization focused on self-assessed health status, contributing towards the limited research existing on Health Economics. To do this, we use data from the EHIS. Thus, the main objective of this paper is to investigate the relationship between health inequality and polarization across 27

European countries. In terms of the period analysed, it is considered the two available waves from the survey: 2006-2009 and 2013-2015. The dependent variable of the study is the self-assessment health status. Thus, data collected in the survey show that an individual rates their health status as very bad when they select a value equal to one. Meanwhile, that value increases until 5 if they report a health status as very good. Therefore, this variable has an ordinal nature and we employ median based measures to analyse inequality and polarization levels. Our empirical results suggest that Greece is the country with the highest level of health polarization in both periods we consider countries where the median category is "very good". By contrast, Ireland has the lowest degree of health polarization. It must be highlighted that the findings obtained from the polarization index coincide with those from the inequality index. Meanwhile, when we focus on those countries whose median category is "good" health, Estonia, Hungary and Lithuania have the highest degree of health polarization in 2006-2009 and 2013-2015 whereas Malta, Netherlands and Spain are the countries with the lowest ones.

Chapter 3 analyses changes in health poverty among Spanish population during the recent period of the economic crisis. Likewise, as a second objective is established the decomposition of several socio-economic factors such as gender, age and education level, to show how they affect population's health poverty during the downturn. To do so, we use microdata from the EU-SILC. In terms of the period considered, as mentioned previously, we focus on the economic crisis. More specifically, we take into account from 2008 to 2016. As methodology, we use the Foster-Greer-Thorbecke index. Besides, in this article, poverty trends over time are estimated focusing on self-perceived health status. Our results show a negative growth of health poverty, if a poor self-rated health status is chosen as a health poverty threshold. By contrast, the findings present a positive

growth whether we choose a fair self-reported health status as a health poverty threshold. Furthermore, in terms of the subgroup decomposition analysis, the results obtained indicate an increase of health poverty in Spain, favouring male population, younger age groups as well as individuals with high education level.

In turn, Chapter 4 studies the relationship between per capita income and childhood vaccination coverage rates. In addition, a secondary aim of the chapter is to examine the existence of conditioned convergence between these two variables. To do this, we use data from the World Bank to analyse per capita income and from the WHO to study eight vaccines. We have tried to carry out this analysis over as many countries as possible, as with the vaccines considered. Likewise, looking at the availability of data across the two data sources used in this paper, we study a period of seventeen years, more specifically, from 2000 to 2016. Thus, the final sample consists of 135 countries around the world, which are divided according to the income level (low, lower-middle, upper-middle and high-income). In the case of the vaccines, we distinguish eight different ones such as Bacillus Calmette–Guérin (BCG); the first and the third dose of the vaccine against Diphtheria-Tetanus-Pertussis; the third dose of the Hepatitis B vaccine; the first and the second dose of the Measles-Containing vaccine; the third dose of Polio; and Tetanus Toxoid. As methodology, we perform a fixed-effects model (one linear and another one dynamic) additionally to a conditioned convergence model. Our findings show a positive correlation between per capita income and vaccination coverage rate for almost all vaccines, except for the second dose of the Measles-Containing vaccine. In addition, we provide new empirical evidence of the existence of conditioned convergence for all vaccines, showing that countries converge towards different steady states.

In the last two chapters of this thesis, it is analysed several factors which affect, on the one hand, mental health and, on the other hand, obesity. In both papers, we consider Spanish population. More specifically, some socio-economic and lifestyle determinants are studied to see how they have influence on the two health variables mentioned.

Chapter 5 shows the determinants of mental health problems before, during and after the Great Recession in Spain. The main objective of this paper is to examine the association between poor mental health and poverty, measuring the last one through households' per capita income. Likewise, we consider other socio-economic characteristics (age, gender, marital status, education level, employment situation or self-assessed health, among others) and lifestyle factors (smoking status and body mass index) which may have impact on population's mental health. We use data from the Spanish National Health Survey. As methodology, we carry out a multilevel logistic regression with random effects. The dependent variable (poor mental health) is focused on the General Health Questionnaire, which measures common mental diseases and it implies poor mental health when, in the questionnaire, it is obtained a value between 3 and 12. Our results indicate that prevalence of poor mental health decreases from 2006 to 2017. On the one hand, there is a relationship between low per capita income and high risk of poor mental health. On the other hand, being minimally educated as well as unemployed supposes higher probability of poor mental health. When we distinguish between women and men, we show that being separated or divorced implies greater risk of poor mental health for women. By contrast, in the case of men, being widowed presents larger probability of poor mental health.

Chapter 6 focus on the influence of socio-economic status levels on obesity among Spanish population. Likewise, a secondary aim of this paper is to analyse the association

between obesity and several socio-economic and lifestyle characteristics at both national and regional level. To do so, we apply microdata from the adult questionnaire provided by the Spanish National Health Survey, using the last available wave from 2017 because we want to provide the most current evidence. Therefore, we have calculated the Concentration Index, the Corrected Concentration Index and the Generalized Entropy index to measure inequality. In addition, we carry out a multivariate logistic regression model to know how and what determinants affect obesity among Spanish people. The dependent variable is the Body Mass Index. We use some explanatory variables such as income, education level, physical activity at leisure time or eating patterns, among others. Our findings suggest that obesity inequality varies widely between the Spanish regions. The Corrected Concentration Index shows that there is higher inequality level among poor population in Melilla and lower degree in Canarias. Besides, our results indicate that women with the lowest income (quintile 1), low educated and do not practising any physical activity present a higher risk of obesity, as do men with upper-middle income (quintile 4), low educated and do not practising any physical activity.

Finally, note that different versions of the six chapters considered in this thesis have been presented in several seminars, conferences and meetings during these years. Versions of Chapters 2 and 3 have been exposed in a recent Seminar organized by the Department of Economics of the University of Cantabria (Santander, November 2019). Besides, Chapter 3 has also been presented at the III Workshop Health Economics (Zaragoza, November 2017) and at the XXV Public Economics Meeting (Valencia, January 2018). Meanwhile, Chapter 4 has led to an exposition at the IV Workshop Health Economics (Zaragoza, May 2019). Similarly, Chapter 5 has been presented at the XXVI Public Economics Meeting (Oviedo, January 2019). The last paper, Chapter 6, has been

exposed at the XXXIX Conference of the Association of Health Economics (Albacete, June 2019). Additionally, this paper has been finished during a pre-doctoral short research stay of three months at the Department of Economics of City, University of London (London, 2019), under the supervision of Professor Victoria Serra-Sastre. We must highlight that we have received positive comments and suggestions to the improvement of these chapters at all the seminars, conferences and meetings.

In addition, some of the results obtained in these papers have been publish, accepted for publication or have passed the first stage of the review process in different journals. More specifically, different versions of Chapter 2 as well as Chapter 3 have been published in The European Journal of Health Economics and Health Policy, respectively:

- Pascual, M., Cantarero, D., & Lanza, P. (2018). Health polarization and inequalities across Europe: an empirical approach. *The European Journal of Health Economics*, **19(8)**, 1039-1051.
- Pascual-Sáez, M., Cantarero-Prieto, D., & Lanza-León, P. (2019). The dynamics of health poverty in Spain during the economic crisis (2008-2016). *Health Policy*.

Additionally, a version of Chapters 1, 3, 4 and 5 are actually at the first stage of the review process in four different journals, all of them with JCR impact factor in the Economics field.

Chapter 1

Inequality, poverty and polarization related to social issues: A systematic literature review

1.1. Introduction

Inequality, poverty and polarization are topics that usually are analysed focusing on the economic area. More specifically, these issues are related to income. Nevertheless, in this review, we study the relationship between health and inequality, poverty and polarization because we are interested in the Health Economics field.

First of all, we define inequality as the concentration around the average of the distribution. Thus, inequality measures are mean based. In the case of health area, it is any difference in populations' health, being the distribution considered related to a disease, causes of death or other characteristics associated with health. Otherwise, we can find several alternatives to mean-based measures looking at median-based polarization measures. We should highlight that there are differences between inequality and polarization in spite of both terms are closely related (Esteban and Ray, 1994; Wolfson,

1994; Apouey, 2007). In this regard, each one highlights a different part of a distribution. However, if policy makers understand the reasons of a polarized system, they can reduce inequalities.

As we previously have made with the term inequality, we can define polarization as the mass relocation from the middle of the distribution to the poles. Therefore, if results suggest low polarization, it means that distributions are very concentrated around the median. In terms of health, we can argue that health polarization explains the mass relocation from the middle of health distribution to the poles. Remember that a health distribution is anyone which are associated with a health issue. In other words, it shows the distance between different causes of death or risk factors, depending on the distribution considered. On the other hand, we also examine health poverty, which exists when the considered value is below the threshold established.

As we mentioned above, populations' health depends on political, economic as well as social characteristics that shape conditions of living. In this respect, most of health resources is usually allocated to rich countries, belonging most disadvantaged population to low-income countries. Therefore, governments should made great efforts at both national and international level to reduce health inequalities on a global scale (Roemer and Dias, 2016). Nevertheless, inequality exists at both between and within countries (Meyer, 2019). In addition, disparities increase due to the Great Recession, which affect several countries to a great extent (Mandeville *et al.*, 2016; Witter *et al.*, 2016). Similarly, in terms of health poverty, this issue has been studied for years because of the high importance of the diseases as well as poverty that affect most disadvantaged in the world. Literature has been mainly focused on life expectancy. Although, it is necessary to develop adequate initiatives to improve populations' health (Aitsi-Selmi, 2008; Andrews, Khan and Crisp, 2017).

Our principal aim is to describe those papers which are focused on health. When we look for some articles that analyse the relationship between health and inequality as well as the association with poverty, literature does not present any problem. Nevertheless, when we focus our study on health polarization, only a few studies so far have examined it. Hence, in this case, we relate polarization with other issues such as income.

This paper sheds light on these issues by providing a critical and systematic review of literature that studies poverty and polarization as well as inequalities focused on social determinants. We begin with an explanation about what we understand as poor or, in contrast, good health. In Section 1.3, we review the main articles found in the literature about income inequality related to Self-Assessed Health (SAH) as well as social inequalities associated with SAH. Section 1.4 describes those papers that focus on health poverty. More specifically, we analyse those articles that examine poverty in terms of SAH as well as poverty linked to access to healthcare services. In Section 1.5, we study polarization in terms of income and health. Finally, we conclude in Section 1.6.

1.2. The concept of Self-Assessed Health

One way to analyse the association between some socio-economic characteristics and health is through SAH because its use has become very common as a study variable in empirical researches. More specifically, this is a health measure that it is presented in certain surveys and which is focused on the view of the interviewed person. In other words, it is a subjective health indicator and it can change over time because, usually, people do not perceive the same health status throughout their whole life.

Despite the fact that these issues of health can be defined from different points of view, in this chapter, we suppose that SAH is understood as the individual's perception of their own health status. Several national and international surveys include a question related to SAH. More specifically, the individual surveyed had to answer to the following question: "How has been your general health status during the last twelve months?". Therefore, the individual has to answer the question taking into account that the value 1 implies very good health, the value 2 is good health, the value 3 suggests fair health, the value 4 represents bad health and the value 5 is very bad health. In addition, we should highlight that a person assesses their own health as poor if they believe that other person of the same gender, age, education or income level, is much healthier than them.

Next, in the following sections, we describe the objective, the methodology and the main results of all the articles considered in this review.

1.3. Linking socio-economic characteristics and inequality

In this section, we describe in detail some empirical evidence regarding the literature related to socio-economic determinants and SAH. More specifically, we examine those papers that associate income inequality and SAH. Besides, we explain the ones that investigate social inequalities in SAH. As we mentioned previously, we focus on the most recent papers.

Literature focused on SAH inequality is very extensive. Some essays prove that social characteristics are associated with inequalities among population. We find that some significant determinants, which imply inequality, are age, education, health, socio-economic and marital status, place of residence or ethnic origin, among others (Van

Doorslaer *et al.*, 1997; Van Doorslaer and Jones, 2003; WHO, 2014). Additionally, there is a clear evidence that health tends to be worse in those societies with larger income differences (Wilkinson and Pickett, 2006; Carroll *et al.*, 2011; Pickett and Wilkinson, 2015), which leads to more disparity.

We review some papers related to SAH inequalities over the last years. More specifically, we analyse those papers which look over health inequality due to our main objective is to examine articles that associated inequality, poverty and polarization with health. Nevertheless, we study other issues to make this survey more extensive as well as interesting.

1.3.1. Associating Self-Assessed Health and income inequality

Looking at income inequalities related to SAH, we find several investigations in the recent literature that analyse this association (Cabieses *et al.*, 2015; Lillard *et al.*, 2015; Rözer, Kraaykamp and Huijts, 2016; Adjei, Brand and Zeeb, 2017; Leão and Perelman, 2017; Leão *et al.*, 2018; Massa, Pabayo and Chiavegatto Filho, 2018; Vincens, Emmelin and Stafström, 2018; Gu *et al.*, 2019; Hong and Lee, 2019). All these papers present the same objective, but they have differences between them as shows Table 1.1.

First, they differ in terms of methodology. Cabieses *et al.* (2015) and Hong and Lee (2019) estimate Erreygers Concentration Indices (CIs) and they use the Erreygers´ decomposition method to demonstrate what factors explain inequalities in SAH. Meanwhile, Lillard *et al.* (2015) and Leão and Perelman (2017) carry out ordered probit models and multivariate logistic regressions, respectively. In the case of Adjei, Brand and Zeeb (2017), they use a multiple binary logistic regression and the Blinder-Oaxaca decomposition method to know the contribution of each factor to gender inequality in health. On the one hand, Leão *et al.* (2018) carry out both absolute and relative measures,

the slope index of inequality and the relative index of inequality, respectively. On the other hand, Rözer, Kraaykamp and Huijts (2016), and Massa, Pabayo and Chiavegatto Filho (2018) use multilevel models. In addition, Vincens, Emmelin and Stafström (2018) consider the Gini index at country-level and carry out fixed effects logistic regressions and cross-level interactions. Gu *et al.* (2019) use a multiple linear regression model and the Corrected Concentration Index (CCI). Besides, they employ the Wagstaff-type decomposition analysis.

Second, all the authors focus on different countries. Cabieses *et al.* (2015) examine Chile; Lillard *et al.* (2015) study the United States; Massa, Pabayo and Chiavegatto Filho (2018) consider Brazil; and Vincens, Emmelin and Stafström (2018) analyse Latin America. Meanwhile, Adjei, Brand and Zeeb (2017) are focused on five countries such as Germany, Italy, Spain, the United Kingdom and the United States. Looking at Europe, we find Leão and Perelman (2017) and Leão *et al.* (2018). On the one hand, Gu *et al.* (2019) study the case of China. On the other hand, Hong and Lee (2019) analyse the case of South Korea. In addition, Rözer, Kraaykamp and Huijts (2016) consider several countries around the world.

More specifically, Cabieses *et al.* (2015) analyse income inequality in SAH before and after the Chilean healthcare system reform from 2005. They examine the period between 2000 and 2013. They use the Caracterización Socio-Económica Nacional (CASEN) survey. In general terms, their results show that income inequality in SAH decreases during the period considered, being concentrated on Chilean adults with low-income. Hence, socio-economic status, education and income are significantly related to inequality in SAH, being educational level, household income and healthcare provision entitlement the major contributing factors to inequality.

Lillard *et al.* (2015) analyse the relationship between income inequality and SAH from 1913 to 2009. More specifically, they focus on population who were a child up to 80 years earlier. They use date from the Panel Study of Income Dynamics (PSID). Their findings show that population are more likely to assess poor SAH whether income was more unequally distributed in their first years of life. In addition, both women and men present higher probability of excellent SAH whether they are younger, white, have a larger stable income, and their parents show high-education levels.

Rözer, Kraaykamp and Huijts (2016) study the association between national income inequality and SAH. Besides, they show whether it is conditioned by social trust. They employ data from the World Value Survey (WVS) and European Value Survey (EVS), using all available waves from 1981 to 2014. Their results present a negative relationship between national income inequality and SAH. In addition, the findings indicate that national income inequality has a negative effect among population with high social trust. By contrast, they show a positive impact for individuals with low social trust.

On the one hand, Adjei, Brand and Zeeb (2017) study gender differences in SAH among elderly population according to socio-economic and family characteristics, time use activities and cross-country differences. The authors use data from the Multinational Time Use Study (MTUS) from 2000 to 2003. Their findings show that elderly people who spend more than one hour on paid work activities, those who spend more than six hours per day on housework activities or who devote more than four hours per day to active leisure activities present lower probability of reporting poor health. In addition, passive leisure and personal activity are related to greater probability of poor health.

On the other hand, Leão and Perelman (2017) analyse whether depression symptoms are associated with inequalities in SAH. The authors use two waves (2011 and 2015) from the Survey of Health, Ageing and Retirement in Europe (SHARE) focusing

on Spain, Italy and Portugal. Their results present that depression symptoms are related to poor SAH. In addition, chronic diseases and functional limitations imply poor SAH, more specifically, among women, low-educated and older population groups.

Leão *et al.* (2018) examine how educational inequalities in SAH affect European welfare states due to the Great Recession. They use individual data from the European Union Statistics on Income and Living Conditions (EU-SILC) survey, analysing 26 European countries from 2005 to 2014. Their findings show that absolute inequalities are constant and the relative ones slightly increase. In terms of educational inequalities in health, they are persistent across all the European countries considered during the whole period.

Meanwhile, Massa, Pabayo and Chiavegatto Filho (2018) investigate the relationship between income inequality and SAH among adult population in the 27 Brazilian capitals. They use data from the 2013 National Health survey. Their results present a significant association between income inequality and SAH. In addition, they find greater probability of poor SAH among adult population who live in medium and high-income Brazilian capitals. They indicate being a woman, older age groups, low-education level, smoking and having chronic diseases as determinants of poor SAH.

Vincens, Emmelin and Stafström (2018) analyse the effects of social capital and income inequality on the social gradient in health. They use data from the WVS and the World Bank from 2010 to 2014. Their findings indicate the existence of a social gradient in health, showing that population with a higher socio-economic level are advantaged. In addition, their results are moderated when they adjusted by generalized and neighbourhood trust at country-level. In terms of collective social capital, the authors show that it can affect social gradient in health.

Furthermore, Gu *et al.* (2019) measure income-related inequalities in SAH among population aged 60 and over years. The authors develop a decomposition analysis using data from the China Health and Retirement Longitudinal Study (CHARLS) survey in 2013. Their results reveal pro-rich inequality in health among the population considered. Besides, the decomposition study shows that income, residence, region and health insurance are the main contributors to health inequality, having all of them a significant association with SAH. The authors highlight the differences found between older women and men.

Hong and Lee (2019) analyse income-related inequalities in SAH as well as in self-perceived depression among married immigrants. In addition, they carry out a decomposition analysis using the National Survey of Multicultural Families in 2015. Their results show that over a quarter of the population considered assesses depressive symptoms. In addition, they indicate health inequalities favouring rich individuals for both SAH and depression. In terms of decomposition, the findings reveal that income, employment situation and subjective social status have a great impact on inequality.

Table 1.1. Selected paper on income inequalities associated with self-reported health

Authors	Time period	Area	Objective	Methodology	Main results
Cabieses *et al.* (2015)	2000-2013	Chile	To analyse income-related inequality in SAH	Erreygers Concentration Indices	Income inequality in SAH decreases after the healthcare reform and it is concentrated on adults from low-income households.
Lillard *et al.* (2015)	1913-2009	USA	To investigate the relationship between income inequality and SAH	Ordered probit models	Adults' health is negatively associated with the income inequality they experienced as children.
Rözer, Kraaykamp and Huijts (2016)	1981-2014	World	To show that social trust is a determinant of individuals' poor health	Multilevel models	There is a negative relationship between income inequality and SAH. High national income inequality harms population with large levels of social trust.
Adjei, Brand and Zeeb (2017)	2000-2003	Germany, Italy, Spain, UK and USA	To examine gender differences in SAH among elderly population	Multiple binary logistic regression	Time allocated to paid work, housework and active leisure activities are positively related to SAH. By contrast, time devoted to passive leisure and personal activities are negatively associated with SAH.
Leão and Perelman (2017)	2011 and 2015	Southern Europe	To corroborate if depression symptoms are related to inequalities in SAH	Multivariate logistic regressions	Depression symptoms, chronic diseases and functional limitations imply poor SAH, more specifically, for women, low-educated and older groups.

Authors	Time period	Area	Objective	Methodology	Main results
Leão *et al.* (2018)	2005-2014	Europe	To show how educational inequalities in SAH affect welfare states	The slope and the relative indices of inequality	Absolute inequalities in SAH are constant and the relative ones slightly increase.
Massa, Pabayo and Chiavegatto Filho (2018)	2013	Brazil	To investigate the association between income inequality and SAH	Bayesian multilevel models	Low-income inequality has a negatively association with individual health. Being an older woman, low educated, smoker and having chronic diseases imply poor SAH.
Vincens, Emmelin and Stafström (2018)	2010-2014	Latin America	To know the effects of two determinants on social gradient in health	Gini index, fixed effects logistic regressions and cross-level interactions	There is a social gradient in health, regardless of country-level heterogeneity and individual-level social capital.
Gu *et al.* (2019)	2013	China	To measure income-related inequalities in SAH among older population	Multiple linear regression model, CCI and the Wagstaff decomposition analysis	There is pro-rich inequality in health as well as differences in the main determinants that imply health inequalities between women and men.
Hong and Lee (2019)	2015	South Korea	To examine income inequalities related to SAH and self-rated depression among married immigrants	Concentration Index and Erreygers Concentration Index	There is pro-rich inequality in SAH and in depression symptoms. Socio-economic characteristics make a larger contribution to the overall inequality.

Note: SAH (Self-Assessed Health); USA (United States of America); UK (United Kingdom); CCI (Corrected Concentration Index).

1.3.2. Showing the relationship between self-rated health and social inequalities

According to the recent literature that analyse social inequalities in SAH, we find several papers that examine employment and occupational situation as well as education level as determinants of poor SAH (Borghesi and Vercelli, 2012; Murcia *et al.*, 2013; Molarius *et al.*, 2014; Maheswaran, Kupek and Petrou, 2015; Hu *et al.*, 2016; Balaj *et al.*, 2017; Holstein *et al.*, 2018; Torsheim *et al.*, 2018). All these studies are summarized in Table 1.2.

Despite the fact that all these articles are focused on social inequalities in SAH, their scopes are different between them. Borghesi and Vercelli (2012) analyse socio-economic determinants associated with happiness and health. On the one hand, Murcia *et al.* (2013) analyse occupational factors that imply social inequalities. On the other hand, Molarius *et al.* (2014) examine the existence of social inequalities in limitation from seeking health care. In addition, Maheswaran, Kupek and Petrou (2015), Hu *et al.* (2016), Holstein *et al.* (2018), and Torsheim *et al.* (2018) study trends in socio-economic inequalities. Besides, Balaj *et al.* (2017) investigate the independent and joint contribution of behavioural, occupational and living conditions factors to social inequality.

In terms of methodology, the articles considered here differ between them. Borghesi and Vercelli (2012) develop a systematic literature review. Murcia *et al.* (2013), Molarius *et al.* (2014), and Holstein *et al.* (2018) carry out logistic regression models. Moreover, Murcia *et al.* (2013) use the chi-square test. On the one hand, Maheswaran, Kupek and Petrou (2015) use a multi-level regression. On the other hand, Balaj *et al.* (2017) carry out binary logistic regression models throughout adjusted rate differences and adjusted rate risks. By contrast, Hu *et al.* (2016) measure socio-economic inequalities by means of absolute prevalence rate differences as well as relative prevalence rate ratios.

Besides, they use the slope index of inequality and relative index of inequality as well as a meta-analysis with random-effects model. Looking at Torsheim *et al.* (2018), they carry out a Poisson regression.

Borghesi and Vercelli (2012) study the main factors of subjective happiness as well as of objective health. Besides, they make a comparison between the two concepts considered. The findings reveal that per capita income presents an important impact on both happiness and health, more specifically, low thresholds. In addition, there exist other social determinants that play a relevant role for happiness and health. As policy implications, the authors show that the strategies intended to reduce poverty and inequality as well as invest in social and environmental capital, can improve happiness and health.

More specifically, Murcia *et al.* (2013) identify the contribution of several occupational status to social inequalities in SAH in France. They use data from the Samotrace survey between 2006 and 2007. They carry out their own questionnaire, collecting data from occupational physicians. Their findings show that manual as well as service workers (clerks) present higher probability of reporting poor SAH. The main differences in the contribution of occupational factors are observed in gender and occupational groups.

Molarius *et al.* (2014) examine the existence of social inequalities in limitation from seeking health care due to economic problems in 2008 in Sweden. The authors carry out their own survey questionnaire among population between 18 and 84 years old. Their results show that unemployed population as well as individuals on disability pension are more likely to limit from seeking health care. In addition, they find these results among young adults and population born outside the Nordic countries. Besides, the probability

of limiting or even refraining from seeking health care are higher among population with longstanding illness.

In addition, Maheswaran, Kupek and Petrou (2015) analyse changes in socio-economic inequalities in SAH. They use data from the Health Survey of England to focus on adult population in the United Kingdom from 1996 to 2011. Their findings show that the risk of reporting bad or very bad health is higher for population of lower social class. In addition, the probability of assessing bad or very bad health remains constant from 1996 to 2009 for individuals from social class I (professional). Meanwhile, it increases for individuals of lower social class, being the social class V (unskilled manual) the one that experiences the greatest increase.

Besides, Hu *et al.* (2016) study changes in socio-economic inequalities of SAH in Europe from 1990 to 2010. They use data from representative health surveys from 17 countries. Their results indicate that absolute inequalities in SAH are constant while relative inequalities increase for most of the countries. Few countries present significant decreases in absolute or relative inequalities. In addition, all countries show inequalities in SAH by education and occupation levels.

Meanwhile, Balaj *et al.* (2017) analyse the independent and joint contribution of behavioural, occupational and living conditions factors to social inequality in SAH. They use data from 21 countries from the 2014 European Social Survey and demonstrate both absolute and relative inequalities in SAH in all countries. In addition, they show that occupational and living conditions factors are the greatest determinants to inequalities across most of the countries, contributing independently and jointly with behavioural characteristics.

On the one hand, Holstein *et al.* (2018) describe changes in social inequality in poor SAH in Denmark between 1991 and 2014. They use data from five Health Behaviour

in School-aged Children surveys, focusing on among Danish teenagers. Their results suggest that both absolute and relative social inequalities in poor SAH are constant during the whole period.

On the other hand, Torsheim *et al.* (2018) examine socio-economic inequalities focusing on assessed family wealth and the Family Affluence Scale of six countries such as Denmark, Finland, Greenland, Iceland, Norway and Sweden from 2013 to 2014. They examine teenagers aged 11, 13 and 15 years using data from the Health Behaviour in School-aged Children (HBSC) survey. Their findings show that fair or poor SAH almost doubled between adolescents with the lowest family affluence and those with the highest family affluence. According to teenagers with the lowest reported family wealth, the results indicate that the probability of fair or poor SAH is four times more than in those with the highest rated family wealth.

Table 1.2. Selected paper on social inequalities related to self-rated health

Authors	Time period	Area	Objective	Methodology	Main results
Borghesi and Vercelli (2012)	-	-	To study socio-economic determinants associated with happiness and health	A systematic literature review	Per capita income and other social determinants have a relevant impact on happiness and health. Redistributing income from the rich to the poor could decrease health inequalities, improving poor populations' health.
Murcia *et al.* (2013)	2006-2007	France	To analyse working determinants that imply social inequalities in SAH	Chi-square test and a logistic regression model	Strong social inequalities are found among manual as well as service workers. Social inequalities in SAH decrease according to gender and occupational groups, where they find great differences.
Molarius *et al.* (2014)	2008	Sweden	To corroborate the existence of social inequalities in limitation from seeking health care	Multivariate logistic regression models	Social inequalities exist in SAH limiting from health care due to economic problems even though they vary between the types of care considered.
Maheswaran, Kupek and Petrou (2015)	1996-2011	United Kingdom	To examine trends in socio-economic inequalities in SAH	Multi-level regression	The probability of assessing bad or very bad health is greater for population of lower social class.

Authors	**Time period**	**Area**	**Objective**	**Methodology**	**Main results**
Hu *et al.* (2016)	1990-2010	Europe	To study trends in socio-economic inequalities of SAH	Means of absolute prevalence rate differences, relative prevalence rate ratios. Inequality indices. Meta-analysis with random-effects model	All countries present inequalities in SAH by education level and occupation. Some of them show constant trends and the remaining present decreases.
Balaj *et al.* (2017)	2014	Europe	To identify the contribution of behavioural, occupational and living conditions factors to inequality in SAH	Binary logistic regression	There are absolute and relative inequalities in SAH in all countries. Besides, occupational and living conditions factors imply inequalities, contributing independently and jointly with behavioural characteristics.
Holstein *et al.* (2018)	1991-2014	Denmark	To analyse trends in social inequality in poor SAH	Multilevel logistic regression models	Absolute and relative social inequalities in poor SAH are constant across the time.
Torsheim *et al.* (2018)	2013-2014	Nordic countries	To estimate socio-economic inequalities in SAH among adolescents	Poisson regression	Both objective and subjective socio-economic indicators show that the risk of fair or poor SAH is higher among adolescents with the lowest perceived family wealth.

Note: SAH (Self-Assessed Health).

1.4. The relationship between poverty and social issues

In this section, although the empirical studies on poverty vary in terms of their focus and scope, we review the literature on poverty related to health due to that is what our objective is based on. More specifically, our search analyses those articles which associate poverty with health, focused mainly on SAH. Most of the articles considered in this review examines overall health, finding that SAH gets worse in low-income countries. There are some factors that imply bad SAH, such as low education level, unemployment or living below the poverty threshold, among others (Brzezinski, 2015; Urbanos-Garrido and López-Valcarcel, 2015; Do, Frank and Iceland, 2017; Del Amo González, Benítez and Martín-Martín, 2018; Lauer and Houtenville, 2018; Pascual-Sáez, Cantarero-Prieto and Lanza-León, 2019). Looking at the literature of health poverty, we highlight some topics related to SAH, such as the access to health services, which we also analyse in this review.

1.4.1.Association between Self-Reported Health and poverty

As we mentioned above, we mainly focus on health due to we are interested in health economics. Therefore, in this subsection, we describe several articles that analyse SAH and poverty (see Table 1.3). Some on the papers considered here relate poverty with other issues such as mental health (Urbanos-Garrido and López-Valcarcel, 2015) or disabled population (Lauer and Houtenville, 2018), among others.

All these articles analyse health poverty focus on SAH. The main differences among them are the following ones. Firstly, in terms of methodology, Brzezinski (2015) as well as Pascual-Sáez, Cantarero-Prieto and Lanza-León (2019) use the Foster-Greer-Thorbecke indicator. Meanwhile, Urbanos-Garrido and López-Valcarcel (2015) use

matching methods based on propensity score, Difference-in-Differences (DiD) techniques as well as probit regressions. In addition, Do, Frank and Iceland (2017) carry out race-stratified multinomial and logistic regression models. On the one hand, Del Amo González, Benítez and Martín-Martín (2018) estimate multilevel logistic longitudinal models. On the other hand, Lauer and Houtenville (2018) use both replicate weights the Fay's balanced repeated replication as well as Taylor Series (linearization) methods. Secondly, each article uses a different database and, therefore, they focus on different countries, except Urbanos-Garrido and López-Valcarcel (2015); Del Amo González, Benítez and Martín-Martín (2018); and Pascual-Sáez, Cantarero-Prieto and Lanza-León (2019), who focus on Spain. For example, Brzezinski (2015) analyse Great Britain; while Do, Frank and Iceland (2017); and Lauer and Houtenville (2018) examine the case of the United States.

More specifically, Brzezinski (2015) analyses health poverty, showing the existing relationship between poverty and SAH. He uses data from the British Household Panel Survey (BHPS) from 1991 to 2008. In addition, he chooses specific population characteristics such as income and education level, household conditions or structure, among others. His findings indicate that health poverty rate raises if a fair or a higher SAH status is chosen as the health poverty threshold. In terms of subgroup decompositions, the most significant effects that influence health poverty are the increase of health poverty and the proportion of individuals cohabiting as well as those without children and, besides, the increase of the retiring population.

Meanwhile, Urbanos-Garrido and López-Valcarcel (2015) analyse the impact of unemployment on mental health as well as overall health (measured as SAH) of Spanish working-age people. As a second objective, they also study if the impact of unemployment on health increases or decreases according to the financial crisis. They use

two waves from the Spanish National Health Survey (SNHS): 2006 and 2011-2012. Their results suggest that long-term unemployment has a significant negative effect on mental health and SAH. In addition, this negative influence has increased since the economic crisis began. Finally, they show that psychological effects of unemployment are worse in recession periods.

Do, Frank and Iceland (2017) examine the relationship between health and metropolitan segregation within the metropolitan area as well as the neighbourhood poverty for black and white population. They use data from the National Health Interview Survey (NHIS) between 2008 and 2013 and their outcome of interest is SAH. They conclude that segregation is related to a larger risk of living in high poverty neighbourhoods for black population. In the case of white population, the authors do not find relevant evidence for a direct association between segregation and poor SAH. The concentration of poverty is greater for blacks. Several determinants that imply the increase in concentrated poverty are suburbanization and exurban development, exclusionary zoning or housing market discrimination, among others. Overall, black-white segregation is related to detrimental health outcomes for blacks.

Table 1.3. Selected articles on the overall relationship between self-assessed health and poverty

Authors	Time period	Area	Objective	Methodology	Main results
Brzezinski (2015)	1991-2008	Great Britain	To examine trends in health poverty, throughout SAH	Ordinal FGT measures	Increase of the individuals cohabiting as well as couples with no children affect health poverty.
Urbanos-Garrido and Lopez-Valcarcel (2015)	2006, 2011-2012	Spain	To analyse the impact of long-term unemployment on both mental and overall health	Matching techniques and DiD method	Anxiety and stress related to unemployment in the future have a negative large impact on individuals' health.
Do, Frank and Iceland (2017)	2008-2013	USA	To study the association between segregation and neighborhood poverty as well as segregation, neighborhood poverty and poor health.	Stratified multinomial and logistic regression models	The concentration of poverty is largest for blacks. Black-white segregation is associated with a greater risk of living in high poverty neighbourhoods for black population.
Del Amo González, Benítez and Martín-Martín (2018)	2007-2011	Spain	To examine the impact of long-term unemployment, poverty and social public expenditure on SAH	Multilevel logistic longitudinal model	Long-term unemployment, poverty and public expenditure raise the probability of reporting poor health. Family income decreases it.
Lauer and Houtenville (2018)	2009-2014	USA	To report the prevalence and socio-demographic factors among disabled people	Fay's balanced repeated replication method and Taylor Series method	Disabled population present disparities and inequity compared to non-disabled people.
Pascual-Sáez, Cantarero-Prieto and Lanza-León (2019)	2008-2016	Spain	To analyse trends in individual SAH and to decompose some socio-economic factors	Ordinal FGT measures	Health poverty increases because of the economic crisis. Age, gender and education level affect SAH poverty.

Note: SAH (Self-Assessed Health); FGT (Foster-Greer-Thorbecke); DiD (Differences-in-Differences); USA (United States of America).

In addition, Del Amo González, Benítez and Martín-Martín (2018) analyse the joint effects of long-term unemployment, poverty (social deprivation) and social public expenditure on bad SAH during the economic crisis. They use data from the Spanish Survey on Living Conditions from 2007 to 2011. Their findings present that long-term unemployment increases the probability of assessing poor health. In addition, being very long-term unemployed raises to a greater extent the likelihood of reporting bad health. Meanwhile, family income is associated with better SAH. In the case of living in poverty (i.e. living with severe material deprivation), it increases the probability of reporting bad health. Furthermore, regional public expenditure is positively related to bad SAH, rising the likelihood of reporting poor health.

Looking at disabled population, Lauer and Houtenville (2018) assess the prevalence and socio-demographic characteristics among disabled population older than 18 years. They use several surveys such as the American Community Survey (2009-2014), Current Population Survey Annual Social and Economic Supplement (2009-2014), National Health Interview Survey (2009-2014) and the Survey of Income and Program Participation (2009-2011). Their findings show that people with disability experience higher probability of bad or very bad SAH as well as having health insurance. Besides, this population group also has a greater risk of lower education level, unemployment, living below the poverty threshold and being single.

More recently, Pascual-Sáez, Cantarero-Prieto and Lanza-León (2019) analyse trends in individual SAH, decomposing several socio-economic factors to examine how these determinants affect population' health. To do this, they use data from the EU-SILC from 2008 to 2016. Their results suggest that, whether it is chosen a fair SAH status as a poverty threshold, there is a positive growth in terms of health poverty. By contrast, it is

shown a negative path if the poverty threshold considered is poor SAH status. In addition, health poverty increases in Spain due to the economic crisis.

1.4.2. Relating poverty and self-related health through the access to health services

In this subsection, another relevant issue is considered such as health insurance and access to health care (see Table 1.4). We find some studies (Van der Wees, Zaslavsky and Ayanian, 2013; Allen *et al.*, 2014; Miller and Wherry, 2016; Dalinjong *et al.*, 2017) that associate these topics with SAH.

Nevertheless, the articles mentioned above present different scopes. Van der Wees, Zaslavsky and Ayanian (2013), and Miller and Wherry (2016) show the differences in SAH and in the use of health services because of any change in the health system. Meanwhile, Allen *et al.* (2014), and Dalinjong *et al.* (2017) examine factors such as the access and utilization of health services and SAH.

As methodology, some of the articles considered here use the same models to carry out their studies. Van der Wees, Zaslavsky and Ayanian (2013) estimate a multivariate logistic regression with DiD analysis. Similarly, Miller and Wherry (2016) employ a quasi-experimental DiD method to compare changes. In addition, Allen *et al.* (2014) use the Pearson's chi-square measure and a multivariate regression. By contrast, Dalinjong *et al.* (2017) consider multiple logistic regression models.

Table 1.4. Selected paper on the association between self-perceived health, poverty and access to healthcare services

Authors	Time period	Area	Objective	Methodology	Main results
Van der Wees, Zaslavsky and Ayanian (2013)	2001-2011	Massachusetts (United States)	To compare trends related to health status and the use of health services	Multivariate logistic regression with DiD analysis	Massachusetts residents show improvements in health status, physical and mental health and in the access to health care compared to other New England states.
Allen *et al.* (2014)	2009-2010	Portland (United States)	To examine if stigma is related to access to health care, quality of care, SAH and socio-economic or systemic factors	Pearson's chi-square measure and multivariate regression	There is a fear of being treated poorly when the individual has unmet health needs, poorer experiences of quality of care and worse SAH.
Miller and Wherry (2016)	2010-2014	United States	To analyse trends on SAH, health insurance coverage, access to and use of health care services due to Medicaid expansions	Quasi-experimental DiD	There is evidence of higher utilization of some health care services due to Medicaid expansions. By contrast, these expansions do not have any significant impact on SAH.
Dalinjong *et al.* (2017)	2012	Ghana	To study the association between health insurance status and use of health services	Multiple logistic regression models	Individuals who need of health services (with poor or very poor SAH, recent illness or injury and taking chronic medication) have higher risk of using health services.

Note: DiD (Difference-in-Differences); SAH (Self-Assessed Health).

Van der Wees, Zaslavsky and Ayanian (2013) analyse SAH as well as the utilization of health services before and after the implementation of the Massachusetts' health care reform in 2006. They use the Behavioural Risk Factor Surveillance System from 2001 to 2011, selecting population between 18 and 64 years old. They find that population assess better their health status in Massachusetts compared with other New England states, as happens with physical and mental health. In addition, they are more likely to report improvements in the access to health care, more specifically, people who live in low-income households. In short, they conclude that health care reform improves health status among Massachusetts residents and they use more some health care services.

On the one hand, Allen *et al.* (2014) examine if stigma is related to access to care, quality of care and SAH as well as to socio-economic or systemic characteristics. More specifically, they define stigma as a perception or fear of being treated poorly in terms of health care. The authors conduct a survey from 2009 to 2010, focusing on non-elderly adults with low-income in Portland. Their results find stigma when the individual present unmet health needs, poorer opinions of quality of care and worse SAH.

On the other hand, Miller and Wherry (2016) study if any changes are made on SAH, health insurance coverage, access to and use of health care services due to the state Medicaid expansions. They use the NHIS between 2010 and 2014, focusing on population aged 19–64, whose incomes are below 138% of the Federal Poverty Level in the United States. Overall, their findings show that low-income adults in expansion states present greater rates as well as larger quality of health insurance coverage and higher use of some health care services compared to adults in states that do not expand Medicaid. Meanwhile, in terms of SAH, the authors do not find evidence of any change related to Medicaid expansions.

In addition, Dalinjong *et al.* (2017) corroborate the relationship between health insurance status and the use of health services. The authors take samples in rural poor communities of Northern Ghana throughout the Navrongo Health and Demographic Surveillance System (NHDSS) 2012, which is a continuous population registration system. Their results find that being insured with the NHIS is related to an increasing use of health services in the area considered. Individuals who were sick in the last month and those with poor or very poor SAH are most likely to be insured. They show that individuals with recent illnesses or injuries as well as those with poor or very poor SAH have greater probability of using health services. The same happens with people who take chronic medications.

1.5. The connection between polarization and social determinants

As we already mentioned, it is recently that polarization has received research attention in spite of a few articles have examined it yet. It should be highlighted that, to the best of our knowledge, the empirical evidence for polarization in Europe is not decisive. In particular, most of the existing literature analyse income polarization and it explains the disappearance of the middle class in income distributions (Wolfson, 1994; Poggi and Silber, 2010; Alichi, Kantenga and Sole, 2016; Mysíková and Večerník, 2018). Nevertheless, other articles focus on polarization, describing social conflicts such as those developed by Esteban and Ray (1994 and 2011). In addition, other studies considered in this review examine health polarization (e.g., Apouey in Britain, 2007; Apouey in France, 2010; Pérez and Ramos in Spain, 2010; Fusco and Silber, and Pascual, Cantarero and Lanza in Europe, 2014 and 2018, respectively).

1.5.1. The relationship between income and polarization

In this subsection, we describe those articles focused on income. There is hardly any other topic on polarization that has received more attention in the existing literature. We can define income polarization as the disappearance of the middle-income class while the low- and high-income classes increase. All these studies are summarized in Table 1.5.

The articles considered in this review show similarities, but also differences among them. All of these papers have similar objectives, investigating the disappearance of the middle class in terms of income. Nevertheless, among the differences, we find that they do not use the same methodology.

Four of the eight studies examined in this subsection (Gochoco-Bautista *et al.*, 2013; Wang *et al.*, 2015; Alichi, Kantenga and Sole, 2016; Sączewska-Piotrowska and Wąsowicz, 2017) are comparable in methodology. In the case of Gochoco-Bautista *et al.* (2013), and Wang *et al.* (2015), they use the polarization index developed by Duclos, Esteban and Ray (2004) (DER) for continuous distributions. The first authors use another polarization measure, the Foster-Wolfson index. Similarly, Alichi, Kantenga and Sole (2016), and Sączewska-Piotrowska and Wąsowicz (2017) employ Wolfson's (1994) polarization index. However, according to those studies which use a different methodology, Alichi, Mariscal and Muhaj (2017) publish an article where they develop two new indicators (the population-share index and income hollowing-out index) to eliminate the deficiencies of Wolfson's index. In addition, the rest of the articles follow another methodology. First, Poggi and Silber (2010) use the polarization index developed by Silber, Deutsch and Hanoka (2007). Second, Foster and Wolfson (2010) propose new methodology. Finally, Mysíková and Večerník (2018) apply the relative distribution method proposed by Handcock and Morris (2006), and Alderson and Doran (2013).

Furthermore, we find another difference looking at the geographical areas considered. We describe each one of the articles considered in this subsection according to the country or area analysed. First, we look at those studies focused on European countries. Therefore, we find articles such as that developed by Poggi and Silber (2010), where they combine both income and income mobility polarization in Italy. More specifically, their principal aim is to show how to make the difference between two components in a change in polarization, one related to structural mobility and the other one associated with exchange mobility. To carry out their analysis, they use the Work Histories Italian Panel (WHIP) from 1985 to 2003, which is a panel database that link employer–employee. Their findings show that, taking into account the identity of the individuals, they distinguish between a change over time in polarization because of "structural mobility" and a change in polarization as the consequence of "exchange mobility". Besides, they define the structural mobility as a change in inequality over time whereas exchange mobility is a change in the ranks of the individuals over time.

Meanwhile, Wang *et al.* (2015) analyse income polarization and decompose it by country clusters due to polarization is relatively unexplored in Europe. Thus, they use microdata from the EU-SILC survey by selecting 28 European countries as well as 3 non-EU countries from 2004 to 2012. Their principal findings show that income polarization remains stable over the period considered in spite of the economic crisis. It increases in some countries from 2004 to 2008, but then it decreases. Meanwhile, the opposite happens in the case of the Central and Eastern Europe New Member States. Decomposing income polarization, there is no evidence that polarization changes are caused by a certain pattern. However, they conclude that polarization raises with market income whereas it decreases with tax-benefit systems.

More recently, Sączewska-Piotrowska and Wąsowicz (2017) make a comparison of income polarization between rural and urban areas in Poland from 2000 to 2015. More specifically, their main objective is to know if the middle-income class of Polish population is disappearing as well as whether it is associated with the place of residence. To do this, they use data from Social Diagnosis project and they distinguish three household groups based on their income: low, middle and high. Their results suggest that rural areas have lower income and they have greater inequality and polarization levels. In the case of urban households, their assessment concerning the economic situation is better than in the case of rural areas. Furthermore, the percentage of middle-income classes and the share of low-income classes are greater in urban and rural areas, respectively.

In addition, Mysíková and Večerník (2018) examine personal income distribution and income polarization in three specific countries (Austria, Czech Republic and Poland), analysing the economic crisis. More specifically, they examine two periods: the first one captures the situation before the crisis (2004-2007) and the second one is during the economic crisis (2007-2010). They use data from the EU-SILC survey and their results suggest that there is no evidence that the crisis affects income polarization. Nevertheless, they show that personal earnings polarization raises in Austria during the crisis period, but in a slower pace than before it. Meanwhile, it remains relatively stable in Czech Republic and Poland. Focused on some characteristics such as gender or education, they demonstrate that education level reduces personal income distribution during the crisis in Austria and Poland. The opposite happens in the Czech Republic. In the case of gender, the crisis period weakens income polarization.

Next, we focus on a geographical area such as the United States and we analyse three articles (Foster and Wolfson, 2010; Alichi, Kantenga and Sole, 2016; Alichi, Mariscal and Muhaj, 2017). In this case, Foster and Wolfson (2010) evaluate the middle

class and the polarization of the income distribution. The authors also add the study of Canada, making a comparison between the two countries. They used available data from Luxembourg Income Study for 1981 and 1987 as well as for 1979 and 1986, in the case of Canada and the United States, respectively. In addition, they also analyse 1988, using data from the Survey of Consumer Finance for Canada and from the March Current Population Survey for the United States. They find clear increases in polarization, showing that income polarization increases in the United States while it remains stable or even decreases in Canada. Thus, when they compare the situation of both countries, they conclude that the United States has a higher polarization level than Canada.

Alichi, Kantenga and Sole (2016) analyse income polarization at the national level using the Michigan's Panel Survey of Income Dynamics (PSID) from 1970 to 2015. The results show that income polarization increases over the period. In addition, household consumption presents important heterogeneity in the income distribution. A similar study is developed by Alichi, Mariscal and Muhaj (2017). In this case, they show the different income polarization levels suffered by different states. More specifically, they analyse income polarization focused on the state level over the last four decades. They use the Current Population Survey (CPS). In general terms, they highlight that income polarization has increased from 1977 to 2016. Their findings suggest that richer states tend to have the greatest percentages of middle-income class population as well as the least shares of low- and high-income class population.

In addition, taking into account the paper developed by Gochoco-Bautista *et al.* (2013), they study income polarization in some Asian countries. More specifically, their article analyses both rural and urban sectors. They examine expenditure per capita using household survey data from 1985 to 2010. Their results show that inequality is positively associated with polarization. In the case of rural areas in most countries, polarization is

lower than in the urban ones. Some factors such as high Gross Domestic Product (GDP) and GDP per capita growth rates as well as high education levels of household heads may be significant to decrease income polarization.

1.5.2. The association between health and polarization

Looking at the investigations focus on health polarization, only a few ones so far have examined it. We can affirm that health polarization explains the mass relocation from the middle of SAH distribution to the poles (very bad or very good health). In other words, it is similar to the distance between different SAH levels. The empirical studies on health polarization vary in terms of their focus and scope. In this review, we analyse specifically those papers whose main objective is SAH (see Table 1.6). Nevertheless, we find other topics that polarization literature analyses in terms of health such as macrophage (Cassetta, Cassol and Poli, 2011; Alfano *et al.*, 2013; Catrysse and van Loo, 2018).

Several studies analyse health polarization through an ordinal variable such as SAH. More specifically, we find papers of Apouey (2007), Apouey (2010), Pérez and Ramos (2010), Fusco and Silber (2014), and Pascual, Cantarero and Lanza (2018). All these studies consider health polarization focus on SAH and the main differences among them are the following ones. First, in terms of methodology, Apouey (2007, 2010) as well as Fusco and Silber (2014) develop their own polarization measures, whereas Pérez and Ramos (2010), and Pascual, Cantarero and Lanza (2018) use methodology already used. On the one hand, Pérez and Ramos (2010) include two inequality indicators such as the Theil index and the Mean Logarithmic Deviation (MLD). On the other hand, Pascual, Cantarero and Lanza (2018) demonstrate their goal throughout the Apouey's bi-polarization indicator.

Table 1.5. Selected paper on the relationship between income and polarization

Authors	Time period	Area	Objective	Methodology	Main results
Poggi and Silber (2010)	1985-2003	Italy	To make a distinction between two elements of the change in polarization, related to structural mobility and exchange mobility	P_G polarization index developed by Silber, Deutsch and Hanoka (2007)	Differences in a polarization change between both structural mobility and exchange mobility.
Foster and Wolfson (2010)	1979, 1986, 1988 1981, 1987, 1988	USA and Canada	To compare polarization in income distribution	New methodology proposed by them	Income polarization increases in USA, but it is stable or decreases in Canada. Thus, USA presents higher polarization than Canada.
Gochoco-Bautista *et al*. (2013)	1985-2010	Asia	To analyse income polarization in both rural and urban areas	Foster-Wolfson and DER polarization indices	Inequality and polarization are positively correlated. Income polarization presents higher levels in urban sectors than in rural ones.
Wang *et al*. (2015)	2004-2012	Europe	To examine income polarization and decompose it by country clusters	DER index	Income polarization is stable, rising with market income and decreasing with tax-benefit systems. There is no evidence that polarization changes are caused by a certain pattern.
Alichi, Kantenga and Sole (2016)	1970-2015	USA	To study income polarization at the national level	Wolfson's index	Income polarization and inequality increase. Household consumption indicates heterogeneity in the income distribution.

Authors	**Time period**	**Area**	**Objective**	**Methodology**	**Main results**
Alichi, Mariscal and Muhaj (2017)	1977-2016	USA	To evaluate income polarization at the state level	Population-share index and income hollowing-out index	Income polarization increases. Richer states present lower polarization level, higher shares of middle-income class population and lower shares of low- and high-income class population.
Sączewska-Piotrowska and Wąsowicz (2017)	2000-2015	Poland	To know if the middle-income class is disappearing in rural and urban areas	Wolfson's index	Urban areas present higher income and lower inequality and polarization levels. These areas have greater share of middle-income classes.
Mysíková and Večerník (2018)	2004-2010	Czech Republic, Austria and Poland	To analyse personal earnings distribution	Relative distribution method	There is no evidence that crisis implies income polarization. Personal earnings polarization increases in Austria and it is stable in Czech Republic and Poland.

Note: USA (United States of America); DER (Duclos, Esteban and Ray (2004)).

Second, each of the studies uses a different database and they also analyse a different country, except Fusco and Silber (2014), and Pascual, Cantarero and Lanza (2018), who carry out their studies focusing on Europe, in general terms. Looking at Apouey (2007), they analyse the case of Great Britain while Apouey (2010) do it for France. Furthermore, Pérez and Ramos (2010) study health polarization in Spain.

More precisely, Apouey (2007) examines the relationship between polarization and inequality, using data provided by the BHPS for thirteen years (from 1992 to 2004). She focuses her study on SAH. To carry out her paper, she develops two polarization measures that can be applied to ordinal distributions. These indices are median based and satisfy axioms whose properties are similar to those polarization measures for cardinal distributions. Her findings suggest that SAH polarization and inequality are empirically different, but they sometimes behave similarly. For example, polarization increases from 1995 to 2001 whereas inequality decreases. By contrast, the distributions of 2001 and 2003 show a smaller polarization degree and a greater inequality level compared to the one of 1992. A few years later, she develops two measures to quantify bivariate polarization (Apouey, 2010). In addition, she provides an empirical approach, using these indicators for women's income in French to analyse polarization in the report of very good health, using a national health survey such as "Enquête Décennale Santé" in 2002 and 2003. She concludes that social polarization in health vary with age. More specifically, the probability of reporting very good health raises between 18 and 64 years old due to increases in income and education level. Meanwhile, the probability of reporting very good health decreases for women older than 65 years, characterised by low education levels.

Furthermore, Pérez and Ramos (2010) examine the association between income polarization and individual health, using data provided by the European Community

Household Panel (ECHP) survey and considering eight waves, from 1994 to 2001. Their findings suggest that income has a positive effect on health. Meanwhile, other factors such as having problems of crime, vandalism and pollution in the area of residence have a negative correlation with individual health. In addition, polarization implies a negative impact on Spanish population' health. When they analyse region polarization, they conclude that it does not have a significant impact on health. By contrast, if they study polarization between reference groups such as education-age, they find that it is negatively correlated with health.

In the case of Fusco and Silber (2014), they measure to what extent the distributions among the five answers about SAH differ from the non-immigrant's subgroup to the immigrants' one. They use cross-section data from the EU-SILC in 2009. The results suggest that Luxemburg and Belgium have the lowest levels of social polarization in health. Meanwhile, Estonia and Latvia have the greatest ones.

In addition, as we seen above, Pascual, Cantarero and Lanza (2018) analyse the association between health polarization (thought SAH) and inequality. They use data from the European Health Interview Survey (EHIS), examining two available waves: 2006–2009 and 2013–2015. On the one hand, focused on the countries where the median category is very good health, their results show a similar situation than that obtained for inequality analysis, having Ireland the lowest level of health polarization whereas Greece presents the highest one. On the other hand, focused on the countries where the median category is good health, their findings suggest that Malta has the lowest health polarization level whereas Estonia has the highest one.

Table 1.6. Selected paper on the association between self-assessed health and polarization

Authors	Time period	Area	Objective	Methodology	Main results
Apouey (2007)	1992-2004	Great Britain	To examine the association between polarization and inequality focused on SAH	Her own polarization indices	Polarization shows variability, increasing and decreasing over time. Both polarization and inequality are empirically different, but sometimes behave similarly.
Apouey (2010)	2002-2003	France	To analyse polarization in the report of very good health among women	Bi-polarization index proposed by her	Social polarization in health varies with age, increasing between 18 and 64 years old due to increases in income and education level.
Pérez and Ramos (2010)	1994-2001	Spain	To show the relationship between income polarization and individual health	Theil index and MLD	Polarization implies a negative impact on Spanish population' health.
Fusco and Silber (2014)	2009	Europe	To study to what extent the SAH distribution differ from natives and immigrants	Their own social polarization measures (POLOR)	Central Europe has the lowest levels of social polarization in health. Meanwhile, Baltic states present the greatest ones.
Pascual *et al*. (2018)	2006-2009 2013-2015	Europe	To examine the association between SAH polarization and inequality	Apouey's bipolarization index	Being the median category as very good health, Greece have the highest health polarization and Ireland the lowest one. If the median category is good health, Estonia has the greatest polarization whereas Malta has the lowest one.

Note: SAH (Self-Assessed Health); MLD (Mean Logarithmic Deviation).

1.6. Conclusions

In this chapter, we have reviewed the most current articles considered in the literature related to health inequality, poverty and polarization. More specifically, those that associate SAH with them, as far as possible, because we are focused on health economics research.

The main results obtained in this paper can be summarized as follows. First, we show the conclusions for health inequality. Looking at the relationship between income inequality and SAH, we can conclude that that being a woman, older as well as having a low-education level imply poor SAH. In addition, population with low-income presents greater risk of very poor SAH. On the one hand, social trust is a determinant of income inequality. On the other hand, having chronic diseases contributes to report poor SAH. Furthermore, passive leisure and personal activity are associated with greater probability of poor health. According to social inequalities and SAH, we find that social inequalities in poor SAH are constant, making occupational and living conditions factors the highest contribution to them. Besides, the risk of assessing bad or very bad health remains constant for individuals from upper social class I (professional) whereas it increases for lower social class population. In addition, the probability of perceiving fair or poor SAH is greater for teenagers with lowest reported family wealth and lowest family affluence.

Second, we describe the conclusions for health poverty. On the one hand, according to the relationship between SAH and poverty, we find that the raise of the proportion of individuals cohabiting and those without children as well as the increase of the retiring population affect health poverty. In addition, race, education level or employment status, among others, are also determinants of health poverty. On the other hand, in the case of poverty in terms of access to health care, we find that health care

reforms and expansions improve SAH and increase the use of health care services. Besides, individuals who assess poor or very poor SAH present larger probability of using health services.

Finally, we suggest the following conclusions for polarization. We can argue that income polarization raises over time. Nevertheless, there is no evidence that economics and financial crisis affect it. In terms of geographical area, we find that rural areas have lower income as well as larger polarization level. Therefore, richer states present lower income polarization degree. Regarding the results of the studies related to SAH polarization, we show the association between socio-economic characteristics and polarization. In the case of age, the probability of reporting very good health increases between 18 and 64 years old. In addition, there is a positive correlation between polarization and income as well as a negative correlation between polarization and environmental factors. In the case of geographical area, we find that Baltic countries present the highest polarization level.

Chapter 2

Health polarization and self-assessed health inequalities across Europe: An empirical approach

2.1. Introduction

Polarization is a term which emerged in the 1980s, because of the impossibility of measuring the disappearance of the middle class with the traditional inequality measurements. It can explain events such as mass relocation from the middle of some distribution (social, income or health, among others) to the poles. The concept of social polarization regards to the measurement of the distance between different social groups, defined on variables such as race, religion or ethnicity. If a distribution is concentrated around the median, it indicates a lower degree of polarization. By contrast, high polarization refers to those distributions expanded to the tails (Chakravarty and Majumder, 2001). In our case, we focus on health polarization, so, it explains the mass

relocation from the middle of Self-Assessed Health (SAH) distribution to the poles (very good or very bad health). In other words, it is similar to the distance measurement between different SAH levels. In this field, only a few studies so far have examined polarization.

In the same way, SAH inequalities have received less attention in health economics. The use of SAH has become very common as a study variable in empirical research. In order to measure dispersion for ordinal data, literature has focused on inequality, which measures are mean based. An alternative to mean-based inequality measures is median-based polarization measures. Authors such as Allison and Foster (2004) recommend using the median as a reference level because it is central in the distribution and does not depend on the scaling.

Both terms, polarization and inequality, are closely related, although each one highlights a different aspect of a distribution. The analysis of polarization may be of a twofold interest: economic and policy. If the economic reasons of a polarized system are understood, it could help policy makers to choose the necessary measures to reduce inequalities. There are contributions in the existing literature that demonstrate the differences between these two concepts, being Wolfson (1994), and Esteban and Ray (1994) the pioneers. In this field, we can also cite Apouey (2007). In short, we define polarization as the concentration around different tails whereas inequality is the concentration around the average.

To the best of our knowledge, empirical evidence for polarization in Europe is not conclusive (Jones *et al.*, 2011; Apouey and Silber, 2013; Fusco and Silber, 2014; Wang *et al.*, 2015). The purpose of this study is to introduce polarization in the literature that analyse health inequalities because the number of empirical studies on health polarization is still limited. Therefore, this paper contributes to the existing research providing the

greatest possible comparison of inequality and polarization in health across Europe. We use the available information on SAH to analyse the most recent evolution. In short, as far as we know, this is the first study that examines health inequalities and polarization through SAH in 27 European countries.

We provide an empirical illustration of health inequality and polarization using data from the European Health Interview Survey (EHIS) in two different waves: 2006-2009 and 2013-2015. As far as we know, this paper develops an original inequality measure, which has only been used in the applied health economics by Madden (2010) and Jones *et al.* (2011). Our findings suggest that inequality increases in countries such as Greece, Ireland, Romania and Spain, among others, as well as polarization, when we focus on the calibration of the parameter α proposed by Apouey (2007).

This paper is therefore structured as follows. Next section reviews the existing literature about inequality and health polarization while Section 2.3 describes data considered and defines the key variable. Section 2.4 shows the approaches used to the measurement of health inequality and health polarization. Section 2.5 presents our main empirical findings. Finally, Section 2.6 makes some concluding remarks.

2.2. Previous literature

Despite the fact that several studies have examined polarization, as we mentioned above, it is only recently that this issue has received research attention. More specifically, it has become popular in economics. Studies on polarization typically describe the evolution of the disappearance of the middle class in income distributions (Wolfson, 1994; Poggi and Silber, 2010). However, other studies on polarization cover issues such as social conflicts

(Esteban and Ray, 1994 and 2011) or health, among others. To describe the existing literature about this issue, we divide it into four sections: i) income polarization in general, ii) income polarization related to economic growth, iii) income polarization introducing health and iv) health polarization (see Table 2.1).

We find some studies focused on income polarization but decomposing it by population groups (Winsberg, 1989; Chakravarty and Majumder, 2001; Wang and Wan, 2015; Sączewska-Piotrowska and Wąsowicz, 2017). First, Winsberg (1989) analyses income polarization of households in central cities and suburbs around the 37 largest metropolitan areas of the United States between 1950 and 1980. He concludes that polarization exists among both rich among poor people, in urban areas as well as in suburbs. Nevertheless, income polarization depends on different socio-economic characteristics in each metropolitan area. Second, Chakravarty and Majumder (2001) investigate the movement in polarization in 6 states of India using household expenditure data from the National Sample Survey Organisation (NSSO) in 1987-1988 and 1993-1994. More specifically, they distinguish between urban and rural sectors. They conclude that in the majority of rural areas, inequality and polarization have decreased in 1997-1988, in comparison with 1993-1994. For China, Wang and Wan (2015) analyse polarization and its changes. For the country as a whole as well as for urban and rural areas, their outcomes suggest that income polarization increases from 1986 to 1994 and from 2000 to 2003, when it reaches the peak. Since 2003, polarization decreases. A similar study by Sączewska-Piotrowska and Wąsowicz (2017) shows how disappeared the middle-income class, analysing households with low-, middle- and high-income in Poland from 2000 to 2015, using data from Social Diagnosis project. In addition, they present how this is related to the place of residence. Their findings conclude that

polarization measure varies over the time. In spite of this, income polarization is higher in rural areas, where people also have lower income.

Focused on income polarization in general, there are some studies such as those developed by Abdel-Ghany (1996) and by Azomahou and Diene (2012). Abdel-Ghany (1996) studies the impact of demographic and economic aspects of household on income polarization in America in 1990. More specifically, he uses the income polarization index to measure income inequality, defined as the bottom-to-top quintile income. His findings show that unemployment rate and education as well as women's labour force participation contribute to income polarization. In addition, Southern States have a greater income inequality than the national average. For the different African economies, Azomahou and Diene (2012) analyse polarization levels at the same time that they examine the effects of innovation over the period 1966-2008. For analysing income polarization, they use the Gross Domestic Product (GDP) as indicator and, in the case of innovation, they use patents and registered trademarks. They use data from the World Bank Africa Database. Their results show a growing bipolarization of income, which is related to specialization of African countries. They also find that two sectors (services and mining) reduce income bipolarization. Regarding innovation indicator, trademarks are statistically more significant than patents.

In addition, based on the European Union Statistics in Income and Living Conditions (EU-SILC), we find Wang, Caminada and Wang (2017) and Mysíková and Večerník (2018). The first authors analyse income polarization as well as its determinants in 20 European countries from 2004 to 2013, differing between West countries and Central and Eastern European New Member States (CEE NMS). They conclude that there is an increase in income polarization followed by a decrease at the end in West countries

whereas the opposite happens in the CEE NMS. Meanwhile, the second authors analyse it in Austria, Czech Republic and Poland in two waves, 2004-2007 and 2007-2010. More specifically, they examine the trends of personal earnings distribution before and during the economic crisis. Their findings show that the work sector, gender and education are factors that contribute the most to income inequality. In addition, they cannot conclude that crisis drives income polarization.

On the other hand, different researches have been made to study income polarization related to economic growth (Seshanna and Decornez, 2003; Duro, 2005; Ezcurra, 2009; Brzezinski, 2013). Firstly, Seshanna and Decornez (2003) analyse polarization and inequality through the mean real GDP per capita, making between-country comparisons from 1960 to 1999. Their results conclude that the constant economic growth has benefited almost every analysed country. The whole world is becoming more polarized over time. Moreover, richer countries are the less polarized regardless if they are classified by organization, level of globalization, geographical or income group. Opposite to this study, Duro (2005) finds no evidence of monotonous growth in the international income polarization from 1960 to 2000, using the Esteban, Gradín and Ray (EGR) index. He observes a curvilinear time trajectory, increasing polarization in the early years but declining afterwards. Secondly, Ezcurra (2009) analyses the relationship between income polarization and socio-economic growth in the European regions from 1993 to 2003, using data from the European Community Household Panel (ECHP) survey. He uses the polarization measures developed by Esteban and Ray (1994) and Esteban, Gradín and Ray (2007). To complete the study, he includes additional variables. His findings suggest that income polarization may affect regional economic growth in a negative way. Polarization level varies significantly in the

European Union regions, being the most polarized located in the Southern Europe. Additionally, we find Brzezinski (2013), who observes if income polarization has an effect on economic growth, using the World Income Inequality Database (WIID) to examine more than 70 countries around the world between 1960 and 2005. His main conclusions are that there is a negative and statistically significant short-term impact of income on growth. Meanwhile, he finds no statistically significant impact of inequality on economic growth.

Furthermore, other studies of income polarization introduce health in their analysis (Blanco and Ramos, 2010; Apouey and Silber, 2013). We find Blanco and Ramos (2010), who analyse the relationship between income polarization and individuals' health, using Spanish data from the ECHP survey. They employ two inequality measures such as the Theil index and the Mean Logarithmic Deviation (MLD). They analyse polarization between regions and age-education groups. Their results indicate that polarization has a negative effect on individuals' health. In addition, polarization is relevant between reference groups and the opposite happens between regions. Besides, Apouey and Silber (2013) measure inequality and bipolarization in socio-economic status, more specifically, income and health, proposing two approaches to quantifying it. They use data for 2004-2006 and 2011 from the EU-SILC. Their findings suggest that Estonia has the highest degree of income and health dispersion, in both periods. Moreover, Cyprus and Portugal also have a large degree. The opposite happens with Iceland and Italy, where they find the lowest levels of inequality and bi-polarization, followed by Netherlands.

In the case of health economics, only a few studies so far have examined polarization (Apouey, 2007; Jones *et al.*, 2011; Fusco and Silber, 2014). Apouey (2007)

compares inequality and polarization, using the British Household Panel Survey (BHPS) data from 1992 to 2004. Her findings demonstrate that inequality and polarization are empirically different, but there are cases where both behave similarly. Based on the European Union, using the World Health Survey (WHS) data, Jones *et al.* (2011) measure and compare inequalities and polarization in health in the responsiveness of health systems of 25 European countries. The results suggest inequalities in responsiveness, showing Northern Europe countries the greatest inequalities and Southern Europe countries the lowest ones. Similarly, Fusco and Silber (2014) develop two social polarization measures based on SAH status, using cross-sectional data from the EU-SILC. Their aim is to know the extent to which the distributions between the five possible answers about SAH vary from the immigrants' subgroup to the non-immigrants one. They conclude that Estonia and Latvia have the largest levels of social polarization in health while Luxemburg and Belgium have the lowest ones.

Table 2.1. Main conclusions of the studies about polarization review

Authors	**Year**	**Country**	**Methodology**	**Main results**
Winsberg (1989)	1950-1980	United States	Polarization or disparity index	Polarization exists in urban areas and suburbs among rich and poor people.
Abdel-Ghany (1996)	1990	United States	Income polarization ratio	Southern States have greater income inequality than the national average.
Chakravarty and Majumder (2001)	1987-1988 1993-1994	India	Wolfson's (1994) polarization index and a new index Q_r	In urban areas, polarization decreases and inequality increases. In rural areas, both decrease.
Seshanna and Decornez (2003)	1960-1999	World	Wolfson's (1994) polarization index	World is more polarized over time. Richer countries are the less polarized.
Duro (2005)	1960-2000	World	Wolfson's (1994) polarization index and EGR indices	Evidence of a curvilinear growth trajectory of income polarization.
Apouey (2007)	1992-2004	Great Britain	Her own measure: P_2	In most cases, inequality and polarization are empirically different.
Ezcurra (2009)	1993-2003	Europe	Polarization measures proposed by Esteban and Ray (1994), and Esteban, Gradín and Ray (2007)	Income polarization has negative effects on regional economic growth.
Blanco and Ramos (2010)	1994-2001	Spain	MLD	Polarization may affect individuals' health in a negative way.
Jones *et al.* (2011)	2002-2003	Europe	The polarization index proposed by Apouey (2007)	Northern Europe has the greatest inequalities in responsiveness and Southern Europe the lowest ones.

Authors	**Year**	**Country**	**Methodology**	**Main results**
Azomahou and Diene (2012)	1966-2008	Africa	Wolfson's (1994) bipolarization index	Growing income bipolarization, but some sectors (services and mining) reduce it.
Apouey and Silber (2013)	2004-2006, 2011	Europe	They develop two approaches to measure bi-polarization	Estonia has the highest degree of income and health dispersion. Iceland and Italy have the lowest ones.
Brzezinski (2013)	1960-2005	World	DER index and Wolfson's (1994) measure	Inequality and polarization indices differ empirically and in significant ways.
Fusco and Silber (2014)	2009	Europe	Their own social polarization measures (POLOR)	Baltic states have the largest levels of social polarization in health whereas central Europe has the lowest ones.
Wang and Wan (2015)	1978-2010	China	Wolfson's (1994) polarization measure	Income polarization increases first (1986-1994 and 2000-2003) and then decreases (2003-2010).
Sączewska-Piotrowska and Wąsowicz (2017)	2000-2015	Poland	Wolfson's (1994) polarization index	Income polarization is higher in rural than in urban areas.
Wang, Caminada and Wang (2017)	2004-2013	Europe	DER family of polarization indices	Income polarization is lower in West countries than in the CEE NMS.
Mysíková and Večerník (2018)	2004-2007, 2007-2010	Austria, Czech Republic and Poland	Distribution method developed by Handcock and Morris (2006)	No evidence that crisis drives income polarization.

Note: EGR (Esteban, Gradín and Ray); MLD (Mean Logarithmic Deviation); DER (Duclos, Esteban and Ray); CEE NMS (Central and Eastern European New Member States).

2.3. Data

We study polarization across Europe, using individual-level data from the EHIS during the period for which data are available. This survey accumulates data from individuals older than 15 years living in private households. Its aim is to provide data across some European countries as SAH, chronic conditions, hospitalisation, use of medicines, height and weight, smoking, sex or age, among others. Thus, it is possible to support the analysis of health policies to prevent on social inclusion as well as those health inequalities. All this information is divided in four modules, which are about health status, health care, health determinants and socio-economic background variables. We are focused on the first one, European Health Status Module (EHSM).

It is expected that these surveys will be conducted every 5 years. So far, there are only two waves available. The first one (EHIS 1) is introduced in 17 Member States between 2006 and 2009. The first year of data depend on the country we are focused on. Meanwhile, the second one (EHIS 2) is implemented between 2013 and 2015 after a review process of the first wave. For our study, we use data from both of them.

Our first attempt was to measure and compare inequalities and polarization between the 28 European Union Member States. Nevertheless, we remove Croatia from our sample because we analyse the dynamics of the countries in two periods of time and it does not make any sense to analyse it as there is only data for the wave between 2013 and 2015. Therefore, our final dataset has information about 27 European countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

As we have indicated above, we are focus on the EHSM, which provides how a person perceives their health status in general, including all the different dimensions of health (physical as well as social). The key variable of our study is SAH, which asks individuals to assess their general level of health through the answer to the following question: "How is your health in general? Is it…". It represents health status over the last 12 months and it is a five-category ordered variable: "very good" (value 5), "good" (value 4), "fair" (value 3), "poor" (value 2) and "very poor" (value 1) health. Therefore, an individual reporting a 4 enjoys better health than one reporting a 2. As we mentioned above, Allison and Foster (2004) suggest using the median health status as reference point.

Table 2.2 and Figure A2.1 give for each country the distribution of reporting each of the five ordered categories of SAH in our sample. The countries are stratified into those with a median of "very good" (first category) and those with a median of "good" health status (second category), being the last one more common in both waves. Looking at the second category, in the period from 2006 to 2009, Spain and Netherlands, with a share of population such as 55.9% and 53.5%, respectively, report better health than the rest of the European countries. In contrast, in 2013-2015, Spain (55.6%) continues at the top of the ranking, but Netherlands (54.1%) takes up the third position, after Malta (54.6%). Nevertheless, there are some exceptions such as Cyprus, Greece and Ireland as well as the United Kingdom in 2006-2009, where the median is higher (category "very good"). We observe that Greece (52.3%) appears as the healthier country in the sample for the first wave. Meanwhile, Cyprus (45.3%) takes up this position in 2013-2015. In the other hand, some countries such as Malta and Slovenia have experienced an improvement in health. We conclude that because the proportion of population in the two top categories

("very good" and "good" health status) increase meanwhile those in the three lowest categories ("fair", "poor" and "very poor" health status) decrease from 2006-2009 to 2013-2015. The opposite happens in the United Kingdom and Portugal.

Now, we define to report a "good" and "fair" health status as the middle categories whereas "very good", "poor" and "very poor" health status are the extreme ones. In this sense, in Finland and Sweden, the percentages of population in the middle categories increase from 2006-2009 to 2013-2015. In contrast, those corresponding to the extreme ones decrease. This means that there is a decrease in (unidimensional) bi-polarization in health over time, since the distribution of SAH is more concentrated around the median category in 2013-2015.

Table 2.2 Distribution of self-assessed health by country and year

	2006-2009						2013-2015					
Country	**Very good**	**Good**	**Fair**	**Poor**	**Very poor**	**Median**	**Very good**	**Good**	**Fair**	**Poor**	**Very poor**	**Median**
Cyprus	43.6	32.9	15.4	6.0	2.1	5	45.3	32.4	16.9	4.5	1.0	5
Greece	52.3	24.4	14.5	6.1	2.7	5	44.8	28.8	15.7	7.8	2.9	5
Ireland	43.4	40.0	13.8	2.3	0.4	5	43.1	39.6	13.4	2.9	1.0	5
United Kingdom	41.2	38.4	15.0	4.4	1.0	5	32.0	38.3	20.8	7.0	1.9	4
Austria	31.7	38.4	21.2	6.6	2.1	4	31.7	37.8	21.6	6.9	1.9	4
Belgium	28.1	45.4	17.8	7.0	1.7	4	30.4	44.6	15.8	7.5	1.7	4
Bulgaria	18.0	47.6	21.7	9.7	2.9	4	17.3	48.7	21.9	9.2	2.9	4
Czech Republic	18.9	42.4	26.1	10.4	2.3	4	19.0	41.9	27.6	9.5	2.0	4
Denmark	29.5	43.3	20.0	4.8	2.3	4	26.8	45.7	20.2	5.7	1.7	4
Estonia	6.6	45.2	34.2	12.6	1.5	4	10.6	41.2	31.7	13.7	2.7	4
Finland	21.7	47.3	23.7	6.0	1.2	4	21.3	48.0	24.3	5.4	1.0	4
France	24.9	43.6	22.4	8.0	1.1	4	23.6	44.7	23.4	7.1	1.2	4
Germany	16.9	48.3	26.9	6.4	1.4	4	17.2	48.0	26.8	6.7	1.4	4
Hungary	17.6	38.4	26.5	13.3	4.2	4	18.1	37.8	26.7	12.2	3.5	4
Italy	13.4	50.9	25.4	8.1	2.2	4	14.4	53.6	20.0	9.2	2.7	4
Latvia	4.1	42.1	37.2	13.7	2.9	4	4.6	41.2	37.1	13.6	3.5	4
Lithuania	7.0	41.5	33.2	15.3	3.1	4	7.4	37.5	37.2	14.9	2.9	4
Luxemburg	33.8	40.5	17.7	6.6	1.4	4	25.3	47.5	18.9	7.0	1.2	4
Malta	24.7	44.8	26.2	3.8	0.5	4	20.2	54.6	21.9	3.0	0.3	4
Netherlands	24.0	53.5	17.6	4.2	0.7	4	23.2	54.1	17.4	4.8	0.5	4
Poland	17.4	39.0	27.2	13.4	2.9	4	17.4	40.9	28.1	11.3	2.3	4
Portugal	10.3	42.5	32.4	11.1	3.7	4	8.2	37.8	35.7	13.4	4.9	4
Romania	26.9	44.1	20.8	6.6	1.6	4	28.0	42.4	20.7	7.3	1.6	4
Slovakia	21.0	41.3	23.3	10.9	3.5	4	20.6	44.2	22.7	10.3	2.2	4
Slovenia	17.2	43.0	26.8	10.1	2.8	4	21.2	43.7	24.2	9.0	2.0	4
Spain	17.3	55.9	19.5	5.5	1.8	4	17.3	55.6	19.0	6.3	1.9	4
Sweden	39.1	40.6	15.1	4.1	1.1	4	32.6	47.6	15.9	3.1	0.8	4
EU-27	21.3	44.1	24.1	8.4	2.1	4	20.4	44.9	24.2	8.5	2.0	4

2.4. Methodology

Next, we describe the indicators used in terms of health inequality and health polarization to show the largest possible comparison of inequality and polarization in health across 27 European countries.

2.4.1. Health inequality measures

In this subsection, we develop the inequality measure used in this paper. In the literature analysing health inequalities, there are several inequality measures. Those include the Generalized Entropy (GE) measures of inequality proposed by Theil (1967). However, a good indicator for overall health with five ordered categories such as SAH, it is not appropriate for the application of standard inequality indices. In other words, Allison and Foster (2004) show that inequality measures used for analysing cardinal variables cannot be employed when the study is ordinal.

Thus, we use indices which are specifically designed to deal with ordinal data. Among them, we find the Foster-Greer-Thorbecke (FGT) index, developed by Foster, Greer and Thorbecke (1984), and Bennett and Hatzimasoura (2011). A more popular measure of poverty is the health Concentration Index (Wagstaff, Van Doorslaer and Paci, 1989), which is a measure of health related to income. Meanwhile, Tubeuf and Perronnin (2008) use the health index. In addition, Abul Naga and Yalcin (2008) propose a parametric family of inequality measures for ordinal data.

To provide originality to our study, we use the Abul Naga-Yalcin index. It should be emphasized that this index can only be used to compare distributions with the same median category.

Suppose we have an ordered variable with n different categories $1, \dots, n$, with the median denoted by m. Besides, P_i is the cumulative proportion of individuals of the sample in each category i, where $i = 1, \dots, n$. That way, we can denote the inequality measure proposed by Abul Naga and Yalcin (2008) as:

$$I_{\alpha,\beta} = \frac{\sum_{i<m} P_i^{\alpha} - \sum_{i \geq m} P_i^{\beta} + (n+1-m)}{k+(n+1-m)}, \qquad \alpha, \beta \geq 1 \tag{2.1}$$

where $k = (m-1)\left(\frac{1}{2}\right)^{\alpha} - \left[1 + (n-m)\left(\frac{1}{2}\right)^{\beta}\right]$ is a normalisation to ensure that this index is in the interval $[0,1]$. In addition, α and β are parameters chosen by the researcher. There are two different possible situations: $(\alpha = \beta)$ and $(\alpha \neq \beta)$. Identical calibrations of these parameters indicate that inequality is at a minimum level when the whole population is in the same category. Meanwhile, if half of the individuals is located in the lowest category and half in the highest one, inequality is at a maximum. By contrast, with $(\alpha \neq \beta)$ it is reflected different weights to inequalities above and below the median of the SAH distribution. That is, for higher values of α, less weight is given to disparities below the median, while, similarly, for higher values of β, less weight is given to inequalities above the median. Thus, we apply this index both in the case of symmetry and in the case of disparity. In the last one, following health economics literature such as Wagstaff (2002), who attributes special importance to inequalities affecting the poorest levels, we analyse the case when a higher weight is given to disparities below the median SAH value $(\alpha = 1,\ \beta = 4)$.

2.4.2. Health polarization measures

In the literature, different methodologies to measure polarization have been proposed and they can be classified into two groups: measures of polarization and measures of bi-polarization. The first set captures the formation of any arbitrary number of poles. The second one analyses polarization as the process by which a distribution becomes bi-polar.

In terms of polarization measures, we highlight Esteban and Ray (1994), who create an index for discrete distributions, and Duclos, Esteban and Ray (2004), who develop a measure for continuous distributions. To that measure for discrete distributions, Esteban, Gradín and Ray (2007), introduce a modification. Besides, alternative measures have been proposed by Chakravarty and Majumder (2001), and Zhang and Kanbur (2001).

In the case of bi-polarization measures, there are some measures such as the one created by Wolfson in collaboration with Foster (2010) and, after that, he improves the index (Wolfson, 1994 and 1997). In addition, we find other indices developed by Alesina and Spolaore (1997) as well as by Wang and Tsui (2000), which can be considered as members of these measures.

Thus, we focus on health polarization, using a more appropriate measure. Apouey (2007 and 2010) proposes a median-based index and applicable to the case of ordered response variables such as the one analysed here. More specifically, she suggests a measure of polarization based on SAH. This index is defined as:

$$P = 1 - \frac{2^{\alpha}}{N-1}\sum_{N=1}^{N-1}\left|P_n - \frac{1}{2}\right|^{\alpha} \quad , \qquad 0 \leq \alpha \leq 1 \tag{2.2}$$

where N denotes the different SAH categories $1, \dots, n$, and P_n is the cumulative proportion of category n in the population. The index is in the interval $[0,1]$. The parameter α

measures the weight given to the median category. We should emphasize that, as α approaches zero, the relative weight given to the median category raises and the relative contribution of the other categories decreases. Now, looking to the values for the calibration of this parameter, we use that proposed by Apouey (2007) where there are five categories, $\alpha = 0.73$. In addition, we use other values such as 0.1, 0.5 and 0.9.

2.5. Empirical results

In this section, we provide an empirical illustration of the use of the indices developed above to a comparison in 27 European countries in the two available waves, 2006-2009 and 2013-2015. In terms of the indices, they integrate different hypothesis about the relative importance of a distribution. On the one hand, that importance is established on several parts of the distribution, that is, inequality measures. On the other hand, the importance is placed on diverse measures of the shape of the distribution, that is, inequality and polarization are compared. Thus, we present two tables giving the numerical estimates of health inequality and polarization indices.

We start by investigating health inequality in Europe. In Table 2.3, we present the findings about it. The first column indicates the country considered. In columns 2 and 5, we present the median category of SAH of each country. Finally, columns 3-4 and 6-7 give the values for the Abul Naga-Yalcin measure. As we seen above, this inequality index can only be used to compare distributions with the same median category. So, we present the countries classified into those with a median of "very good" and those with a median of "good" health status. For each category, the rank in inequality across countries

is provided in parentheses. So, comparing the rankings, we can see that 4 countries have a median category of "very good" SAH in the period 2006-2009 whereas 23 belong to "good" SAH. For 2013-2015, 3 countries have a median category of "very good" and 24 corresponding to "good" SAH.

The absolute values and ranking countries are equivalent for both when inequality index weights the top and bottom of the distribution symmetrically ($\alpha = \beta = 1$) and when greater weight is placed on the lower part of the distribution ($\alpha = 1,\ \beta = 4$). This happen only if we have the highest median category of the distribution. If we observe the 4 countries with a median category of "very good" (5^{th} category) in the period 2006-2009, SAH inequality ranges from 0.381 (Ireland) to 0.451 (Cyprus). For 2013-2015, for the 3 countries with a median category of "very good", it varies between 0.396 (Ireland) and 0.476 (Greece).

If we are focus on the set of countries for which the median category is "good", our findings indicate a greater variation in SAH inequality than when compared to the countries in the 5^{th} category in both periods. The values of the index, with symmetrical weights, vary from 0.261 (Netherlands) to 0.417 (Hungary) in 2006-2009. When inequality index is weighted away from the top of the distribution, the values of the index become lower, ranging from 0.359 (Estonia) to 0.491 (Hungary). In other words, comparing both cases when symmetric weights are applied, and when larger weight is placed on the lower part of the distribution in 2006-2009, in the first situation inequality in Hungary is clearly greater than the observed in Netherlands. In the second one, Netherlands takes up a fifth place ranking, whereas if $\alpha = \beta = 1$, it comes in last. Notably, the ranking of countries changes depending on which weight is used. Only two countries are placed in the same position: Czech Republic and Hungary.

Meanwhile, in 2013-2015, the index ranges from 0.245 (Malta) to 0.427 (Portugal) when $\alpha = \beta = 1$. In the other case, if $\alpha = 1$ and $\beta = 4$, the values of the index become lower again, ranging from 0.360 (Malta) to 0.493 (Hungary). During this period, Malta is in the last place in both situations whereas Portugal and Hungary are in first place when symmetric weights are applied and when greater weight is placed on the lower part of the distribution, respectively. This time, three countries retain their rank when comparing the two indices.

On the one hand, countries that seem to perform relatively well on inequality in both years are Finland, Germany, Italy and Spain. We can include Malta, but only in 2013-2015. Meanwhile, countries that seem to perform relatively poorly consist of Hungary, Czech Republic, Latvia and Lithuania. Last two countries only have high levels of inequality whether $\alpha = \beta = 1$. All these countries remain in the same or in a very similar position in the two years considered. The other countries vary their place more widely. On the other hand, inequality level decreases from 2006-2009 to 2013-2015 in Cyprus whereas it increases in countries such as Greece and Ireland in the case of a median category as "very good". When we focus on the "good" median category, we find that inequality degree decreases in Northern Europe (Denmark, Finland and Sweden) and in Central Europe (Czech Republic, Luxemburg, Slovakia and Slovenia). It increases in other countries of the north of Europe (Estonia, Latvia and Lithuania), the centre (Belgium and Romania) and the south (Portugal and Spain).

Table 2.3 Inequality index in self-reported health in 2006-2009 and 2013-2015

Country	Wave 1			Wave 2		
	m	$I_{\alpha,\beta}$		***m***	$I_{\alpha,\beta}$	
		$I_{1,1}$	$I_{1,4}$		$I_{1,1}$	$I_{1,4}$
Cyprus	5	0.451 (1)	0.451 (1)	5	0.419 (2)	0.419 (2)
Greece	5	0.413 (3)	0.413 (3)	5	0.476 (1)	0.476 (1)
Ireland	5	0.381 (4)	0.381 (4)	5	0.396 (3)	0.396 (3)
United Kingdom	5	0.428 (2)	0.428 (2)	4	0.363 (8)	0.489 (3)
Austria	4	0.362 (9)	0.488 (2)	4	0.365 (7)	0.490 (2)
Belgium	4	0.325 (17)	0.452 (10)	4	0.332 (13)	0.461 (5)
Bulgaria	4	0.340 (12)	0.430 (13)	4	0.332 (14)	0.419 (16)
Czech Republic	4	0.363 (8)	0.453 (8)	4	0.358 (9)	0.449 (8)
Denmark	4	0.331 (14)	0.459 (7)	4	0.317 (16)	0.442 (9)
Estonia	4	0.352 (10)	0.359 (23)	4	0.390 (5)	0.425 (14)
Finland	4	0.306 (19)	0.418 (15)	4	0.297 (20)	0.409 (17)
France	4	0.333 (13)	0.451 (11)	4	0.324 (15)	0.440 (10)
Germany	4	0.305 (20)	0.396 (18)	4	0.308 (18)	0.399 (18)
Hungary	4	0.417 (1)	0.491 (1)	4	0.407 (3)	0.493 (1)
Italy	4	0.308 (18)	0.377 (20)	4	0.305 (19)	0.382 (21)
Latvia	4	0.387 (4)	0.364 (22)	4	0.397 (4)	0.377 (22)
Lithuania	4	0.400 (3)	0.402 (17)	4	0.416 (2)	0.420 (15)
Luxemburg	4	0.345 (11)	0.475 (4)	4	0.310 (17)	0.433 (12)
Malta	4	0.300 (21)	0.423 (14)	4	0.245 (24)	0.360 (24)
Netherlands	4	0.261 (23)	0.475 (5)	4	0.259 (23)	0.384 (20)
Poland	4	0.401 (2)	0.389 (19)	4	0.375 (6)	0.456 (6)
Portugal	4	0.380 (6)	0.414 (16)	4	0.427 (1)	0.436 (11)
Romania	4	0.329 (15)	0.452 (9)	4	0.341 (12)	0.465 (4)
Slovakia	4	0.383 (5)	0.479 (3)	4	0.353 (10)	0.452 (7)
Slovenia	4	0.364 (7)	0.446 (12)	4	0.347 (11)	0.399 (19)
Spain	4	0.266 (22)	0.366 (21)	4	0.273 (22)	0.370 (23)
Sweden	4	0.329 (16)	0.463 (6)	4	0.286 (21)	0.426 (13)
EU-27	4	0.347	0.460	4	0.346	0.456

Note: *m* is the median category of self-rated health. The inequality rank appears in parentheses.

We highlight the case of the United Kingdom. In the first wave, most of the respondents report a "very good" health whereas, in the second wave, the medium category goes down to "good". So, it is not possible to make an appropriate comparison.

Table 2.4 shows the estimates of the polarization index across the European countries considered. The first column indicates the country analysed. In columns 2-5 and 6-9, we present the values for the Apouey polarization measure for four different values of the parameter $(0.1; 0.5; 0.73; 0.9)$ in 2006-2009 and 2013-2015, respectively. As previously, we present the countries classified into those 4 with a median of "very good" and those 23 with a median of "good" SAH in 2006-2009. Meanwhile, 3 countries have a median category of "very good" and 24 corresponding to "good" health status in 2013-2015. In addition, for each country, we provide the rank in polarization in parentheses. In general, if we examine the value for the calibration of α, proposed by Apouey (2007), $\alpha = 0.73$, most of the considered countries show a decrease in health polarization from 2006-2009 to 2013-2015.

Firstly, we describe the findings obtained for the period 2006-2009. When we are focused on the four countries whose median category is "very good", the ranking of countries is equivalent for all the weights of α, except for $\alpha = 0.1$. In this case, polarization in SAH ranges from 0.056 (the United Kingdom) to 0.088 (Greece). The absolute values for each country increase with $\alpha = 0.5$, $\alpha = 0.73$ and $\alpha = 0.9$. In the last case, polarization varies from 0.300 (Ireland) to 0.394 (Greece). In other words, Ireland takes up a third-place ranking when we talk about $\alpha = 0.1$, but if $\alpha = 0.5;\ 0.73;\ 0.9$, it is in last place. Quite the opposite happens with the United Kingdom, it moves from fourth to third place, whether $\alpha = 0.1$ and if $\alpha = 0.5;\ 0.73;\ 0.9$, respectively.

If we are focused on those countries whose median category is "good", the polarization index ranges from 0.033 (Netherlands) to 0.089 (Lithuania) whereas it varies from 0.149 (Netherlands) to 0.282 (Lithuania), when $\alpha = 0.1$ and whether $\alpha = 0.5$, respectively. Besides, the polarization measure varies from 0.204 (Netherlands) to 0.348

(Hungary) while it varies from 0.241 (Netherlands) to 0.393 (Hungary). In other words, Netherlands is in last place for all α values. Lithuania takes up the first, second and third place whether $\alpha = 0.1; 05$, $\alpha = 0.73$ and $\alpha = 0.9$, respectively, and Hungary is in fourth, second and first position if $\alpha = 0.1$, $\alpha = 0.5$ and $\alpha = 0.73; 0.9$, respectively. Most of the European countries analysed change their position in the ranking, based on the value given to α. Nevertheless, Denmark, Netherlands, Romania and Spain continue in the same position.

Table 2.4. Values of the polarization index in self-rated health in 2006-2009 and 2013-2015

	Wave 1				Wave 2			
Country	**α = 0.1**	**α = 0.5**	**α = 0.73**	**α = 0.9**	**α = 0.1**	**α = 0.5**	**α = 0.73**	**α = 0.9**
Cyprus	0.067 (2)	0.255 (2)	0.325 (2)	0.366 (2)	0.070 (2)	0.253 (2)	0.317 (2)	0.353 (2)
Greece	0.088 (1)	0.294 (1)	0.358 (1)	0.394 (1)	0.076 (1)	0.283 (1)	0.359 (1)	0.402 (1)
Ireland	0.058 (3)	0.213 (4)	0.268 (4)	0.300 (4)	0.058 (3)	0.217 (3)	0.276 (3)	0.309 (3)
United Kingdom	0.056 (4)	0.219 (3)	0.283 (3)	0.321 (3)	0.052 (9)	0.219 (9)	0.292 (8)	0.338 (7)
Austria	0.051 (10)	0.218 (10)	0.292 (10)	0.338 (9)	0.052 (8)	0.221 (8)	0.294 (7)	0.340 (6)
Belgium	0.044 (18)	0.190 (17)	0.258 (17)	0.302 (17)	0.045 (14)	0.195 (14)	0.264 (14)	0.308 (14)
Bulgaria	0.047 (13)	0.201 (13)	0.271 (12)	0.316 (12)	0.046 (13)	0.196 (13)	0.264 (13)	0.308 (13)
Czech Republic	0.055 (9)	0.224 (9)	0.296 (9)	0.340 (7)	0.054 (7)	0.222 (7)	0.292 (9)	0.335 (9)
Denmark	0.045 (15)	0.195 (15)	0.264 (15)	0.307 (15)	0.043 (17)	0.186 (16)	0.252 (16)	0.294 (16)
Estonia	0.084 (2)	0.263 (4)	0.312 (5)	0.339 (8)	0.087 (1)	0.282 (1)	0.340 (1)	0.373 (2)
Finland	0.041 (21)	0.179 (20)	0.243 (20)	0.284 (19)	0.040 (20)	0.174 (20)	0.236 (20)	0.276 (20)
France	0.046 (14)	0.197 (14)	0.266 (14)	0.310 (13)	0.044 (15)	0.192 (15)	0.259 (15)	0.301 (15)
Germany	0.043 (19)	0.182 (19)	0.244 (19)	0.284 (20)	0.044 (16)	0.184 (17)	0.247 (17)	0.286 (18)
Hungary	0.071 (4)	0.271 (2)	0.348 (1)	0.393 (1)	0.066 (5)	0.260 (3)	0.337 (2)	0.383 (1)
Italy	0.044 (17)	0.185 (18)	0.247 (18)	0.287 (18)	0.041 (19)	0.178 (19)	0.241 (19)	0.283 (19)
Latvia	0.070 (5)	0.245 (6)	0.301 (7)	0.333 (10)	0.069 (3)	0.245 (5)	0.305 (6)	0.338 (8)
Lithuania	0.089 (1)	0.282 (1)	0.338 (2)	0.369 (3)	0.068 (4)	0.247 (4)	0.311 (4)	0.347 (5)
Luxemburg	0.049 (12)	0.208 (11)	0.278 (11)	0.321 (11)	0.041 (18)	0.180 (18)	0.245 (18)	0.287 (17)
Malta	0.041 (20)	0.178 (21)	0.240 (21)	0.279 (21)	0.031 (24)	0.140 (24)	0.192 (24)	0.226 (24)
Netherlands	0.033 (23)	0.149 (23)	0.204 (23)	0.241 (23)	0.033 (23)	0.147 (23)	0.202 (23)	0.239 (23)
Poland	0.068 (6)	0.260 (5)	0.334 (3)	0.378 (2)	0.061 (6)	0.239 (6)	0.310 (5)	0.353 (4)
Portugal	0.079 (3)	0.268 (3)	0.328 (4)	0.363 (4)	0.074 (2)	0.264 (2)	0.330 (3)	0.368 (3)
Romania	0.045 (16)	0.194 (16)	0.262 (16)	0.305 (16)	0.047 (12)	0.202 (12)	0.272 (12)	0.317 (12)
Slovakia	0.056 (7)	0.234 (7)	0.310 (6)	0.358 (5)	0.050 (10)	0.211 (10)	0.283 (10)	0.328 (10)
Slovenia	0.056 (8)	0.226 (8)	0.297 (8)	0.341 (6)	0.049 (11)	0.208 (11)	0.278 (11)	0.323 (11)
Spain	0.034 (22)	0.151 (22)	0.208 (22)	0.245 (22)	0.035 (22)	0.155 (22)	0.213 (22)	0.251 (22)
Sweden	0.051 (11)	0.207 (12)	0.270 (13)	0.309 (14)	0.040 (21)	0.170 (21)	0.229 (21)	0.266 (21)
EU-27	0.048	0.207	0.277	0.323	0.047	0.204	0.274	0.319

Note: The polarization rank appears in parentheses.

Secondly, we report the results for 2013-2015. If we turn attention to the set of countries for which the median category is "very good", the polarization ranking across countries is equivalent for all the weights given to α. In addition, it ranges from 0.058 (Ireland) to 0.076 (Greece) when $\alpha = 0.1$ whereas it varies from 0.309 (Ireland) to 0.402 (Greece) if $\alpha = 0.9$.

If now we are focused on the twenty-four countries whose median category is "good", polarization in SAH varies from 0.031 (Malta) to 0.087 (Estonia) whether $\alpha = 0.1$. The polarization ranking in Malta is equivalent for all the weights given to α. Estonia is always in first place except if $\alpha = 0.9$, when Hungary leads the ranking. So, if we give to α a value such as 0.9, polarization ranges from 0.226 (Malta) to 0.383 (Hungary). Similar to 2006-2009, half of the countries in the sample change slightly their position in the ranking, based on the value given to α. However, the other half is in the same place (Belgium, Bulgaria, Finland, France, Italy, Malta, Netherlands, Romania, Slovakia, Slovenia, Spain and Sweden).

In short, in the case of the set of countries for which the median category is "very good", more specifically, Cyprus and Greece, the polarization ranking is equivalent for all the weights given to α for both periods of time, 2006-2009 and 2013-2015.

The polarization measure produces a very similar ranking as that observed for inequality when applying symmetric weighting. In our study, comparing both inequality and polarization indices, when we are focused on that countries whose median category is "very good", we can see that in 2006-2009, the indices do not exhibit the same ranking whereas in 2013-2015 they do it.

2.6. Conclusions

This paper adds important insights to the empirical evidence on health polarization and inequalities using the two available waves from EHIS, 2006-2009 and 2013-2015, for 27 European countries. Our main objective is to analyse the evolution of health inequality and polarization. In addition, our focus is to propose measures of inequality and polarization degrees of an ordinal variable such as SAH. So, we use an appropriate median-based measure of inequality because of the nature of our key variable. More specifically, this measure is the Abul Naga-Yalcin index, which has advantages respect of the ordinality data and that is why it has applicability in our study. Moreover, we do the same for the case of polarization. We develop the Apouey index, with different values in the parameter α. This is a polarization measure, based on SAH.

Our results suggest that inequalities in SAH exist in a high number of European countries. The indices change across countries, being Cyprus and Greece the countries with the greatest inequality in 2006-2009 and 2013-2015, respectively, and Ireland the one with the least inequality for both years when the median category is "very good". If the median category is "good", Czech Republic and Hungary have the highest level of inequality. Meanwhile, Malta, Italy and Spain have the lowest ones. In the case of Malta, the inequality degree, in 2013-2015, indicates an improvement compared to the one obtained in 2006-2009.

In the case of polarization, the ranking is very similar for all the weights given to α for both periods, 2006-2009 and 2013-2015. This study provides evidence that, when the median category is "very good", Greece has the highest level of health polarization whereas the United Kingdom and Ireland have the lowest ones, in 2006-2009 and in 2013-2015, respectively. If the median category is "good", Estonia, Hungary and Lithuania are

the countries with the highest level of health polarization whereas Malta, Netherlands and Spain have the lowest ones.

In both cases, inequality and polarization, we cannot compare the United Kingdom from the two periods because, it is classified as a country with a "very good" median category in the wave 1 and it belongs to the "good" median category in the second wave.

In short, four years ago, in 2013-2015, both inequality and polarization indices exhibit the same ranking, what means that countries with higher inequality also have greater polarization.

Chapter 3

The dynamics of health poverty in Spain during the economic crisis (2008-2016)

3.1. Introduction

Health outcomes are often affected by socio-economic conditions and vice-versa. More specifically, health status and poverty are negatively associated with living in poor health. However, an important empirical gap in literature concerns the relationship between health and socio-economic status through Self-Assessed Health (SAH), which is a subjective health measure and changes over time. Nevertheless, these health issues have been less considered although they can be defined from different points of view. On the one hand, in the case of SAH, individuals assess their own health as poor if they believe that another person of the same gender, age, income or education level, is much healthier than them. On the other hand, individuals are poor in health when their health are below the chosen health poverty threshold (Allison and Foster, 2004; Brzezinski, 2015).

According to the use of subjective health measures, such as SAH, some authors are in favour of its use instead of objective measures. Several studies argue that SAH is a relevant predictor of future mortality and morbidity within countries. In addition, it has a great capacity to cover a large part of individuals' health conditions, being commonly used in epidemiological surveys, among others (Hernández-Quevedo, Jones and Rice, 2004; Apouey, 2007; Johnston, Propper and Shields, 2009; Fusco and Silber, 2014; Pascual, Cantarero and Lanza, 2018). Therefore, it should not disregard health data obtained through individuals' SAH as it provides valuable information about their well-being. If it is used with caution, SAH data are appropriate in health economics research.

Nevertheless, other authors are sceptical about its use and they prefer a more objective health measure. They indicate that SAH is strongly correlated with a set of clinical health conditions and it can cause measurement errors (Van Doorslaer and Jones, 2003). In other words, respondents with the same real health status may have different response styles or reference points when they evaluate their overall health. Hence, the different measures of social inequalities in health economics literature must be considered (Groot, 2000; Crossley and Kennedy, 2002; Jürges, 2006).

This paper analyses the recent dynamics in SAH in Spain using poverty indices. Thus, the first purpose is to analyse trends in individuals' health status in Spain. The period analysed is between 2008 and 2016, which are the first and the last years in which data are available. For this purpose, we have used data provided by the European Union Statistics on Income and Living Conditions (EU-SILC). The second goal is to decompose some socio-economic determinants (gender, age and education level) to analyse how these characteristics affect health poverty during the economic crisis (2008-2016).

The paper is organised as follows. Firstly, Section 3.2 introduces a review of the last studies interested in health poverty. Secondly, in Section 3.3, we describe some methods proposed in literature to measure health inequalities. Next, we provide a brief description of the data source used in Section 3.4. Meanwhile, Section 3.5 explains the main empirical results of health poverty, highlighting those obtained with the Foster-Greer-Thorbecke (FGT) index, as well as with the subgroup decomposition. The paper ends with conclusions in Section 3.6.

3.2. Self-assessment health and poverty: a survey

Social determinants are in part responsible for health inequalities. Some significant ones that influence health are education, socio-economic status, place of residence, race, marital status or ethnic origin, among others (Van Doorslaer *et al.*, 1997; Van Doorslaer and Jones, 2003; World Health Organization, 2014). Below, we describe in detail some empirical evidence regarding literature.

There are some papers which prove that health trends to be worse in those societies with greater income differences (Wilkinson and Pickett, 2006; Carroll *et al.*, 2011; Pickett and Wilkinson, 2015). The studies of Meer, Miller and Rosen (2003), Buddelmeyer and Cai (2009), Ásgeirsdóttir and Ragnarsddóttir (2013), Brzezinski (2015), Mackenbach *et al.* (2015), Simões *et al.* (2016) and Ivaldi, Bonatti and Soliani (2018) analyse the relationship between poverty and health. The main difference between these papers is the methodology used. Meer, Miller and Rosen (2003) use Ordinary Least Squares (OLS) regressions as well as a two-stage probit model; Buddelmeyer and Cai (2009) combine a dynamic model and the Pearson's chi-squared test; Ásgeirsdóttir and

Ragnarsddóttir (2013) calculate the Concentration Index and the Absolute Concentration Index; Brzezinski (2015) uses the FGT index; Mackenbach *et al.* (2015) and Simões *et al.* (2016) propose an ordered probit model; and Ivaldi, Bonatti and Soliani (2018) present factor analysis and Pena distance, a non-parametric method and another parametric, respectively.

According to the area considered, Ásgeirsdóttir and Ragnarsddóttir (2013), Mackenbach *et al.* (2015) and Ivaldi, Bonatti and Soliani (2018) focus their studies on Europe. In addition, Brzezinski (2015) analyses Great Britain while Simões *et al.* (2016) do it for Portugal. By contrast, Meer, Miller and Rosen (2003) examine the United States; and Buddelmeyer and Cai (2009) analyse the case of Australia.

Moreover, Meer, Miller and Rosen (2003) corroborate the effect of wealth on individuals' health status, using four waves (1984, 1989, 1994, and 1999) from the Panel Study of Income Dynamics (PSID). Their results suggest that wealth presents a positive and statistically significant impact on SAH, but it is not as important as it is supposed to be.

Besides, Buddelmeyer and Cai (2009) analyse the trends of poverty and health, using data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. Their results indicate that households headed by a person with poor health are more likely to be in poverty than those headed by a healthy person. A man, whose family is poor in a specific year, is more likely to be ill the following year than a man, whose family is well positioned economically. They also determine that there is persistence over time in both poverty and health.

For example, Ásgeirsdóttir and Ragnarsddóttir (2013) measure to what extent it has been produced health and decreased variation in health by socio-economic status,

using data from the EU-SILC. Their results suggest that in most high-income countries, men value their health better than women. Moreover, health status gets worse with age whereas countries with a higher education level report better health. Being unemployed, retired, disabled or a part-time worker is positively related to poor health. In addition, being at risk of poverty is associated with poor health in most countries.

On the one hand, Brzezinski (2015) analyses trends in SAH poverty from 1991 to 2008. This study uses data from the British Household Panel Survey (BHPS), establishing his results on differences in income, education, household structure and conditions. As a result, if a fair SAH status such as the poverty threshold is chosen, the health poverty rate will increase. Furthermore, if a higher health poverty threshold is chosen, poverty will raise too, and it will be statistically significant. Focused on decompositions, the most important effects are health poverty as well as the proportion of persons cohabiting.

On the other hand, Mackenbach *et al.* (2015) analyse changes in mortality by socio-economic status. They show a growing inequality in health, both within and between each analysed country. Their results display an increase in the relative inequality in premature mortality in most European countries since 1990. However, a tendency of decreased population with lower education level is shown and they emphasize the contrast between the South and East Europe. The former group of countries presents small inequalities while the second group shows greater ones.

In addition, Simões *et al.* (2016) assess the determinants of health inequalities, using the National Health Survey. They evaluate poverty, wealth and health inequality. Their results suggest that there are huge health inequalities, highlighting education and income as important determinants. They emphasize the aging of the Portuguese

population because age is negatively correlated with health, which generates more inequality.

Finally, Ivaldi, Bonatti and Soliani (2018) study the relationship between health and income distribution. Their results find that health trends to be better in those countries with a high Gross Domestic Product (GDP) per capita and it gets worse when some determinants influence such as lifestyle or diet. Furthermore, they conclude that there is an indirect relationship between health and income distribution.

3.3. Measures of self-rated health poverty

In the literature which analyses health inequalities, several measures are used (Aristondo, 2018). We analyse a variable such as SAH, which has an ordinal scale and represents one of the most commonly-used health indicators. Many general population surveys include it using the following question: How is your health in general? Thus, respondents are asked to rate their own health. When they answer the survey question about SAH, they assess their true health and project it into a scale. The answers usually vary according to different categories, ranging from 1 (very good) to 5 (very poor).

3.3.1. Foster-Greer-Thorbecke index

Regarding the discrete variables, we have considered the FGT index, which is developed by Foster, Greer and Thorbecke (1984), and Bennett and Hatzimasoura (2011), among others. We use this index to analyse the dynamics of health poverty. It considers a sample of N individuals, whose SAH is represented by a vector of S categories, all ordered, such

as $Y = (y_1, y_2, \dots, y_S)$, with $y_i > y_j$ if and only if health status i is preferred to health status j. In practice, y_1 is the worst health status proposed in the self-assessment survey, while y_S is the best possible one. If the assumption of selecting a category k as a poverty threshold is supposed, Bennett and Hatzimasoura (2011) propose the following measure:

$$\pi_\alpha(Y;k) = \sum_{j=1}^{k} p_j \left(\frac{k-j+1}{k}\right)^\alpha \; when\; 1 \le j \le k;\; \alpha \ge 0 \qquad (3.1)$$

Equation 3.1 is a weighted sum of the probabilities of having SAH below the chosen health poverty threshold, where $p_j = Pr[Y = y_j]$ is the proportion of people y in self-assessment j. Moreover, when the parameter α takes the value 0 ($\alpha = 0$), the standard poverty head-count ratio is obtained, showing the proportion of poor households below the poverty line. Thus, the simplest version can be described as $\frac{q}{n}$ (where q is the number of poor households and n is the total households). In addition, if $\alpha = 1$, it is weighted equal to the lowest health status. If α is greater than 0, this index is more sensitive to the depth of health poverty, whereas if α is greater than 1, FGT index is a more sensitive indicator to depth. As α grows, the lower valuation categories have more weight. Therefore, the poverty index is sensitive to changes in the probability of population with poor health status.

Furthermore, the FGT index is additive. This means that the poverty measure for the whole population is the weighted sum of the poverty measures for the different population subgroups. Thus, changes in poverty over time from t_1 to t_2 can be denoted as follows:

$$\Delta\pi_\alpha = \pi_\alpha(Y_{t_2};k) - \pi_\alpha(Y_{t_1};k) = \sum_{i=1}^{h}\left[v^i(t_2)\pi_\alpha^i(Y_{t_2};k) - v^i(t_1)\pi_\alpha^i(Y_{t_1};k)\right] \qquad (3.2)$$

where v^i is the population share of subgroup $i \in (1, \dots, h)$ and π_α^i is the poverty level of subgroup $i \in (1, \dots, h)$. If we consider poverty changes over time and the Shapley value, the subgroup decomposition can be written as follows:

$$\Delta\pi_\alpha = \sum_{i=1}^{h}\left(W^i + P^i\right) = \sum_{i=1}^{h}\left[\frac{v^i(t_1)+v^i(t_2)}{2}\Delta\pi_\alpha^i + \frac{\pi_\alpha^i(Y_{t_1};k)+\pi_\alpha^i(Y_{t_2};k)}{2}\Delta v^i\right] \quad (3.3)$$

3.3.2. Poverty Gap measure

In order to support the results obtained with the FGT index, we calculate two other indices. Firstly, the Poverty Gap (PG) index, which represents the proportion of individuals below the poverty line and express it as a percentage. However, it has the disadvantage that it only evaluates poor individuals. The $PG\ (G_i)$ is defined as the poverty line (z) minus real income (y_i) and it is given by:

$$G_i = (z - y_i) * I(y_i < z) \quad (3.4)$$

The index (P_1) is obtained as:

$$P_1 = \frac{1}{N}\sum_{i=1}^{N}\frac{G_i}{z} \quad (3.5)$$

This measure is the mean poverty gap in the population, where N represents the individuals in the sample.

Similar to P_1, we have the squared PG index, which considers inequalities among the poor population. The corresponding measure is given by:

$$P_2 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{G_i}{z}\right)^2 \quad (3.6)$$

However, this measure is not very commonly-used because it does not have an intuitive appeal and it is not easy to interpret.

3.3.3. Generalized Entropy index

Secondly, we calculate the Generalized Entropy (GE) to measure inequality. Among these indices, there are those proposed by Theil (1967). The general formula can be written as:

$$GE(\alpha) = \frac{1}{\alpha(\alpha-1)}\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^{\alpha} - 1\right] \quad (3.7)$$

where α represents the weight given to distances between incomes at different parts of the income distribution, N is the number of individuals in the sample, y_i is the income or expenditure corresponding to individual i and $\bar{y}$ is the mean income or expenditure per capita. The values of this measure vary between 0 (it represents an equal distribution) and infinite (it represents high values of inequality).

If $\alpha = 0$, we obtain the mean logarithmic deviation measure that may be written as:

$$GE(0) = \frac{1}{N} \quad (3.8)$$

And if $\alpha = 1$, we have the Theil index, which is defined as follows:

$$GE(1) = \frac{1}{N}\sum_{i=1}^{N}\frac{y_i}{\bar{y}}\ln\left(\frac{y_i}{\bar{y}}\right) \quad (3.9)$$

3.4. Data

In this paper, we use micro-data from waves 1-9 of the EU-SILC for the case of Spain. We are mainly interested in analysing the dynamics of health poverty in the period of economic crisis, from 2008 to 2016. EU-SILC accumulates data from all private households and individuals residing in countries at the moment in which data are

collected. All members are surveyed, but only those older than 15 years old are interviewed. It collects micro-data about income, social exclusion, household conditions, poverty, education, work and health, covering the objective and subjective requirements of these issues.

The distribution of the dependent variable SAH, in its five different ordered categories, is shown in Table 3.1. Thus, more than half of the respondents declares that their health status is good. Additionally, the population who claims to have a very good health status increases from 2008 to 2016. The same is true for those individuals who declare a fair health status. By contrast, there is a decrease in the population who reports good, poor and very poor health status between 2008 and 2016. Likewise, respondents who rate a poor health status do not exceed 7.0%. Similarly, less than 2.3% of the population rate their health as very poor.

Table 3.1. Relative frequencies of individuals' self-assessed health status in each wave for Spain

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Very good	13.94	14.92	16.20	19.77	20.64	18.55	16.17	15.08	14.91
Good	56.70	54.37	53.73	53.31	51.70	51.74	54.79	55.73	55.86
Fair	20.73	21.44	21.28	18.69	18.75	20.66	20.06	21.01	21.63
Poor	6.82	6.99	6.70	6.09	6.71	6.95	6.84	6.38	5.98
Very poor	1.81	2.27	2.09	2.14	2.20	2.10	2.14	1.80	1.62

Source: European Union Statistics on Income and Living Conditions.

Meanwhile, Table 3.2 shows descriptive statistics of individuals' health conditions from 2008 to 2016. Every year, the average of the general health status is greater than 2 and this means a "good" average of the health status. The lowest value is recorded (2.1752) in 2011. There is an increase in the general health status from this year

to 2016. In addition, most of the surveyed people declare that they have no health problems or chronic diseases. This question reaches the highest value (1.7454) in 2011 and the lowest one (1.6492) in 2015. According to being limited, most of the respondents declare not to be limited, all values being greater than 2.5.

If the question is about having visited the doctor during the last 12 months, all values are greater than 1.9 although most people did not attend. The lowest value (1.9190) is reached in 2009 while the highest one (1.9852) is registered in 2016. In the case of not consulting a doctor, the lowest value is 3.7671, in 2016, which is focused between not having time and living too far away. Meanwhile, the highest value (5.4553) is reached in 2009. Thus, individuals are afraid of doctors/hospitals and they wanted to wait and see if the problem improved by itself. If the question is having attended to a dentist during the last 12 months, all values are greater than 1.8 and again most people did not attend. The lowest value (1.8808) is reached in 2015 and the highest one (1.9323) in 2011. In the case of not consulting a dentist, the average of the answers in 2015 is 1.9047 and most people are on a waiting list or do not have a referral note. Meanwhile, the average of the answers is 3.6927 in 2009. Therefore, more than half the respondents did not have time because of their job, child or other people care.

Table 3.2. Descriptive statistics of individuals' health conditions: 2008-2016

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016
General health status[1]	2.2585 (0.8457)	2.2734 (0.8794)	2.2476 (0.8773)	2.1752 (0.8889)	2.1812 (0.9096)	2.2231 (0.8997)	2.2399 (0.8780)	2.2410 (0.8486)	2.2354 (0.8338)
Chronic illness or health problem[2]	1.6779 (0.4673)	1.6727 (0.4692)	1.6817 (0.4658)	1.7454 (0.4357)	1.7176 (0.4502)	1.6670 (0.4702)	1.6796 (0.4666)	1.6492 (0.4772)	1.6689 (0.4706)
Limited to perform the activities that people usually do (last 6 months)[3]	2.7006 (0.5672)	2.6816 (0.5792)	2.6975 (0.5722)	2.7142 (0.5568)	2.7104 (0.5619)	2.6867 (0.5752)	2.6960 (0.5708)	2.6873 (0.5692)	2.7125 (0.5505)
Need to see a doctor (except for a dentist) but did not (last 12 months)[4]	1.9440 (0.2299)	1.9190 (0.2728)	1.9357 (0.2453)	1.9476 (0.2228)	1.9464 (0.2251)	1.9331 (0.2498)	1.9455 (0.2270)	1.9837 (0.1265)	1.9852 (0.1209)
Main reason for not consulting a doctor (except dentist)[5]	4.9081 (1.9086)	5.4553 (1.9858)	5.0892 (1.8227)	5.2687 (2.1989)	4.8413 (2.0295)	4.9361 (2.0414)	4.9861 (2.0038)	3.9699 (2.5697)	3.7671 (2.3459)
Need to see a dentist but did not (last 12 months)[6]	1.9230 (0.2666)	1.9135 (0.2811)	1.9190 (0.2729)	1.9323 (0.2512)	1.9183 (0.2739)	1.8936 (0.3083)	1.8953 (0.3061)	1.8808 (0.3241)	1.8883 (0.3151)
Main reason for not consulting a dentist[7]	3.3438 (2.4650)	3.6927 (2.8417)	3.0648 (2.5536)	3.2034 (2.6825)	2.3182 (2.2037)	2.4701 (2.3689)	2.3483 (2.3400)	1.9047 (1.9871)	1.9075 (1.9903)

Note: standard errors appear in parentheses.

[1] Respondents can say if their health is very good, good, fair, poor or very poor, ranging from 1 to 5, respectively.
[2] The answer is affirmative (1) or negative (2).
[3] The possible answers, which are valued from 1 to 3, are severely limited, limited but not severely and no limited, respectively.
[4] There are two responses: yes, at least once (1) and no, on any occasion (2).
[5] The responds are as follows: you cannot afford it (1), you were on a waiting list or you did not have a referral note (2), you did not have time because of work, children care or any other people (3), the doctor is too far to travel or you do not have any means of transport (4), you are afraid of doctors/hospitals (5) you wanted to wait and see if the problem improved by itself (6), you did not know any doctor or specialist (7) and any other reasons (8).
[6] The answer is affirmative (1) or negative (2).
[7] Respondents can say: you cannot afford it (1), you were on a waiting list or you did not have a referral note (2), you did not have time because of work, children care or other people (3), the doctor is too far to travel or you do not have any means of transport (4), you are afraid of doctors/hospitals (5), you wanted to wait and see if the problem improved by itself (6), you did not know any doctor or specialist (7) and another reasons (8).

3.5. Empirical results

Table 3.3 presents the results for FGT index. It presents the mean, standard error and 95% confidence intervals for three different values of α as well as for three different poverty thresholds (k). Firstly, the alpha (α) values have been selected with the guideline of being π_0 $(\alpha = 0)$, π_1 $(\alpha = 1)$ and π_2 $(\alpha = 2)$. Secondly, the following health poverty thresholds are chosen: a very poor SAH status $(k = 1)$, a poor SAH status $(k = 2)$ and a fair SAH status $(k = 3)$. Nevertheless, some authors such as Brzezinski (2015) argues that a health poverty threshold such as $k = 1$ is unsuitable to analyse because people, who declared a higher SAH condition, consider it poor.

Now, we discuss the results obtained for a poor SAH status $(k = 2)$ in 2008. The values obtained represent the weight of those individuals whose SAH is below the threshold chosen. Hence, if we determine a poor SAH as measured by poverty headcount rate (π_0), we will get a value such as 0.1142. This value reaches 0.0802 if health poverty is measured by π_1. Whereas, in the case of π_2, a value such as 0.0749 is accomplished. Meanwhile, if we choose a fair SAH status $(k = 3)$ like the health poverty threshold, it has a value of 0.4114 for π_0, it falls to 0.2745 for π_1, but it increases at 0.3209 for π_2.

For 2016, when there is a health poverty threshold such as $k = 2$ with a SAH poverty as measured by π_0, a value such as 0.1082 is obtained and it decreases (measured by π_1) reaching 0.0786. The same happens in the case of π_2, where a value of 0.0760 is achieved. In the meantime, if we choose $k = 3$ as the health poverty threshold at a SAH poverty as measured by π_0, it has a value of 0.4064, which is reduced to 0.2682. Besides, for π_2, it takes the value 0.3153.

Table 3.3. Foster-Greer-Thorbecke index for self-rated health status (2008-2016)

		k = 2			***k = 3***		
		π_0	π_1	π_2	π_0	π_1	π_2
2008	Mean	0.1142	0.0802	0.0749	0.4114	0.2745	0.3209
	Standard Error	0.0022	0.0019	0.0022	0.004	0.0041	0.0068
	[95% CI]	[0.1098; 0.1185]	[0.0766;0.0839]	[0.0706:0.0792]	[0.3900;0.4058]	[0.2664;0.2825]	[0.3076; 0.3342]
2009	Mean	0.1410	0.1065	0.1072	0.4575	0.3295	0.4178
	Standard Error	0.0025	0.0022	0.0027	0.0044	0.0047	0.0080
	[95% CI]	[0.1361;0.1459]	[0.1022;0.1108]	[0.1020;0.1124]	[0.4488;0.4661]	[0.3202;0.3387]	[0.4019;0.4336]
2010	Mean	0.1376	0.1046	0.1060	0.4489	0.3230	0.4104
	Standard Error	0.0025	0.0220	0.0026	0.0044	0.0047	0.0080
	[95% CI]	[0.1327;0.1424]	[0.1003;0.1089]	[0.1008;0.1112]	[0.4404;0.4575]	[0.3139;0.3322]	[0.3947;0.4261]
2011	Mean	0.1212	0.0910	0.0911	0.3971	0.2840	0.3576
	Standard Error	0.0024	0.0021	0.0025	0.0043	0.0045	0.0077
	[95% CI]	[0.1165;0.1279]	[0.0869;0.0951]	[0.0862;0.0960]	[0.3887;0.4056]	[0.2751;0.2980]	[0.3425;0.3726]
2012	Mean	0.1246	0.0913	0.0891	0.4064	0.2891	0.3591
	Standard Error	0.0024	0.0021	0.0025	0.0044	0.0046	0.0077
	[95% CI]	[0.1198;0.1294]	[0.0872;0.0954]	[0.0842;0.0941]	[0.397;0.4150]	[0.2801;0.2980]	[0.3441;0.3742]
2013	Mean	0.1434	0.1093	0.1109	0.4524	0.3318	0.4269
	Standard Error	0.0027	0.0024	0.0029	0.0048	0.0051	0.0088
	[95% CI]	[0.1381;0.1488]	[0.1045;0.1140]	[0.1052;0.1166]	[0.4431;0.4617]	[0.3217;0.3418]	[0.4097;0.4442]
2014	Mean	0.1233	0.0893	0.0862	0.4182	0.2904	0.3534
	Standard Error	0.0025	0.0021	0.0025	0.0045	0.0046	0.0078
	[95% CI]	[0.1184;0.1286]	[0.0851;0.0935]	[0.0812;0.0911]	[0.4093;0.4271]	[0.2813;0.2994]	[0.3381;0.3687]
2015	Mean	0.1211	0.0895	0.0883	0.4210	0.2904	0.3549
	Standard Error	0.0025	0.0021	0.0026	0.0045	0.0046	0.0078
	[95% CI]	[0.1163;0.1259]	[0.0853;0.0937]	[0.0833;0.0933]	[0.4122;0.4297]	[0.2814;0.2995]	[0.3396;0.3702]
2016	Mean	0.1082	0.0786	0.0760	0.4064	0.2682	0.3153
	Standard Error	0.0022	0.0019	0.0022	0.0041	0.0041	0.0068
	[95% CI]	[0.1040; 0.1125]	[0.0749;0.0822]	[0.0717;0.0803]	[0.3985;0.4144]	[0.2602;0.2761]	[0.3019;0.3286]

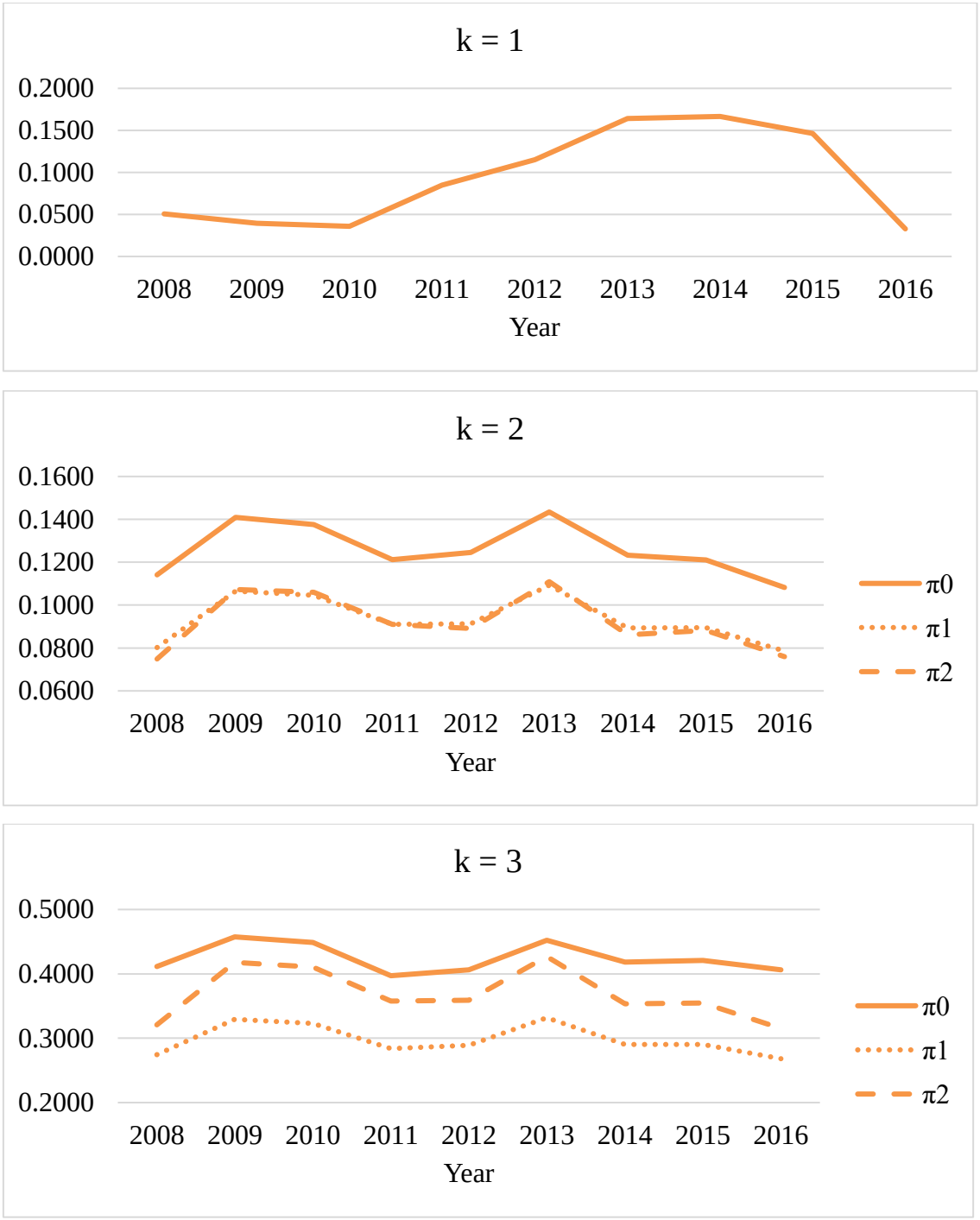
Note: CI (Confidence Interval).

Comparing the first and the last year of our period, we observe that health poverty as measured by π_0 decreased by 5.25% and by 1.21% for a poor SAH ($k = 2$) status and for a fair SAH status ($k = 3$), respectively. This decrease is lower when $k = 2$ and the health poverty as measured by π_1 (1.99%). Nevertheless, if SAH poverty is measured by π_2, there is an increase of 1.46%. In the event of $k = 3$, the decreases are higher. The reduction is 2.29% and 1.74% if SAH poverty as measured by π_1 and by π_2, respectively.

It also provides the results of significance tests using the conventional 5% significance level. Firstly, the findings of the health poverty threshold such as a poor SAH ($k = 2$) are discussed. If a SAH poverty headcount (π_0) is used, the result is not significant. Moreover, this means, if health poverty is measured by π_0 as well as by π_1 or by π_2, that our results are significant. Secondly, we assume a fair SAH ($k = 3$), where the opposite happens and changes in all SAH poverty decreases are statistically significant.

In addition, Figure 3.1 shows the recent dynamics in health poverty, which result from applying the FGT index for a very poor SAH status ($k = 1$), a poor SAH status ($k = 2$) and a fair SAH status ($k = 3$). We focus on the figures that correspond to health poverty thresholds such as a poor SAH and a fair SAH, because it does not make sense to analyse a poverty threshold such as a very poor SAH, as we mentioned above. We can observe that the poverty rate in health decreases since 2013 and it can be explained by the recovery of the economic crisis. In general terms, we have a similar situation in 2008 and 2016.

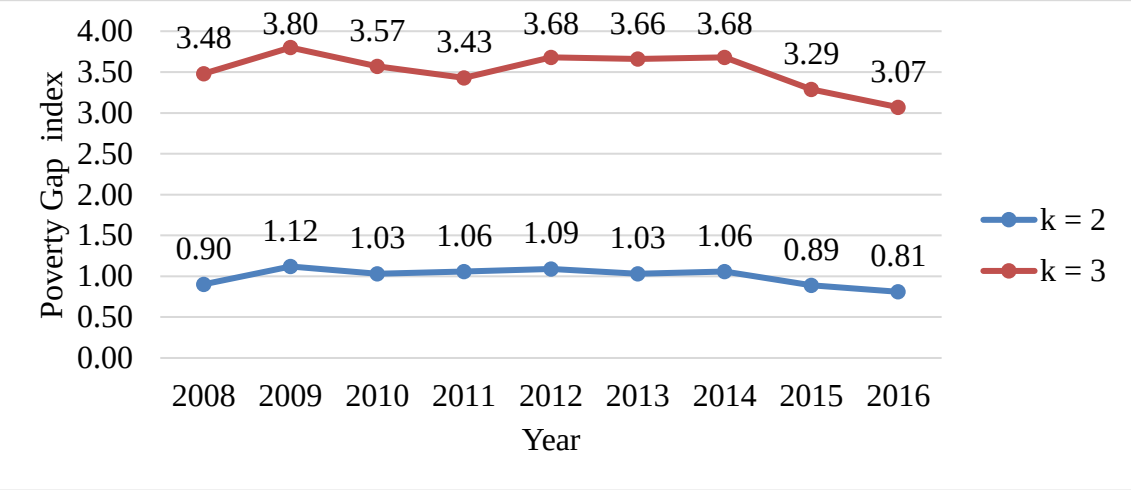
Figure 3.1. Trends in Foster-Greer-Thorbecke index (π_k) for different health poverty thresholds: very poor ($k = 1$), poor ($k = 2$), and fair ($k = 3$) self-rated health status (2008-2016)



As it has been mentioned before, two other indices have been calculated in order to support our results obtained with the FGT index. We calculate the PG index expressed

as a percentage (Figure 3.2) which considers the poor population (those who are situated below the poverty line). This index calculates the depth of poverty, considering how far the poor population is from the poverty line, on average. Nevertheless, the PG index does not capture differences of inequality among poor population.

Figure 3.2. Poverty Gap index for self-reported health status (2008-2016)



We assume two health poverty thresholds. On the one side, there is a poor SAH status ($k = 2$) formed by those individuals who report poor and very poor health. Alternatively, there is a fair SAH status ($k = 3$). This poverty line incorporates individuals just mentioned and additionally those who report a fair health status.

The results obtained for 2008 are 0.90% for $k = 2$ and 3.48% for $k = 3$. Meanwhile, our findings for 2016 are lower in both cases for a poor and a fair SAH status, 0.81% and 3.07%, respectively. These values indicate the ratio between poverty and the poverty line. If a general evaluation is made of the progress of health poverty in Spain between 2008 and 2016, it can be argued that at the beginning of the economic crisis, there was a higher proportion of poor population than there is now. This value increases by almost 0.10% for $k = 2$ and more than 0.40% for $k = 3$.

Moreover, we calculate some GE measures, based on the most common values of α used, which are 0, 1 and 2 (see Table 3.4). As a result, if $\alpha = 0$, we obtain the mean logarithmic deviation measure, also known as Theil's L, $GE(0)$. Instead, whether it is $\alpha = 1$, the Theil's T index, $GE(1)$ is obtained.

In 2008, the weighted average of SAH in the sample is 2.2585. To find $GE(1)$, for a "very poor" and a "poor" health status ($SAH = 1$ and $SAH = 2$), the ratio between SAH and population shares for the individuals with worst health is lower than one (0.4428 and 0.8855). Meanwhile, its logarithm is negative (-0.8147 and -0.1216). However, the same ratio for the people with better levels of health (fair: $SAH = 3$; good: $SAH = 4$; very good: $SAH = 5$) has values higher than one. Consequently, the logarithm of each of them is positive. Thus, the contribution of each health status to the index is specified. Consequently, the Theil's T index (0.0677) is obtained through the aggregation of these values. For $GE(0)$, the mean logarithmic deviation measure as 0.0703 is reached. Therefore, it can be assumed that the α value is higher for $GE(0)$ than for $GE(1)$. But if it is increased to 2, the GE measure is bigger than the unit (1.1402).

The same happens in 2016 and the weighted average of SAH in the sample is 2.2354. Also, $GE(1)$ is calculated and its value is 0.0676. The value that corresponds to $GE(0)$ is 0.0706 and for $GE(2)$ the highest value for this year, 1.1391, is reached. In general, the lower the SAH is, the smaller the value gets.

We also compare inequality between health status for 2008 and 2016. The last year comes across as more unequal than 2008 by having a lower Theil index, although both years have very similar values, only varying by 0.0001 and for 2008 and 2016 (0.0677 and 0.0676, respectively).

Table 3.4. Generalized Entropy inequality indices for self-rated health status (2008-2016)

2008	GE(0): Theil's L	0.0703
	GE(1): Theil's T	0.0677
	GE(2)	1.1402
2009	GE(0): Theil's L	0.9864
	GE(1): Theil's T	0.0713
	GE(2)	1.134
2010	GE(0): Theil's L	0.9848
	GE(1): Theil's T	0.0726
	GE(2)	1.1348
2011	GE(0): Theil's L	0.9908
	GE(1): Theil's T	0.0795
	GE(2)	1.0585
2012	GE(0): Theil's L	0.9929
	GE(1): Theil's T	0.0831
	GE(2)	1.1655
2013	GE(0): Theil's L	0.9831
	GE(1): Theil's T	0.0781
	GE(2)	1.1442
2014	GE(0): Theil's L	0.9936
	GE(1): Theil's T	0.0736
	GE(2)	1.1462
2015	GE(0): Theil's L	0.9888
	GE(1): Theil's T	0.0686
	GE(2)	1.1306
2016	GE(0): Theil's L	0.0706
	GE(1): Theil's T	0.0676
	GE(2)	1.1391

Once the poverty indices are calculated, we analyse the contribution of diverse population subgroups to changes in overall poverty between 2008 and 2016. We decompose health poverty into their determinants using information for three subgroups defined by: i) gender, which is divided between men and women; ii) age, where we distinguish between age groups at 10 year intervals (except the first and the last one) and

iii) education level, which is divided into 5 levels (primary school, 1st stage of secondary school, 2nd stage of secondary school, non-higher post-secondary education and higher education). These three variables have been chosen, partly because authors such as Jürges (2006) argue that SAH is likely to be comparable only within clearly defined socio-economic groups. It suggests using subjective health measures within a subsample. Therefore, it would have to be divided, raising problems when answering interesting research questions. There is no clear finding on which characteristics should be used to divide it, but gender and age are the most likely ones.

Table 3.5 shows the results of these decompositions of changes in SAH poverty between 2008 and 2016. We assume that health poverty is measured by π_2, with a fair SAH status ($k = 3$). Therefore, the time period as well as the hypotheses of π and k, have been determined. So, it can be defined that the total change in health poverty, in relative terms, is 0.0001 or 0.303% and this total change is expressed as δ. In addition, when we analyse total population, the trend remains stable in all decompositions (gender, age and education level).

Table 3.5. Subgroup decompositions for self-assessed health status (2008-2016)

Subgroup		2008		2009		2010		2011		2012		2013		2014		2015		2016	
		v	π_2	v	π_2	v	π_2	v	π_2	v	π_2	v	π_2	v	π_2	v	π_2	v	π_2
Gender	Men	41.32	0.18	41.58	0.18	42.63	0.19	42.36	0.19	42.73	0.19	41.62	0.19	42.05	0.19	43.04	0.19	42.93	0.19
	Women	58.68	0.07	58.42	0.06	57.37	0.06	57.64	0.06	57.27	0.06	58.38	0.06	57.95	0.06	56.96	0.06	57.07	0.06
Total population		100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02
Age	16-20	0.59	0.16	0.79	0.22	0.62	0.17	0.48	0.13	0.63	0.17	0.64	0.17	0.70	0.19	0.79	0.21	0.65	0.17
	21-30	3.37	2.13	3.58	2.31	2.78	1.85	2.23	1.44	2.01	1.22	2.68	1.57	2.71	1.63	2.37	1.42	2.36	1.58
	31-40	7.33	9.06	7.88	9.75	7.21	8.82	5.96	7.31	5.29	6.54	6.28	7.77	6.15	7.67	5.79	7.17	5.49	6.81
	41-50	13.12	26.97	13.35	27.39	12.75	26.13	11.56	23.71	11.10	22.94	13.12	27.13	13.02	26.93	11.86	24.54	11.99	24.62
	51-60	18.37	56.89	17.55	54.20	17.75	54.76	16.99	52.66	17.58	54.51	19.35	59.66	19.29	59.88	19.14	59.37	19.84	61.57
	61-70	20.75	90.25	21.89	94.95	24.49	95.16	22.53	98.26	22.44	98.13	21.60	94.26	21.10	92.03	21.87	95.31	20.86	90.72
	71-80	23.33	136.11	22.19	129.66	21.79	128.11	23.26	136.69	22.95	135.48	20.16	118.60	20.19	118.42	20.44	119.68	20.59	119.85
	80+	13.13	96.12	12.72	93.28	14.55	106.65	16.99	124.47	17.96	131.85	16.18	118.56	16.83	123.65	17.76	130.55	18.22	134.04
Total population		100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02
Education level	Primary	55.46	0.25	53.70	0.24	53.82	0.24	56.53	0.25	55.20	0.25	49.49	0.22	37.56	0.17	36.58	0.16	36.06	0.16
	Secondary (1^{st} stage)	21.40	0.02	22.75	0.03	22.66	0.03	20.07	0.02	22.03	0.02	24.28	0.03	31.43	0.03	30.63	0.03	30.12	0.14
	Secondary (2^{nd} stage)	11.84	0.02	12.01	0.02	12.15	0.03	11.71	0.02	11.84	0.02	13.00	0.03	14.55	0.03	16.24	0.03	17.29	0.03
	No higher post-secondary	0.33	0.00	0.43	0.00	0.20	0.00	0.45	0.00	0.24	0.00	0.25	0.00	0.12	0.00	0.20	0.00	0.18	0.00
	Higher education	10.97	0.05	11.11	0.05	11.18	0.05	11.24	0.05	10.96	0.05	12.99	0.06	16.34	0.07	16.35	0.07	16.35	0.07
Total population		100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.02	100	0.0209

Surveyed men who rate a poor SAH, have increased approximately 2% between 2008 and 2016, thereby offsetting the female population decreases by the same percentage. The pattern of the existence of negative correlations between SAH and gender, to the detriment of women, also can be observed in studies such as McCallum, Shadbolt and Wang (1994) or Cantarero, Pascual and Sarabia (2005).

In the age subgroup, there is little change in population rates from 2008 to 2016. The biggest increase can be seen in the subgroup of individuals older than 80 years, which raise from 14.04% in 2008 to 18.22% in 2016. The opposite happens with the population who are between 71 and 80 years old, which is reduced by more than 3%. Other authors, such as Contoyannis, Jones and Rice (2004), conclude that young people evaluate their health more favourably than older people. Similarly, Bago d'Uva *et al.* (2008) show that there are huge health inequalities and older people has lower health expectations than younger ones.

Lastly, the decomposition based on education level shows that people who only finished primary school, decreases 20% between 2008 and 2016. Hence, it increases in the secondary school (2^{nd} stage) and higher education people contribute to more than 5% each. In other words, the weight of the Primary education level is reduced and, therefore, the weight of the Secondary education level (1^{st} and 2^{nd} stages) as well as the weight of the Higher education is increased. Some authors like Van Doorslaer and Koolman (2004) find that most important factors are changes in the distribution of learning achievements and health inequalities among different education groups.

3.6. Conclusions

In this paper, we have analysed the recent dynamics of health poverty in subjective terms (SAH). To this end, we have used micro-data from the EU-SILC for the case of Spain over 2008-2016. The study is mainly focused on FGT poverty index and we provide the main results of statistical inference. Other indices have been calculated to confirm and to consolidate our findings. Besides, the subgroup decomposition has been made to analyse health poverty changes during the economic crisis.

Our results of the FGT index for 2008 suggest the following issues. If a poor SAH status as a health poverty threshold is chosen, the values from the FGT index reach their lowest value in the case of SAH poverty, as measured by π_2. Meanwhile, if it is chosen a fair SAH, the lowest value is reached for π_1. The same happens in both situations (a poor and a fair SAH status) for 2016. FGT index shows a negative growth of health poverty in Spain between 2008 and 2016, when it is chosen a poor SAH status as a health poverty threshold. This happens for SAH poverty as measured by poverty headcount rate (π_0) and π_1. As with the negative growth of health poverty, in the case of SAH poverty it is measured by π_2. Moreover, in all of these three cases the results are not significant. However, when a fair SAH status is chosen, FGT index shows a positive growth for SAH poverty as measured by poverty headcount rate (π_0), π_1 or π_2, in a statistically significant way.

Furthermore, based on our findings obtained for the subgroup decomposition, the following insights can be stated. In terms of gender, an increase (2%) of the surveyed men is shown. Therefore, female population decreases in the same proportion. Population aged 80 and older is the one that has experienced the greatest increase (more than 4%)

from 2008 to 2016. The opposite happens with the population between 71 and 80 years old, which is reduced by 3%, approximately. Besides, our findings for the decomposition analysis show that most of the respondents are individuals with low education, more specifically, who only finished primary school.

Chapter 4

Is childhood vaccination related to per capita income? Evidence from 135 low, middle and high-income countries

4.1. Introduction

Vaccination is one of the most relevant prevention measures as a health strategy and the different programs implemented are a matter of public choice because they are cost-effective for improving population's health and well-being. Richer countries are, on average, healthier than poorer ones because they have more resources to improve health, health infrastructure investments and conduct trainings to raise vaccination rates (Ozawa *et al.*, 2016). Therefore, we can assume that vaccination rates vary significantly across countries (Bloom, Canning and Fink, 2014).

In this regard, The Global Vaccine Action Plan (GVAP) has made some progress, but it remains too limited for reaching its main goals by the end of the current Decade of

Vaccines in 2020 (WHO, 2017). It is necessary to improve immunization rates for the most disadvantaged groups, being children the main population at risk (Masia *et al.*, 2018). In other words, children who are not vaccinated are more likely to get sick, have disabilities or even die prematurely. Hence, their productivity can be reduced during their lives. Nevertheless, vaccination coverage is associated with family characteristics and parental attitudes, among others.

The body of literature on vaccination is very extensive. Many health economists have analysed vaccines cost-effectiveness, immunizing an additional child or comparing it with savings for National Health Systems, among others (Lu *et al.*, 2006; Damm *et al.*, 2015; Ozawa *et al.*, 2016; Varghese *et al.*, 2018). In our case, we study the relationship between income and immunization coverage rates. Previous research about this topic is wide, but only for one vaccine (i.e., if studies analyse Human Papilloma Virus (HPV), they only focus on that vaccine). Meanwhile, we mainly focus on eight vaccines. LaMontagne *et al.* (2011) show that countries achieve high HPV immunization coverage rates through some strategies, but they need more funding. On the one hand, Shavit *et al.* (2012) conclude that the HPV vaccine can reduce mortality rates in countries where there are large burdens of cervical cancer. On the other hand, Bruni *et al.* (2016) estimate the coverage of vaccinated women against HPV by region and income level. They present burden and prevention inequalities between low- and high-income countries, finding the highest immunization rates in upper-middle and high-income countries, and higher incidence and mortality in low- and middle-income countries. Similarly, Wymann *et al.* (2018) show that HPV vaccination is not related to decreased uptake of cervical cancer screening in Switzerland.

Therefore, the aim of our study is to analyse if per capita income has some impact on infant and children vaccination rates. We analyse as many countries and vaccines as possible, considering the availability of data for the 2000-2016 period. As far as we know, this is the first paper that examines if childhood vaccination, analysing eight vaccines included in the global immunization schedules, is related to per capita income, studying 135 economies around the world. We use the per capita Gross National Income (GNI) from the World Bank and the coverage rates of eight vaccines from the World Health Organization (WHO). We follow both a linear and a dynamic econometric model and we show if there is conditioned convergence. Our findings indicate that per capita income has a positive correlation with immunization coverage rates and the existence of conditioned convergence.

The structure of this paper is as follows. Section 4.2 describes the vaccines considered using data from both the WHO and the World Bank. Empirical analysis is shown in Section 4.3, where we develop both a linear and a dynamic model to carry out our research and we show our results. In addition, we study if there is convergence between income growth rates and immunization coverage. Section 4.4 compares our findings with other articles from the most recent literature. Finally, Section 4.5 summarizes our findings.

4.2. Data

Based on the data availability from the World Bank and the WHO, we analyse as many countries as possible as well as vaccines. We consider a period of time that covers 17 years, more specifically, we analyse from 2000 to 2016. Hence, the number of

observations for each vaccine has been limited by the availability of data. That is, we have eliminated from the sample those countries for which there was no data on vaccination coverage between 2000 and 2016 due to they are missing relevant data points.

On the one hand, we use per capita income data according to the World Bank classification. We use the most current information measured at Purchasing Power Parity (PPP) terms. Economies are divided among income groups according to 2016 per capita GNI, in U.S. dollars. The World Bank classifies countries dividing their economies into four income groups. First, low income economies are those countries with a per capita GNI lower or equal to $1,005. Second, lower-middle income economies are countries whose per capita GNI is between $1,006 and $3,955. Third, upper-middle income economies present a per capita GNI between $3,956 and $12,235. Last, but not least, high income economies are those countries with a per capita GNI equal or higher than $12,236. Therefore, our income variable can have a clear ordering of the four categories (low, low-middle, upper-middle and high). In addition, we are able to classify countries into these four categories. More precisely, our income variable is ordinal.

As we have mentioned above, we exclude certain countries because they are missing relevant data points. Therefore, our final sample is composed of 135 countries: 24 low-income economies, 39 lower-middle income countries, 41 upper-middle income economies and 31 high-income countries (Table A4.1).

On the other hand, we use data from the WHO's Department of Immunization, Vaccines and Biologicals, which includes the childhood vaccination coverage rate of many countries and we analyse the following vaccines (WHO, 2018).

The first dose of the Bacillus Calmette-Guérin (BCG) vaccine, used against tuberculosis. In terms of immunization, coverage rates range from 75% to 90% and from

90% to 93%, in low income and upper-middle economies, respectively, between 2000 and 2016. In the case of lower-middle income countries this value ranges from 87% to 91%, being the situation very similar in high economies.

The first and the third dose of the vaccine that conveys immunity to Diphtheria, Pertussis and Tetanus (DTP1 and DTP3). The coverage rate of the first dose ranges from 87% to 94% for all countries while 81% and 91% of children get the third dose of the vaccine, in 2000 and 2016, respectively.

The third dose of the vaccine HepB3 protects from Hepatitis B. We have coverage rates for all groups of countries, except for the low-income ones. The average coverage rate is 94% across countries considered in 2016, improving the situation in comparison with the immunization rate in 2000 (79%).

The first and the second dose of the Measles-Containing vaccine (MCV1 and MCV2), used against the measles virus. On the one hand, the coverage rate of the first dose ranges from 86% to 94% for all countries. On the other hand, for the second dose, lower-middle economies reach the greatest immunization coverage levels (94%). So, in the case of the second dose, we could expect that this vaccine would not have a positive association with per capita income.

The third dose of the Polio vaccine (Pol3), used to prevent poliomyelitis. Looking at immunization coverage rates in 2016, all countries have high values, ranging from 85% to 95%, in low- and high-income countries, respectively.

For the Tetanus Toxoid vaccine (TT2), we have coverage rates for all countries, except for the high-income ones. In 2000, around 47% infants and children get the vaccine in poorer countries, that is, low income economies. Meanwhile, lower-middle and upper-

middle countries have similar values, ranging, nearly, from 55% to 65%, in 2000 and 2016, respectively.

Table 4.1 shows the descriptive statistics of the vaccines considered as well as of the per capita GNI, where the number of observations corresponds to the average income (US $) of the 135 countries analysed. According to the vaccines, the number of observations varies among them due to the lack of data. There are three vaccines (Pol3, DTP3 and MCV1) which present more than 2,000 observations. In the case of Pol3, 129 countries are considered and we have the coverage rate for 17 years for each of them, so the total observations for that vaccine is equal to 2,193. Similarly, when we look at DTP3, we have 2,210 observations due to we analyse 130 countries as well as the immunization rate for the whole period (2000-2016). The same happens with MCV1. Besides, the TT2 vaccine has a relatively small number of observations because many high income countries do not use it or we do not have the necessary information. In addition, this vaccine has the lowest mean coverage rate. Meanwhile, the mean coverage rate is highest for the MCV2, followed by the DTP vaccine.

Table 4.1. Summary statistics of the eight vaccines and the per capita Gross National Income

Variable	Observations	Mean	Standard Deviation	Min	Max
3rd dose of Diphtheria, Pertussis and Tetanus	2,210	88.44	13.36	10	99
3rd dose of Polio	2,193	88.15	13.21	12	99
1st dose of Measles-Containing	2,040	88.18	13.44	19	99
Bacillus Calmette-Guérin	1,785	90.16	13.32	16	99
1st dose of Diphtheria, Pertussis and Tetanus	1,411	91.71	11.08	14	99

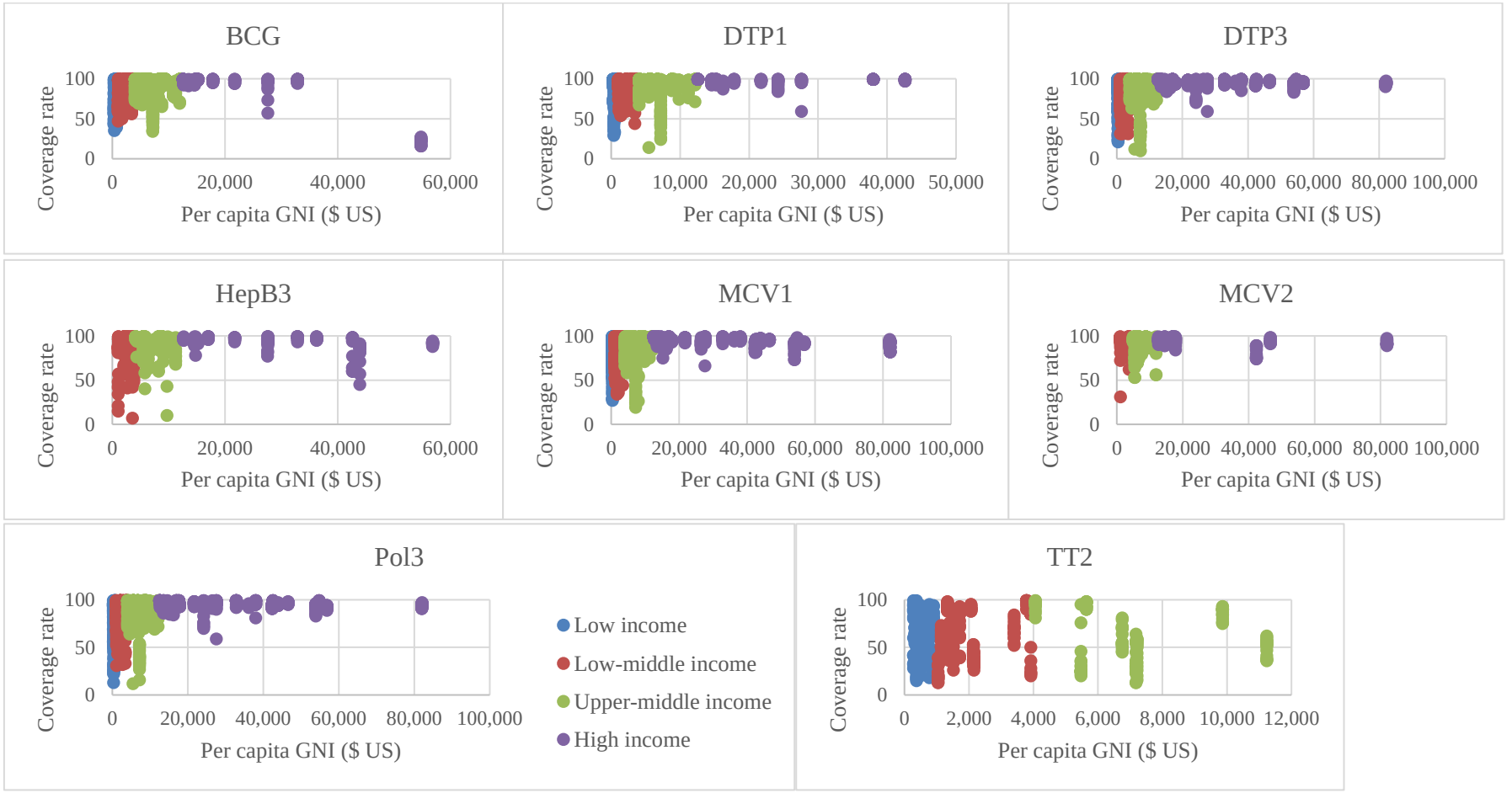
Variable	Observations	Mean	Standard Deviation	Min	Max
3rd dose of Hepatitis B	816	90.65	12.49	7	99
Tetanus toxoid	629	64.20	23.08	13	99
2nd dose of Measles-Containing	442	92.67	8.45	31	99
GNI per capita (US $)	2,295	8,444.28	13,954.81	80	104,540

Note: GNI (Gross National Income).

Figure 4.1 shows the relationship between per capita GNI and the coverage rates of the eight vaccines considered: BCG, DTP1, DTP3, Hep3, MCV1, MCV2, Pol3 and TT2. It can be seen the grouping of most of the points in the top left corner, indicating a general pattern that vaccination rates are higher in those countries characterised by higher per capita income. Nevertheless, we find atypical data (outliers) when we focus on countries with high per capita income. Mainly, these data are found in the BCG vaccine, where Sweden, which has an income above $50,000, has low vaccination rates that do not exceed 30% coverage. Likewise, in the HepB3 vaccine, Germany has values below 60% coverage in 2000 and 2016. The same happens with Belgium between 2000 and 2004, which does not exceed 65%. In addition, the Republic of Korea (with an income of $27,600) presents outliers for the BCG, DTP1, DTP3, MCV1 and Pol3 vaccines in 2001.

However, we check that excluding these countries does not modify our findings.

Figure 4.1. Per capita Gross National Income and coverage vaccination rates



Note: BCG (Bacillus Calmette-Guérin) is the first dose of the vaccine against tuberculosis; DTP1 and DTP3 are the first and the third dose of the vaccine for Diphtheria, Pertussis and Tetanus; HepB3 is the third dose of the vaccine against Hepatitis B; MCV1 and MCV2 are the first and the second dose of the vaccine for Measles-Containing; Pol3 is the third dose of the Polio vaccine and TT2 is the vaccine against the Tetanus Toxoid; GNI (Gross National Income).

4.3. Empirical analysis

In this section, we conduct two econometric regressions. In addition, we study if there is conditioned convergence. It is expected that per capita income has a positive correlation with vaccination coverage rates. That is, we would assume that vaccination coverage rate would be higher in those countries with higher income. Therefore, in some poor countries, which are characterised by low income economies, we would find lower vaccination coverage because of the limitation supply of vaccines (Sakai, 2018). It must be highlighted that our principal aim is to analyse the association between per capita income and vaccination coverage rates. Thus, the models used are specified at the national level. We rely on the classification of the country in particular, without focusing on the differences within each of the countries.

4.3.1. Linear econometric model

Despite the fact that Figure 4.1 suggests that the relationship between per capita income and childhood vaccination coverage is not linear, we want to make sure. Hence, we estimate a regression as follows:

$$inc_{it} = \alpha_i + \mu_t + \beta_1 cov_{it} + X_{it}\delta + u_{it} \quad (4.1)$$

where inc_{it} represents per capita income in the country i at year t, α_i is the country-fixed effects, μ_t is the year-fixed effects, cov_{it} is the vaccination coverage rate in the country i at year t, X_{it} is a vector of control variables and u_{it} is the error term.

Moreover, the Equation 4.1 contains country- and year-fixed effects. On the one hand, country-fixed effects control unobservable time factors that do not vary over time for a specific country, such as historical and institutional factors. On the other hand, year-

fixed effects are also important because our sample consists of an extended period. Nevertheless, these factors can be correlated with per capita income and/or with vaccination coverage rates. Thus, we could have a problem from omitted variable bias if we left it in the error term.

We add control variables for each country for the following reasons. Overall, we focus on socio-demographic variables that characterise each of the countries considered because our objective is to broadly examine countries according to their income level (low, low-middle, upper-middle and high). Hence, we use the population variable to check if a greater number of inhabitants affects to a greater or lesser extent the immunization coverage rates. The same applies to population density, to observe how the average number of inhabitants in each country affects a given area. On the one hand, the percentage of population between 15 and 64 years as well as the percentage of population over 65 years are used to check whether there is a difference between age groups. On the other hand, the percentage of female population is used to cover a basic variable such as gender. Finally, we analyse the percentage of rural population to have a variable that can, as far as possible, contain the differences within each country. As we mentioned above, we do not want to have correlation problems, so we exclude the share of male population and the urban one to prevent that problem.

Regarding the existence of some degree of correlation across the eight vaccines considered within countries, it would be logical to think that this correlation would exist across that vaccines used against the same disease. That is, DTP vaccine, considering the first and third doses; and the MCV, taking into account the first and second doses. However, we think it would be better to analyse each type of vaccine independently, without assessing all at once in the analysis. In addition, if we look at the data collected

for each dose of MCV, we see that the second dose has only 442 observations compared to the first dose, which present 2,040. That is, taking into account the period of 17 years (2000-2016) analysed, we only have data from 29 countries. Therefore, it is not entirely clear that these doses were correlated with each other. However, it is true that we could consider it for future studies.

Our findings considering Equation (4.1) are shown in Table 4.2. Each vaccine represents an estimation, so, we perform eight estimates, showing them in columns 2-9. Our dependent variable is per capita income, which is based on the per capita GNI in 2016, using the most current information measured at PPP terms.

We present the standard error in our findings and it shows how much the value of a test statistic varies from sample to sample. Therefore, it is possible to check how disperse data are when comparing all countries considered.

When we show the coverage vaccination variables, they are separately significant for most of the vaccines, except for DTP3, Pol3 and MCV2. In addition, coverage variables present positive coefficients, having per capita income a positive correlation with immunization rates for all vaccines, except for MCV2. That is, for BCG, our estimate on the coverage rate is 0.0014 and it is significant at the 5% level. The coefficient implies that a 1 percentage point increase in the immunization coverage of BCG, it will raise per capita income by 0.0014, holding other factors constant. The opposite happens for MCV2, whose coverage rate is negative (-0.0062) and it is not significant. This coefficient implies that a 1 percentage point increase in the immunization coverage of MCV2, it will decrease per capita income by 0.0062, holding other factors constant.

It is possible that MCV2 is the only vaccine that presents a negative association with per capita income because of the availability of data. The sample size for this vaccine

consists of 442 observations, taking into account the period considered (seventeen years) and the countries (26) which implement this vaccine. More specifically, 7 of the 26 countries correspond to low-middle income economies, 10 to upper-middle income economies and the remaining (9) to high-income ones.

Table 4.2. Linear estimation of per capita income and vaccination coverage rates

	BCG		**DTP1**		**DTP3**		**HepB3**		**MCV1**		**MCV2**		**Pol3**		**TT2**	
Coverage	0.0014	**	0.0012	**	0.0002		0.0037	***	0.0022	**	-0.0062		0.0001		0.0052	***
	(0.0006)		(0.0006)		(0.0009)		(0.0011)		(0.0010)		(0.0044)		(0.0010)		(0.0009)	
Population	0.0014		0.0040	***	0.0023		0.0015		0.0012		-0.0335	**	0.0026		0.0130	***
	(0.0011)		(0.0015)		(0.0019)		(0.0018)		(0.0025)		(0.0145)		(0.0019)		(0.0031)	
Population density	-0.0004		0.0004		0.0015	**	0.0101	***	0.0010	*	0.0130	**	0.0015	**	-0.0031	***
	(0.0004)		(0.0004)		(0.0007)		(0.0013)		(0.0006)		(0.0062)		(0.0007)		(0.0009)	
Share pop. 15-64 years	0.0178	***	0.0288	***	0.0090	*	-0.0009		0.0136	**	0.0798	***	0.0099	*	0.0710	***
	(0.0033)		(0.0033)		(0.0054)		(0.0069)		(0.0055)		(0.0186)		(0.0055)		(0.0103)	
Share pop. >64 years	0.2328	***	0.2064	***	0.2809	***	0.2568	***	0.2815	***	0.2514	***	0.2856	***	0.1298	***
	(0.0085)		(0.0079)		(0.0119)		(0.0141)		(0.0118)		(0.0276)		(0.0115)		(0.0416)	
Share female pop.	-0.3135	***	-0.2442	***	-0.5087	***	-0.4428	***	-0.5794	***	-1.3265	***	-0.5159	***	-0.2083	***
	(0.0216)		(0.0205)		(0.0364)		(0.0476)		(0.0366)		(0.1540)		(0.0364)		(0.0489)	
Share rural pop.	-0.0013		0.0128	***	-0.0009		0.0077		-0.0047		-0.0918	***	-0.0004		0.0241	***
	(0.0024)		(0.0030)		(0.0041)		(0.0055)		(0.0042)		(0.0155)		(0.0042)		(0.0071)	
N	1,785		1,411		2,210		816		2,040		442		2,193		629	
Countries	105		83		130		48		120		26		129		37	
R^2 within	0.4360		0.4454		0.3090		0.4904		0.3423		0.3598		0.3277		0.2246	
R^2 between	0.3497		0.4809		0.4457		0.3213		0.5272		0.3732		0.4559		0.8357	
R^2 overall	0.3387		0.4701		0.4299		0.3200		0.5093		0.3524		0.4404		0.7802	

Note: Income is in $10,000. Standard errors appear in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Now, we describe our findings for control variables. In the case of population variable, it affects positively per capita income, except for MCV2, although it is not relevant enough. Meanwhile, in the case of population density variable, it decreases for BCG and TT2 vaccines, being significant in most cases. Focused on the share of population between 15 and 64 years as well as older than 64, all the coefficients have a positive sign, except for HepB3 in the first variable. In terms of significance, the share of active population is significant for all vaccines, except for HepB3. Meanwhile, the second variable is significant at the 1% level for all vaccines. The share of female population variable presents negative and significant values for all vaccines. Moreover, the empirical results for the share of rural population vary among all the estimates, showing both positive and negative signs and being significant in some vaccines (DTP1, MCV2 and TT2).

Our findings for MCV2 differ from those obtained for the rest of vaccines. It might happen due to the sample is composed of 26 countries meanwhile other samples are based on a larger number of countries.

4.3.2. Dynamic panel data model

Next, we perform a dynamic regression, using panel data, to show if per capita income on a year is conditioned by the previous one. We add the delayed dependent variable on the right-hand side of the Equation (4.1). Therefore, our model can be described as follows:

$$inc_{it} = inc_{it-1} + \alpha_i + \mu_t + \beta_1 cov_{it} + X_{it}\delta + u_{it} \quad (4.2)$$

where inc_{it} represents per capita income in the country i at year t, inc_{it-1} is the lagged per capita income, α_i and μ_t are the country and year-effects, cov_{it} presents the

vaccination coverage rate in the country i at year t, X_{it} is a vector of control variables and u_{it} is the error term.

Our findings for the dynamic model (4.2) differ from those obtained in linear model (4.1) (see Table 4.3). The estimate for each vaccine is displayed in columns 2-9. In the first row, we show the delayed per capita income that is separately statistical significant at the 1% level and it presents positive coefficients. So, we can conclude that per capita income on a year is conditioned by the previous one (anchorage effect).

Moreover, per capita income has positive correlations with all coverage vaccines considered, except for MCV1. For example, for this vaccine, we obtain a negative coverage rate (-0.0001), which implies that a 1 percentage point increase in the immunization coverage, it will decrease per capita income by 0.0001, holding other factors constant. Meanwhile, MCV2 presents a coverage rate equal to 0.0012, which implies that a 1 percentage point increase in the immunization coverage, it will raise per capita income by 0.0012, holding other factors constant. Additionally, HepB3 and TT2 vaccines are the only ones which show statistical significance at the 5% and 1% level, respectively. Thus, we highlight that coverage variables are not relevant enough.

In the case of control variables, first, we describe the population one, which is not relevant enough although it affects always per capita income in a positive way. The same happens with the variable related to population density, which is not significant enough (only BCG and MCV2 indicate significance at the 10% level), and it presents negative values for all vaccines, except for HepB3. On the one hand, the share of population between 15 and 64 years shows positive and significant coefficients for all vaccines. On the other hand, the share of rural population indicates positive coefficients in all vaccines, being only significant for MCV2. As happened with the population density variable, the

share of population older than 64 years presents negative values, except for TT2 vaccine and it is significant in most cases. Moreover, the share of female population variable has positive coefficients for all vaccines, except for HepB3 and TT2, and it is significant in most cases.

Table 4.3. Dynamic estimation of per capita income and vaccination coverage rates

	BCG		DTP1		DTP3		HepB3		MCV1		MCV2		Pol3		TT2	
Income $_{t-1}$	0.9159	***	0.9196	***	0.9214	***	0.9120	***	0.9168	***	0.9290	***	0.9219	***	0.7875	***
	(0.0083)		(0.0099)		(0.0069)		(0.0120)		(0.0075)		(0.0155)		(0.0070)		(0.0184)	
Coverage	0.0003		0.0004		0.0002		0.0010	**	-0.0001		0.0012		0.0002		0.0012	***
	(0.0002)		(0.0002)		(0.0003)		(0.0004)		(0.0003)		(0.0016)		(0.0003)		(0.0004)	
Population	0.0007	*	0.0001		0.0007		0.0006		0.0002		0.0026		0.0008		0.0010	
	(0.0004)		(0.0005)		(0.0006)		(0.0006)		(0.0008)		(0.0046)		(0.0007)		(0.0015)	
Population density	-0.0003	*	-0.0001		-0.0001		0.0002		-0.0002		-0.0037	*	-0.0002		-0.0003	
	(0.0001)		(0.0001)		(0.0002)		(0.0005)		(0.0002)		(0.0020)		(0.0002)		(0.0004)	
Share pop. 15-64 years	0.0069	***	0.0068	***	0.0094	***	0.0066	***	0.0101	***	0.0146	**	0.0096	***	0.0035	
	(0.0012)		(0.0013)		(0.0018)		(0.0025)		(0.0019)		(0.0064)		(0.0018)		(0.0054)	
Share pop. >64 years	-0.0029		-0.0016		-0.0128	***	-0.0034		-0.0124	***	-0.0234	**	-0.0117	***	0.0553	***
	(0.0037)		(0.0037)		(0.0044)		(0.0060)		(0.0046)		(0.0100)		(0.0044)		(0.0199)	
Share female pop.	0.0286	***	0.0255	***	0.0413	***	-0.0031		0.0371	***	0.1670	***	0.0409	***	-0.0336	
	(0.0085)		(0.0084)		(0.0128)		(0.0182)		(0.0136)		(0.0554)		(0.0130)		(0.0240)	
Share rural pop.	0.0007		0.0019		0.0014		0.0016		0.0011		0.0095	*	0.0017		0.0023	
	(0.0009)		(0.0012)		(0.0014)		(0.0020)		(0.0014)		(0.0053)		(0.0014)		(0.0035)	
N	1,680		1,328		2,080		768		1,920		416		2,064		592	
Countries	105		83		130		48		120		26		129		37	
R^2 within	0.9332		0.9283		0.9309		0.9417		0.9289		0.9374		0.9316		0.8220	
R^2 between	0.9673		0.9924		0.9914		0.9813		0.9976		0.8857		0.9906		0.9905	
R^2 overall	0.9625		0.9855		0.9853		0.9767		0.9912		0.8867		0.9846		0.9752	

Note: Income is in $10,000. Standard errors appear in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

4.3.3. Conditioned convergence

Now, following the conditional convergence framework developed by Barro and Sala-i-Martín (1992), and Barro (2012), we examine if there is convergence between per capita GNI growth and immunization coverage rates. We show how countries' economic initial conditions as well as their changes affect the speed at which poor countries reach richer ones in terms of GNI. In other words, we check whether countries considered behave in a similar way according to the income group which they belong to. If the coefficient $(1 + b)$ of the lagged dependent variable (i.e., the delayed income or per capita GNI) presents a positive sign, there is evidence of this type of convergence.

More specifically, there is conditioned convergence when each country converges towards its own stationary state due to its own characteristics, very different from one another. In other words, each country can have its own stationary state due to the different characteristics that exist between them and it can converge towards its own stationary state in the long term, but never towards the same.

The convergence equation can be written as follows:

$$\Delta inc_{it} = \Phi\,(a, (1 + b)\ln(inc_{it-1}), cov_{it}, X_{it}, \dots) \tag{4.3}$$

where Δinc_{it} is the is the average growth rate of per capita GNI. The model also includes other variables such as the logarithm of the lagged per capita GNI, the lagged coverage vaccine rate as well as variables related to population. In addition, we estimate another model using the three-year forward coverage vaccine rate instead of the lagged coverage vaccine rate. According to our previous models, we eliminate those variables that are not significant for each one of the vaccines.

We show the growth regressions without non-significant variables of previous models and with the lagged immunization rate to each vaccine. We also run the same

regressions with the three-year forward coverage immunization rate. We perform eight estimates, which correspond to each vaccine (see columns 2-9 of Table 4.4 and Table 4.5). Our dependent variable is per capita GNI, but we transform it into the average growth rate of per capita GNI.

In Table 4.4, we present the growth regressions without non-significant variables of previous models and with the delayed immunization rate. The most important independent variable is the logarithm of lagged per capita income, which represents the relationship between starting GNI and its growth rate. All vaccines show a positive and significant coefficient at the 1% level, showing that there is conditioned β convergence.

In the case of control variables, both population density and the share of rural population are not significant in the vaccines considered (BCG and MCV2 in the first variable and HepB3 in the second variable). In addition, both variables are negatively related to growth rate of per capita GNI. Population variable is positive related to income and is significant at the 5% level for BCG. When we focus on the share of population between 15 and 64 years old, all the growth regressions are positive and significant at the 1% level, being understood as a result of this group is labour force. The opposite happens in the share of population older than 64 years, where we show negative coefficients and no significance in some vaccines (DTP3, MCV1 and Pol3) and another one with positive sign and significant at the 1% level (TT2). The share of female population shows positive and significant findings, except for MCV2. Coverage variable is considered for HepB3 and TT2 and it displays similar findings. Moreover, we present the lagged coverage vaccine rate. All vaccines present positive and significant results, except for TT2.

Table 4.4. Growth regressions without non-significant variables and with lagged vaccine rate

	BCG		DTP1		DTP3		HepB3		MCV1		MCV2		Pol3		TT2	
Ln(Income $_{t-1}$)	-0.1145	***	-0.1105	***	-0.1097	***	-0.1184	***	-0.1115	***	-0.1376	***	-0.1089	***	-0.1158	***
	(0.0073)		(0.0079)		(0.0070)		(0.0087)		(0.0075)		(0.0123)		(0.0070)		(0.0131)	
Population	0.0014	**														
	(0.0006)															
Population density	-0.0002										-0.0008					
	(0.0003)										(0.0011)					
Share pop. 15-64 years	0.0184	***	0.0171	***	0.0163	***	0.0134	***	0.0171	***	0.0373	***	0.0160	***		
	(0.0022)		(0.0022)		(0.0018)		(0.0023)		(0.0019)		(0.0046)		(0.0018)			
Share pop. >64 years					-0.0016				-0.0030		0.0043		-0.0011		0.0406	***
					(0.0037)				(0.0038)		(0.0068)		(0.0035)		(0.0146)	
Share female pop.	0.0814	***	0.0795	***	0.0724	***			0.0632	***	-0.0337		0.0709	***		
	(0.0127)		(0.0128)		(0.0112)				(0.0117)		(0.0318)		(0.0110)			
Share rural pop.											0.0017					
											(0.0033)					
Coverage							0.0011	**							0.0014	***
							(0.0005)								(0.0004)	
Coverage $_{t-1}$	0.0007	**	0.0008	***	0.0010	***	0.0010	**	0.0005	*	0.0021	**	0.0008	***	-0.0001	
	(0.0004)		(0.0004)		(0.0003)		(0.0005)		(0.0003)		(0.0009)		(0.0003)		(0.0004)	
N	1,635		1,290		2,033		760		1,876		411		2,017		559	
Countries	105		83		130		48		120		26		129		37	
R^2	0.1711		0.1725		0.1669		0.2141		0.1689		0.3529		0.1705		0.1434	

Note: Standard errors appear in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

In Table 4.5, we show the growth regressions without non-significant variables of previous models and the three-year forward coverage immunization rate. The most important independent variable is the logarithm of lagged income, which presents very similar results to those obtained previously, explaining that there is conditioned β convergence.

Additionally, we find similar results in some control variables such as population, population density, the share of population between 15 and 64 years old, the share of female population, and the vaccine coverage. Living in rural areas decreases per capita income, but it is not relevant enough. Meanwhile, the share of population older than 64 years shows positive signs in all the vaccines considered and statistical significance in some of them (MCV1, Pol3 and TT2). The three-year forward coverage immunization rate presents positive and significant coefficients for all the vaccines, except for MCV2.

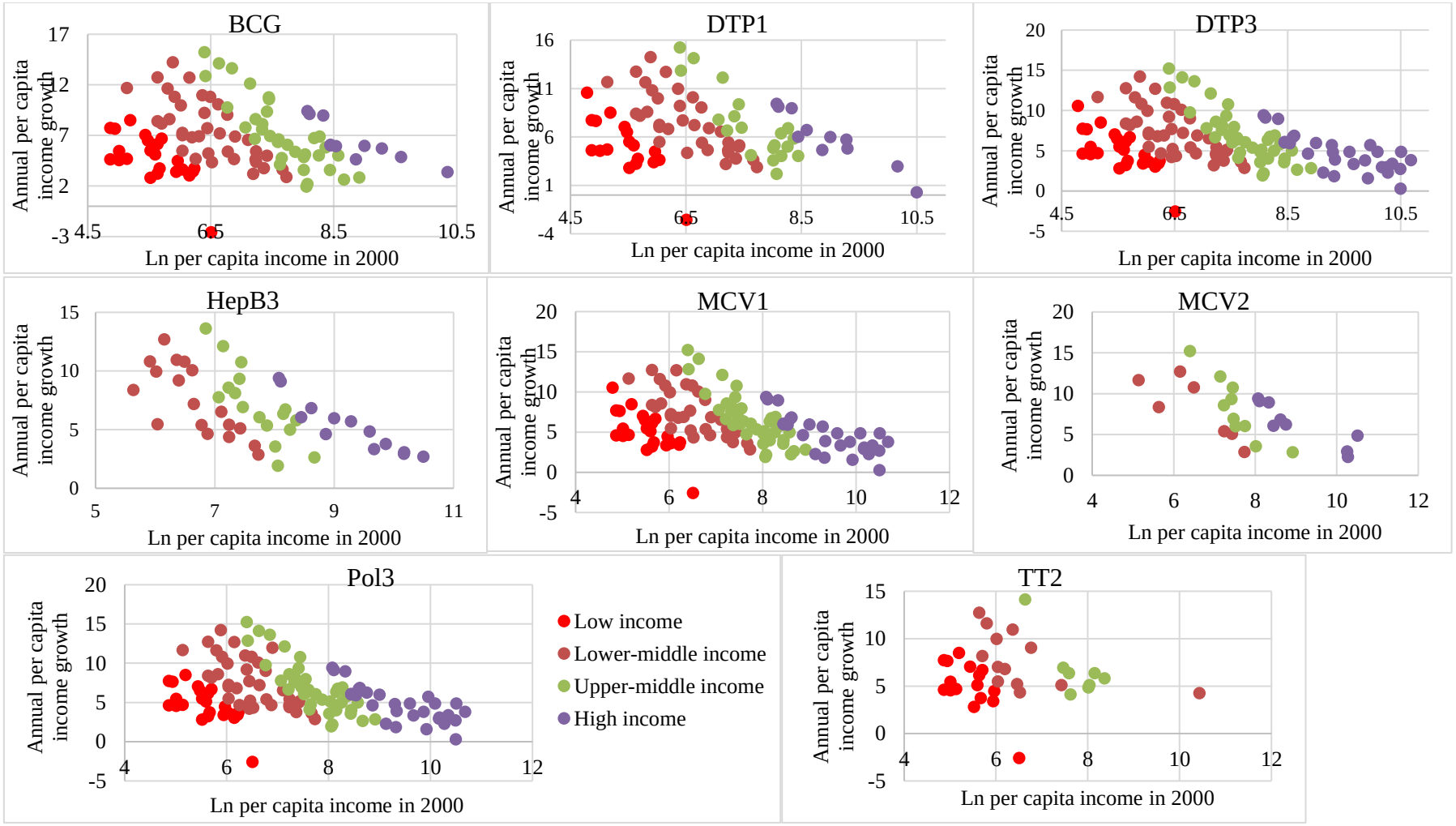
Moreover, our findings show that countries converge by groups. If we examine countries according to the World Bank classification, we find that countries that belong to the same group of income have a similar behaviour (Figure 4.2).

Table 4.5. Growth regressions without non-significant variables and with three-year forward vaccine coverage rate

	BCG		DTP1		DTP3		HepB3		MCV1		MCV2		Pol3		TT2	
Ln(Income $_{t-1}$)	-0.0830	***	-0.0744	***	-0.0791	***	-0.0699	***	-0.0859	***	-0.1097	***	-0.0806	***	-0.0878	***
	(0.0086)		(0.0091)		(0.0080)		(0.0107		(0.0086)		(0.0164)		(0.0082)		(0.0151)	
Population	0.0020	**														
	(0.0008)															
Population density	0.0003										-0.0007					
	(0.0003)										(0.0016)					
Share pop. 15-64 years	0.0217	***	0.0199	***	0.0201	***	0.0150	***	0.0206	***	0.0374	***	0.0207	***		
	(0.0027)		(0.0027)		(0.0023)		(0.0030)		(0.0025)		(0.0057)		(0.0023)			
Share pop. >64 years					0.0087				0.0098	*	0.0097		0.0096	*	0.0621	***
					(0.0053)				(0.0054)		(0.0100)		(0.0051)		(0.0216)	
Share female pop.	0.0616	***	0.0626	***	0.0504	***			0.0420	***	-0.0459		0.0529	***		
	(0.0148)		(0.0148)		(0.0134)				(0.0141)		(0.0381)		(0.0132)			
Share rural pop.											-0.0052					
											(0.0043)					
Coverage							0.0013	***							0.0008	*
							(0.0005)								(0.0004)	
Coverage $_{t+3}$	0.0023	***	0.0031	***	0.0023	***	0.0012	*	0.0023	***	0.0009		0.0018	***	0.0016	***
	(0.0005)		(0.0005)		(0.0004)		(0.0007)		(0.0004)		(0.0015)		(0.0004)		(0.0005)	
N	1,680		1,051		1,655		618		1,528		334		1,642		457	
Countries	105		83		130		48		120		26		129		37	
R^2	0.1028		0.1188		0.0977		0.0862		0.1036		0.1790		0.0950		0.0917	

Note: Standard errors appear in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Figure 4.2. Conditioned convergence for all vaccines according to the World Bank classification



4.4. Discussion

Similar studies such as that developed by Sakai (2018), show that immunization rates increase, but there is a time when they decrease as per capita income raises for country-level data from the WHO. He also demonstrates that both low and high-income parents are less predisposed to follow the national immunization schedule. Our findings show that the share of female population has a positive correlation with per capita income in the dynamic model. An interesting discussion point would be their attitudes of vaccinating children.

In this analysis, we have mentioned that parental refusal could be a factor that decreases vaccination coverage rates. It is determined by some factors such as confidence, complacency and/or convenience of parents in most cases (MacDonald, 2015). This situation can change if parents are provided with clear and appropriate information about vaccine efficacy and safety, side effects and health protection. Similarly, Muñoz, Llamas and Bosch-Capblanch (2015) study some concerns about vaccination in low- and middle-income countries, including religious reasons or social stigma for mothers, among others. We can consider this issue for future analysis.

For example, Szucs and Müller (2005) examine the determinants for influenza vaccination coverage rates across Europe, showing that city and household size as well as household income have a significant effect on vaccination coverage rate. The same happens with age and chronic illness.

Meanwhile, Odusanya *et al*. (2008) analyse the DTP vaccination coverage of rural Nigeria after the implementation of a private financed vaccination project, which increases the coverage rate until 81%. Besides, immunization rates are correlated with the

knowledge of mothers. Similarly, Rainey *et al*. (2011) conclude that there are factors such as gender, education level or religion related to non- and under-vaccination of children in low and middle-income countries. In the case of Williams *et al*. (2013), they show that an educational intervention destined to parents could improve parental attitudes about childhood vaccination. Likewise, Lukusa *et al*. (2015) affirm that strategies for informing, educating and involving parents are necessary. In addition, Kien *et al.* (2017) corroborate that children of mothers with lower education or belonging to the poorest socio-economic group are less likely to be vaccinated.

Analysing the determinants of childhood vaccination, we find Kusuma *et al*. (2010). They show that prenatal and obstetric care as well as personalized health care service in India increases the probability of childhood immunization rates. Meanwhile, people with lower socio-economic level reduce these rates. Hence, government must invest in education and economic development. Based on Europe, Tabacchi *et al*. (2016) argue that there are strong predictors of negative attitudes and behaviours of parents about childhood vaccination such as low income and education levels as well as non-married status. They propose to implement policies focused on increasing vaccination coverages as well as improving parental attitudes and behaviours.

On the one hand, Molina-Aguilera (2015) show that new vaccines introduction is a problem to financial sustainability in developing countries because they must compete with other public health priorities. Economic characteristics should be considered due to the high cost of new vaccines. On the other hand, Phillips *et al*. (2017) conclude that there is an increase in the demand for childhood vaccination in developing countries, although the quantitative evidence is limited. Likewise, they express that mass media campaigns can be effective.

4.5. Conclusions

This paper provides new empirical evidence on the relationship between per capita income and vaccination coverage rates. Our sample consists of 135 countries classified as low, lower-middle, upper-middle and high-income economies and eight vaccines included in the global immunization schedules.

In view of our results, the linear model indicates a positive and significant relationship between per capita income and vaccination coverage rates to most of the vaccines, while the dynamic regression shows that per capita income has a positive association with immunization rates for all vaccines, except for MCV1. In the case of control variables, most of them have a positive relationship with per capita income, except the share of female population and, in some vaccines, the share of rural population in the linear regression. The same happens with the density population and the share of population older than 64 years in the dynamic model.

In the case of conditioned convergence, it will exist, if the coefficient of the lagged dependent variable presents a positive sign. Thus, in our study, this coefficient for all the vaccines is positive, concluding the existence of conditioned convergence. In addition, we add some variables to account for the different characteristics of population and they vary between the vaccines considered. Hence, when theses variables are not significant, we reject it because they cannot explain the process that leads countries to converge towards different steady states.

In short, each country has its own steady state due to the different characteristics that exist between them. Countries converge by groups according to the World Bank classification.

Chapter 5

What are the determinants that affect common mental diseases? Towards understanding the impact of the Great Recession

5.1. Introduction

Social, physical and economic living conditions affect population's health, contributing to several Common Mental Diseases (CMD). We define mental health as a state of well-being, going beyond the absence of mental disorders. In addition, it is determined by several socio-economic, biological and environmental characteristics (WHO, 2018).

According to mental health field, the impact of the Great Recession is interesting as well as relevant as we can see on the literature. Economic and financial crises are likely to have a long-lasting impact on society as a whole, changing the social structure and social determinants of health.

Besides, crises have harmful effects on mental health status, more specifically, on depressive symptoms. In addition, Great Recession has influenced social and health inequalities, which have increased since the beginning of the economic crisis in Spain as well as in Europe. Literature develops a classification of social inequalities as an effect and a determinant factor of crises (Navarro, 2013; Zapata Moya *et al.*, 2015; Abebe, Tøge and Dahl, 2016; Reibling *et al.*, 2017).

Looking at health inequalities, they may be caused by socio-economic factors like income, among others. Economic recessions increase income loss and unemployment rates, affecting population's health because of high stress levels. Nevertheless, crises do not affect all population in the same way. In other words, it may affect some population groups (population at risk) more than others. For example, disabled population has greater probability to experience health inequalities. In addition, that population is more likely to present higher health risk than those without disabilities (Oeseburg *et al.*, 2011; Cooper *et al.*, 2015). Existing literature concludes that having intellectual disabilities implies having poor health and a mental health condition, which increases with the ageing process (Young-Southward *et al.*, 2017).

Most of research analysing social factors on mental health are focused on high-income countries. Meanwhile, the interest on the association between income inequality and CMD in low and middle-income countries is recent. Otherwise, income is not the only determinant that affects mental health. Economic literature finds other factors that imply poor mental health such gender, marital status or social networks (Lund *et al*., 2011; Burns, 2015).

There are evidences of positive correlations between poverty indicators and CMD (Lund *et al.*, 2010). Hence, the purpose of this article is to examine the relationship

between mental health and income inequality. In addition, we analyse personal and socio-economic characteristics, associating them with poor mental health. This paper adds to the existing literature the most current data, based on the Spanish National Health Survey (SNHS). Besides, to the best of our knowledge, this study is the first that examines the main determinants that imply common mental health issues before, during and, more specifically, after the interesting and relevant period of the Great Recession in Spain.

We have developed an empirical illustration focused on the association between poor mental health and income inequality, measured as per capita households' income. Data provided by the SNHS are used to analyse three different periods: first, before the Spanish economic crisis; second, during the Great Recession; and, finally, after this period. We carry out a multilevel logistic regression, using personal and socio-economic characteristics as independent variables. Our findings suggest that either separated or divorced as well as unemployed, retired or homemaker population present higher risk of poor mental health. The same happens with those individuals with low income and education levels.

The paper is structured as follows. Section 5.2 describes the data used. We present our empirical results in Section 5.3, analysing the prevalence of poor mental health and the multilevel logistic regression. Then, in Section 5.4, we introduce the discussion of our main findings. Finally, Section 5.5 presents the conclusions.

5.2. Data

We use three different waves (2006, 2011-2012 and 2017) from the SNHS to carry out our study. This survey is elaborated by the Spanish Ministry of Health, Social Services and Equality in cooperation with the National Institute of Statistics. More specifically, this cross-section survey interviews population who lives in family homes across the country and provides the necessary information at both national and regional level. In addition, the survey includes three different samples for households, adults and children, collecting data about the health status of Spanish population as well as its determinants, among others. The SNHS is conducted every five years, alternating with the European Health Survey every two and a half years. Therefore, we can study the evolution of mental health across the economic recession experienced by Spain. In our case, we use the adult questionnaire because we add some variables such as occupation and employment rates in the analysis, which can only be answered by active population. Hence, we are focused on population older than 15 years.

We carry out a cross-sectional descriptive analysis of three periods: before the Spanish economic crisis (2006), during the Great Recession (2011-2012) and after this period (2017). In terms of population surveyed, our sample presents 25,234 adults in 2006, 20,754 adults in 2011-2012, and 24,357 adults in 2017 (INE, 2018). Nevertheless, we take into account the availability of data to carry out the analysis. Hence, the final sample consists of 22,499 persons in 2006, 12,418 persons in 2011-2012, and 15,920 persons in 2017.

Table 5.1 shows the variables considered. Our dependent variable is based on the self-assessment of mental health status. Interviewed individuals are asked to rate their

own mental health. We use the General Health Questionnaire (GHQ), which measures psychological well-being and is based on 12 items (GHQ-12) (Goldberg, 1972). It indicates if respondents are unable to carry out everyday activities or if they have experienced emerging anxiogenic or psychiatric disorders in the weeks before the survey. The answers vary into a 4-point Likert-type scale (better than usual (0), just as usual (1), less than usual (2) and much less than usual (3)), indicating high scores worse mental health. Nevertheless, we transform it into a bimodal scale (1 less or much less than usual, 0 otherwise). Then, we add the points obtained from the 12 items. The total score varies between 0 and 12 points, from better to worse mental health, respectively.

According to the literature as well as the possible 12 points obtained from the total score, we establish the poor mental health threshold at 3 points. In other words, if the value obtained is less than 3, it is considered good mental health. By contrast, whether the value is equal to or greater than 3, it supposes an assessment of poor mental health (Sánchez-López and Dresch, 2008; Esteban *et al.*, 2012).

In the case of independent variables, we select personal and socio-economic characteristics included in the literature (Esteban *et al.*, 2012; Reibling *et al.*, 2017; Ruiz-Pérez, Bermúdez-Tamayo and Rodríguez-Barranco, 2017). More specifically, we include variables such as gender, age, nationality, education level, socio-professional class and Self-Assessed Health (SAH). Firstly, in the case of gender, we focus on women and men. Secondly, for age, we distinguish three population groups from 16 to 39 years, from 40 to 64 years old and older than 65 years. In addition, looking at nationality, we examine Spanish and foreign population. According to International Standard Classification of Education (ISCED), we consider three education groups: low (population who finishes early childhood education, primary or lower secondary school), medium (population who

finishes upper secondary school or post-secondary non-tertiary education) and high (population who finishes short-cycle tertiary, university studies or equivalent) (Eurostat, 2016). In the case of socio-professional class, looking at the National Classification of Occupations CNO-2011, we find four different categories: class I (executives and managers), class II (intermediate occupations, skilled technical and self-employed population), class III (primary sector skilled workers) and class IV (unskilled workers) (INE, 2012). Besides, we distinguish five SAH states: very good, good, fair, bad and very bad. More specifically, we focus on how individuals assess their general health status and on the relationship between it and the assessment of mental health. Our findings show that respondents who report a better general health are those who consider their mental health as very good. By contrast, individuals who assess having very bad health would be those who have worse mental health.

Moreover, we consider other characteristics such as marital status, employment situation and smoking status. Firstly, looking at marital status, we divide the variable into four different categories: single, married, widowed and separated or divorced. Secondly, for employment situation, we distinguish five categories: working, unemployed, retired, student and homemaker. In addition, we examine three smoking groups: current (population who currently smokes), former (population who formerly smokes) and never (population who has never smoked). We should highlight that we do not include a variable related to alcohol or drug consumption due to several individuals do not answer the question in the second wave considered (2011-2012). In other words, our sample would have been reduced considerably and it would imply multicollinearity problems.

In this regard, our main goal is to demonstrate if mental health problems are related to income inequality. Therefore, we use income as measured by households'

income per month. We divide it into three groups taking into account the intervals considered on SNHS: low (with an interval of less than €800), middle (with an interval from €800 to €1,800) and high income (with an interval over €1,800).

Table 5.1. Variables considered and their descriptions

Variable	**Description**
Dependent variable	
Mental health	Poor (GHQ ≥ 3) or good (GHQ < 3) mental health.
Independent variables	
Age	Intervals from 16 to 39 years, 40 to 64 years or over 65 years.
Gender	Female = 1; male = 0.
Nationality	Spanish = 1; foreign = 0.
Marital status	Single, married, widowed or separated/divorced.
Education level	Low, medium or high.
Employment situation	Working, unemployed, retired, studying or housekeeping.
Socio-professional class	Executives and managers (class I); intermediate occupations, skilled technical, self-employed (class II); primary sector skilled workers (class III); or unskilled workers (class IV).
SAH	Very good, good, fair, bad or very bad health status.
Smoking status	Current, former or never.
Income	Low, middle or high.

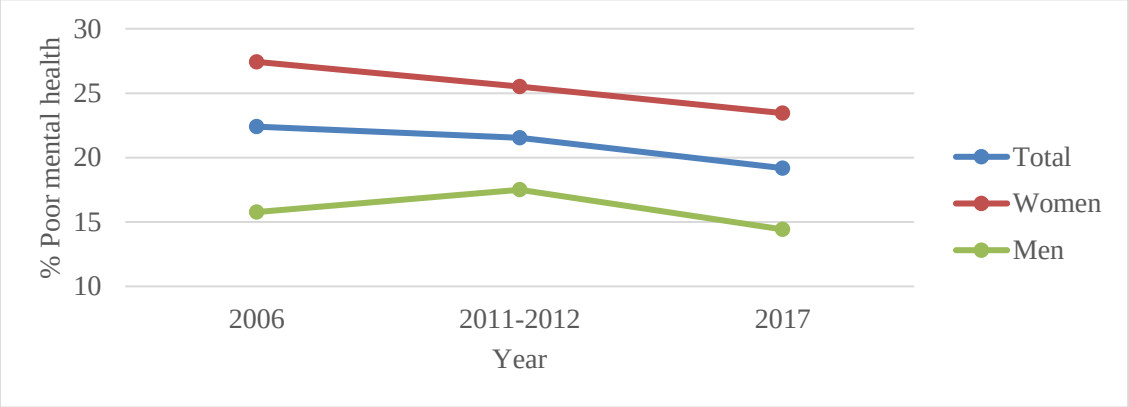
Note: GHQ (General Health Questionnaire); SAH (Self-Assessment Health).

Next, we analyse the prevalence of poor mental health over the whole period of the Great Recession. We define prevalence as the percentage of population who suffers from a disease, in this case, poor mental health. According to the availability of data, we show how the prevalence pattern of poor mental health as well as personal and socio-economic characteristics varies from 2006 to 2017 for either women or men (Figure 5.1 and Table 5.2).

Firstly, focused on total population, we reveal that the prevalence of assessing poor mental health decreases from 2006 (22.40%) to 2017 (19.18%). In the case of

women, our results suggest a similar trend, achieving the highest rate in 2006 (27.43%) and then decreasing until 23.45% in 2017. By contrast, for men, we find the largest value during the Great Recession (17.50%) and then it reduces to 14.42% in 2017.

Figure 5.1. Prevalence of poor mental health (percentage)



According to the model focused on women and looking at those variables which imply social inequalities, we can affirm that poor mental health decreases significantly in the 16 – 39 age group (26.87% - 20.13%) from 2006 to 2017 whereas it reduces slightly in population over 65 years (40.42% - 39.25%). By contrast, it raises from 2006 (32.71%) to 2017 (40.62%) in the 40 – 64 age group. Spanish women show a small increase (93.03% - 94.41%) whereas foreign women suffer a little decrease in the prevalence of poor mental health (6.97% - 5.59%). Looking at education level, prevalence of poor mental health decreases among low education level group (from 56.99% to 42.76%). By contrast, it increases in medium education level (26.87% - 38.23%), as does in high education level (16.14% - 19.01%). Besides, in the case of socio-professional class, poor mental health decreases for class II (38.31% - 29.79%), as does for class IV (from 27.73%

to 22.06%). By contrast, it increases for class III (22.97% - 36.45%). Meanwhile, prevalence is constant for class I.

When we focus on marital status, there is no significant differences in prevalence of poor mental health for all the categories considered. Looking at employment situation, groups which show significant differences in poor mental health are working (37.23% - 30.86%) and unemployed women (drop from 8.43% to 14.95%). Meanwhile, retired and women who study vary slightly (36.69% - 34.21% and 1.17% - 3.91%, respectively). Prevalence is constant for housekeeping women.

Besides, we do not find an association between SAH and differences in prevalence of poor mental health. According to smoking status, poor mental health decreases among women who currently smoke (23.57% - 20.79%), as does among women who have never smoke (from 63.82% to 61.72%). By contrast, it increases among women who formerly smoke (12.61% - 17.49%).

In the case of poverty, middle-income women (42.24% - 48.25%) show a significant increase in the prevalence of poor mental health, similarly to high-income women (18.05% - 22.47%). By contrast, low-income women (39.71% - 29.28%) show a decrease.

According to the model focused on men, we show a quite similar situation in the prevalence of poor mental health as we find among women. Looking at those variables which imply social inequalities, we can affirm that poor mental health decreases in the 15 – 39 age group (from 27.70% to 20.81%). By contrast, it increases in the 40 – 64 age group (40.21% - 46.04%) as well as in population over 65 years (32.09% - 33.15%). In the case of nationality, we find the same situation among women and men, rising within the Spanish men group (from 92.53% to 95.49%) and decreasing within the foreign group

(7.47% - 4.51%). In addition, prevalence of poor mental health decreases among low education level men (52.19% - 37.85%). By contrast, it increases in medium education level (30.45% - 42.45%) as well as in high education one (17.35% - 19.71%). In the case of socio-professional class, groups which show significant differences in poor mental health are class II (decreasing from 55.66% to 35.08%) and class III (increasing from 14.73% to 35.45%), while prevalence is constant for both class I and IV.

Focused on social characteristics, poor mental health does not present significant changes according to marital status. Looking at employment situation, poor mental health decreases among both working and retired men (from 46.56% to 37.29% and from 43.75% to 37.94%, respectively). Meanwhile, it increases among unemployed men (8.45% - 20.63%), as does in the studying group (1.11% - 4.05%). Prevalence is constant for housekeeping men.

In addition, we do not find an association between SAH and differences in prevalence of poor mental health. According to smoking status, poor mental health decreases among men who currently smoke (35.30% - 30.39%), but it increases among men who formerly smoke (from 34.91% to 39.87%). Prevalence is constant among men who never smoke.

Finally, for men, in the case of poverty, middle-income men (42.37% - 49.08%) show a significant increase in the prevalence of poor mental health, similarly to high-income men (22.66% - 25.60%). By contrast, low-income men (34.97% - 25.32%) show a decrease.

Table 5.2. Prevalence of poor mental health according to individuals' socio-demographic characteristics

	Total			Women			Men		
	Wave 1	**Wave 2**	**Wave 3**	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 1**	**Wave 2**	**Wave 3**
% Poor Mental Health	5,040 (22.40)	2,675 (21.54)	3,053 (19.18)	3,513 (27.43)	1,596 (25.52)	1,967 (23.45)	1,527 (15.76)	1,079 (17.50)	1,086 (14.42)
Age									
15-39	1,367 (27.12)	707 (26.43)	622 (20.37)	944 (26.87)	385 (24.12)	396 (20.13)	423 (27.70)	322 (29.84)	226 (20.81)
40-64	2,034 (40.36)	1,185 (44.30)	1,299 (42.55)	1,420 (32.71)	690 (43.23)	799 (40.62)	614 (40.21)	495 (24.28)	500 (46.04)
≥65	1,639 (32.52)	783 (29.27)	1,132 (37.08)	1,149 (40.42)	521 (32.64)	772 (39.25)	490 (32.09)	262 (45.88)	360 (33.15)
Nationality									
Spanish	4,681 (92.88)	2,508 (93.76)	2,894 (94.79)	3,268 (93.03)	1,497 (93.80)	1,857 (94.41)	1,413 (92.53)	1,011 (93.70)	1,037 (95.49)
Foreign	359 (7.12)	167 (6.24)	159 (5.21)	245 (6.97)	99 (6.20)	110 (5.59)	114 (7.47)	68 (6.30)	49 (4.51)
Marital Status									
Single	1,032 (20.48)	658 (24.60)	652 (21.36)	616 (17.53)	325 (20.36)	360 (18.30)	416 (27.24)	333 (30.86)	292 (26.89)
Married	2,563 (50.85)	1,379 (51.55)	1,489 (48.77)	1,719 (48.93)	780 (48.87)	891 (45.30)	844 (55.27)	599 (55.51)	598 (55.06)
Widowed	1,025 (20.34)	408 (15.25)	595 (19.49)	886 (25.22)	344 (21.55)	496 (25.22)	139 (9.10)	64 (5.93)	99 (9.12)
Separated/Divorced	420 (8.33)	230 (8.60)	317 (10.38)	292 (8.31)	147 (9.21)	220 (11.18)	128 (8.38)	83 (7.69)	97 (8.93)
Education level									
Low	2,799 (55.54)	799 (29.87)	1,252 (41.01)	2,002 (56.99)	799 (50.06)	841 (42.76)	797 (52.19)	286 (26.51)	411 (37.85)
Medium	1,409 (27.96)	1,435 (53.64)	1,213 (39.73)	944 (26.87)	513 (32.14)	752 (38.23)	465 (30.45)	607 (56.26)	461 (42.45)
High	832 (16.51)	441 (16.49)	588 (19.26)	567 (16.14)	828 (51.88)	374 (19.01)	265 (17.35)	186 (17.24)	214 (19.71)
Employment situation									
Working	2,019 (40.06)	933 (34.88)	1,012 (33.15)	1,308 (37.23)	541 (33.90)	607 (30.86)	711 (46.56)	392 (36.33)	405 (37.29)
Unemployed	425 (8.43)	471 (17.61)	518 (16.97)	296 (8.43)	239 (14.97)	294 (14.95)	129 (8.45)	232 (21.50)	224 (20.63)
Retired	1,957 (38.83)	819 (30.62)	1,085 (35.54)	1,289 (36.69)	535 (33.52)	673 (34.21)	668 (43.75)	284 (26.32)	412 (37.94)
Studying	58 (1.15)	151 (5.64)	121 (3.96)	41 (1.17)	104 (6.52)	77 (3.91)	17 (1.11)	47 (4.36)	44 (4.05)
Housekeeping	581 (11.53)	301 (11.25)	317 (10.38)	579 (16.48)	177 (11.09)	316 (16.07)	2 (0.13)	124 (11.49)	1 (0.09)

	Total			Women			Men		
	Wave 1	**Wave 2**	**Wave 3**	**Wave 1**	**Wave 2**	**Wave 3**	**Wave 1**	**Wave 2**	**Wave 3**
Socio-professional class									
Class I	609 (12.08)	399 (14.92)	372 (12.18)	386 (10.99)	228 (14.29)	230 (11.69)	223 (14.60)	171 (15.85)	142 (13.08)
Class II	2,196 (43.57)	829 (30.99)	967 (31.67)	1,346 (38.31)	491 (30.76)	586 (29.79)	850 (55.66)	338 (31.33)	381 (35.08)
Class III	1,032 (20.48)	978 (36.56)	1,102 (36.10)	807 (22.97)	558 (34.96)	717 (36.45)	225 (14.73)	420 (38.92)	385 (35.45)
Class IV	1,203 (23.87)	469 (17.53)	612 (20.05)	974 (27.73)	319 (19.99)	434 (22.06)	229 (15.00)	150 (13.90)	178 (16.39)
SAH									
Very good	269 (5.34)	190 (7.10)	172 (5.63)	186 (5.29)	98 (6.14)	101 (5.13)	83 (5.44)	92 (8.53)	71 (6.54)
Good	1,405 (27.88)	992 (37.08)	913 (29.91)	934 (26.59)	523 (32.77)	544 (27.66)	471 (30.84)	469 (43.47)	369 (33.98)
Fair	2,020 (40.08)	888 (33.20)	1,133 (37.11)	1,439 (40.96)	569 (35.65)	751 (38.18)	581 (38.05)	319 (29.56)	382 (35.17)
Bad	969 (19.23)	478 (17.87)	617 (20.21)	679 (19.33)	312 (19.55)	409 (20.79)	290 (18.99)	166 (15.38)	208 (19.15)
Very bad	377 (7.48)	127 (4.75)	218 (7.14)	275 (7.83)	94 (5.89)	162 (8.24)	102 (6.68)	33 (3.06)	56 (5.16)
Smoking status									
Current	1,367 (27.12)	775 (28.97)	739 (24.21)	828 (23.57)	388 (24.31)	409 (20.79)	539 (35.30)	387 (35.87)	330 (30.39)
Former	976 (19.37)	563 (21.05)	777 (25.45)	443 (12.61)	219 (13.72)	344 (17.49)	533 (34.91)	344 (31.88)	433 (39.87)
Never	2,697 (53.51)	1,337 (49.98)	1,537 (50.34)	2,242 (63.82)	989 (61.97)	1,214 (61.72)	455 (29.80)	348 (32.25)	323 (29.74)
Income									
Low	1,929 (38.27)	747 (27.93)	851 (27.87)	1,395 (39.71)	462 (28.95)	576 (29.28)	534 (34.97)	285 (26.41)	275 (25.32)
Middle	2,131 (42.28)	1,375 (51.40)	1,482 (48.54)	1,484 (42.24)	819 (51.32)	949 (48.25)	647 (42.37)	556 (51.53)	533 (49.08)
High	980 (19.44)	553 (20.67)	720 (23.58)	634 (18.05)	315 (19.74)	442 (22.47)	346 (22.66)	238 (22.06)	278 (25.60)

Note: percentage in parenthesis. Class I (Executives and managers); Class II (Intermediate occupations, skilled technical, self-employed); Class III (Primary sector skilled workers); Class IV (Unskilled workers); SAH (Self-Assessment Health).

5.3. Methodology and results

Following Browne and Rasbash (2004) as well as the techniques developed by Fairbrother (2014), we carry out a multilevel logistic regression with random effects, according to personal and socio-economic factors for poor mental health (GHQ ≥ 3). We distinguish between women and men and calculate adjusted Odds Ratios (OR), which measure the magnitude of the effects. We establish 95% Confidence Intervals (CI) and, therefore, a significance level of 0.05 to check our hypothesis. Statistical analysis is performed using Stata 15 software.

The OR reports the relationship between the average odds of reporting the risk factor at the outcome (in this case, poor mental health) and the average odds of reporting the risk factor when the individual does not report poor mental health. If we obtain an OR greater than 1, it implies an increase in the risk factor variable when we measure the outcome (i.e., higher risk of poor mental health). By contrast, if we obtain an OR less than 1, it shows a decrease in the risk factor variable when we measure the outcome (i.e., lower probability of poor mental health).

These regressions must present associations between observations within levels (clusters) to make valid and efficient inference. We can consider the model as:

$$MH_{ij} = \beta_{j[i]} X_{ij} + \mu_j + \varepsilon_{ij} \tag{5.1}$$

where MH_{ij} is the risk of poor mental health for individual i in region j; X_{ij} is a vector of control variables; μ_j is the residual of the higher level unit (region) and ε_{ij} is the residual associated with an individual within this higher level unit.

According to the multilevel logistic regression, recent literature shows that socio-economic factors increase the risk of ischemic heart disease (Roux *et al.*, 2001; Larsen

and Merlo, 2005). In this paper, we demonstrate if these factors affect population with poor mental health. Therefore, we show how the pattern of poor mental health changes with some characteristics between women and men before, during and after the Great Recession. Our findings expressed as OR with their 95% CI, are shown in Table 5.3.

Table 5.3. Multilevel logistic regression according to social characteristics for poor mental health

Poor mental health	Women				Men		
	OR	95% CI	p-value		OR	95% CI	p-value
Year							
2006	1	-	-		1	-	-
2011-12	0.759	(0.705 - 0.818)	***		0.710	(0.647 - 0.780)	***
2017	0.663	(0.618 - 0.710)	***		0.583	(0.533 - 0.638)	***
Age							
15-39	1	-	-		1	-	-
40-64	0.675	(0.625 - 0.729)	***		0.615	(0.558 - 0.678)	***
≥65	0.529	(0.465 - 0.602)	***		0.533	(0.450 - 0.631)	***
Nationality							
Spanish	1	-	-		1	-	-
Foreign	0.936	(0.829 - 1.057)			0.800	(0.684 - 0.935)	***
Marital status							
Single	1	-	-		1	-	-
Married	0.607	(0.563 - 0.655)	***		0.597	(0.547 - 0.651)	***
Widowed	0.945	(0.846 - 1.054)			1.188	(0.999 - 1.413)	*
Separated/Divorced	1.028	(0.910 - 1.161)			1.045	(0.891 - 1.226)	
Education level							
High	1	-	-		1	-	-
Medium	0.919	(0.780 - 1.083)			0.937	(0.766 - 1.148)	
Low	1.056	(0.860- 1.297)			1.111	(0.874 - 1.411)	
Employment situation							
Working	1	-	-		1	-	-
Unemployed	1.343	(1.210 - 1.491)	***		2.017	(1.780 - 2.286)	***
Retired	1.006	(0.894 - 1.132)			1.142	(0.992 - 1.314)	*
Studying	0.874	(0.739 - 1.035)			0.642	(0.514 - 0.801)	***
Housekeeping	1.136	(1.028 - 1.256)	**		1.296	(1.029 - 1.632)	**

Poor mental health	**Women**				**Men**		
	OR	**95% CI**	**p-value**		**OR**	**95% CI**	**p-value**
Socio professional class							
Class I	1	-	-		1	-	-
Class II	0.587	(0.538 - 0.640)	***		0.463	(0.419 - 0.513)	***
Class III	0.631	(0.573 - 0.695)	***		0.567	(0.503 - 0.640)	***
Class IV	0.690	(0.620 - 0.767)	***		0.500	(0.434 - 0.576)	***
SAH							
Very good	1	-	-		1	-	-
Good	1.150	(0.960 - 1.379)			1.377	(1.091 - 1.737)	***
Fair	2.407	(2.201 - 2.632)	***		2.310	(2.068 - 2.579)	***
Bad	7.017	(6.229 - 7.904)	***		7.492	(6.452 - 8.700)	***
Very bad	13.330	(11.026 - 16.114)	***		13.727	(10.524 - 17.907)	***
Smoking status							
Never	1	-	-		1	-	-
Former	0.778	(0.714 - 0.848)	***		0.761	(0.695 - 0.833)	***
Current	0.826	(0.767 - 0.890)	***		0.763	(0.699 - 0.833)	***
Income							
High	1	-	-		1	-	-
Middle	0.855	(0.793 - 0.920)	***		0.779	(0.713 - 0.851)	***
Low	1.051	(0.947 - 1.166)			1.177	(1.034 - 1.340)	**

Note: OR (Odds Ratios); CI (Confidence Interval); Class I (Executives and managers); Class II (Intermediate occupations, skilled technical, self-employed); Class III (Primary sector skilled workers); Class IV (Unskilled workers); SAH (Self-Assessment Health).

We mainly focus on those characteristics which imply higher risk of poor mental health. Firstly, we analyse the model focused on women. In the case of marital status, separated or divorced women (OR: 1.028 CI 95%: 0.910-1.161) show higher probability of poor mental health than single women. Looking at education level, low educated women (OR: 1.056 CI 95%: 0.860-1.297) present larger risk of poor mental health than those with high education level. In addition, unemployed women (OR: 1.343 CI 95%: 1.210-1.491) suggest higher risk of poor mental health compared with working women, as do retired (OR: 1.006 CI 95%: 0.894-1.132) and homemaker ones (OR: 1.136 CI 95%: 1.028-1.256). Besides, we find that reporting good, fair, bad or very bad health shows

higher probability of poor mental health than assessing very good SAH. In terms of income, we demonstrate an association between lower income and higher probability of poor mental health. In other words, low-income women (OR: 1.051 CI 95%: 0.947-1.166) present higher risk of poor mental health than high-income women.

Afterwards, we describe the model focused on men. In the case of marital status, widowers (OR: 1.188 CI 95%: 0.999-1.413) reveal higher risk of poor mental health compared with single ones, as do separated or divorced men (OR: 1.045 CI 95%: 0.891-1.226). Regarding education level, low educated men (OR: 1.111 CI 95%: 0.874-1.411) show greater probability of poor mental health than high educated ones. Besides, unemployed men (OR: 2.017 CI 95%: 1.780-2.286) suggest higher risk of poor mental health compared with working men, as do homemaker (OR: 1.296 CI 95%: 1.029-1.632) and retired men (OR: 1.142 CI 95%: 0.992-1.314). In addition, we show that reporting good, fair, bad or very bad SAH shows greater risk of poor mental health than assessing very good health. In terms of income, we find that low-income men (OR: 1.177 CI 95%: 1.034-1.340) present higher risk of poor mental health than high-income ones.

Next, we analyse what independent variables are significant. The association between poor mental health (GHQ $\geq$ 3) and low-income is significant for men. Besides, the relationship between poor mental health and middle-income is significant for both women and men. In terms of age, we find that ageing process is significantly associated with poor mental health for women and men. Looking at nationality, the relationship between poor mental health and being foreign is only significant for men. On the one hand, the relationship between poor mental health and being married is significant for both women and men. On the other hand, unemployed as well as homemaker population are significantly related with poor mental health (i.e., increased risk of poor mental

health). In addition, all categories considered for socio-professional class as well as for smoking status are significantly associated with poor mental health for women and men. Similarly, individuals who assess their health as good, fair, bad or very bad have increased risk of poor mental health, except for women assessing their health as good.

5.4. Discussion

As far as we know, this is the first study that analyses the association of poor mental health and income inequality (measured as per capita households' income) before, during and after the Great Recession in Spain. Looking at the association between mental health and marital status, we conclude that being separated or divorced and widowed raises the probability of poor mental health. Similarly, Ruiz-Pérez, Bermúdez-Tamayo and Rodríguez-Barranco (2017) find out that widowers as well as separated or divorced men show greater risk of poor mental health. Meanwhile, married, widows and separated or divorced women reveal higher probability of poor mental health. For example, Chung *et al*. (2018) find that being unmarried is associated with a worse mental health. In addition, Cortès-Franch *et al*. (2018) conclude that employment stability is associated with poor mental health, except for married women. Nevertheless, the greatest relationship is found among separated or divorced population.

According to education level, we find that low educated population presents higher risk of poor mental health. Similarly, Bartoll *et al*. (2014) argue that the prevalence of poor mental health increases among secondary or low educated and foreigners' men. Meanwhile, prevalence of poor mental health decreases for women. In addition, Ruiz-

Pérez, Bermúdez-Tamayo and Rodríguez-Barranco (2017) conclude that medium or low educated individuals have larger risk of poor mental health. They also show that being foreign has greater risk of poor mental health. Besides, Chung *et al*. (2018) conclude that Chinese adults who are deprived and low educated have higher risk of worse physical and mental health.

On the one hand, we find that unemployed, retired or homemaker individuals present greater risk of poor mental health. This can also be observed in other studies such as the one developed by Buffel, Van de Velde and Bracke (2015), who demonstrate that there is a positive association between depression and unemployment rates in countries affected by the economic recession. In addition, they suggest that effects of depression have changed comparing before and during the crisis, in terms of gender, age and employment situation. Additionally, Drydakis (2015) analyses the impact of unemployment on SAH and mental health, showing that unemployment situation implies a deterioration of mental health during the economic crisis. Similarly, Bacigalupe, Esnaola and Martín (2016) examine changes in mental health among working-age population during the Great Recession, concluding that students, unemployed and employed population are more likely to report poor mental health in 2013 compared to 2007. Likewise, Ruiz-Pérez, Bermúdez-Tamayo and Rodríguez-Barranco (2017) demonstrate that unemployed, retired, students and homemaker individuals have greater risk of poor mental health. Chung *et al*. (2018) analyse population who is looking after family or home, which has significantly increased risk of worse mental health.

On the other hand, according to socio-professional class, we find a significant association between it and poor mental health. Based on Spain, Bartoll *et al*. (2014) show that prevalence of poor mental health increases among supervisors, qualified and semi-

qualified men (class IV) and among homemakers and managers with more than ten workers (class I) for women. In addition, Bacigalupe, Esnaola and Martín (2016) present a relevant increase of poor mental health among manual workers (classes IV and V) and socio-professional class IV among men and women, respectively. Meanwhile, Ruiz-Pérez, Bermúdez-Tamayo and Rodríguez-Barranco (2017) study mental health determinants during the Great Recession, demonstrating that executives and managers; intermediate occupations, skilled technical, self-employed; primary sector skilled workers and unskilled workers show higher risk of poor mental health.

Finally, there is not enough literature that relates CMD and income inequality. Our findings show that low income households present larger risk of poor mental health. Boutayeb, Boutayeb and Boutayeb (2013) indicate that Mediterranean countries, affected by the economic recession, are increasing in multimorbidity of depression and mental diseases. More recently, Chung *et al*. (2018) conclude that having lower income is associated with higher risk of worse mental health.

5.5. Conclusions

This paper adds new empirical evidence to the existing literature focused on mental health, using the most current data (2017) as well as two other waves (2006 and 2011-2012) from SNHS. Therefore, this study analyses several factors which can affect common mental health issues before, during and after the relevant period of the Great Recession in Spain. Our principal aim is to analyse the association between mental health and income inequality (measured as per capita households' income) before, during and

after the economic crisis. Hence, as far as we know, this is the first study that examines what determinants have a major impact on common mental health issues over the whole period of the Great Recession in Spain.

Our findings suggest the following issues. The prevalence of poor mental health decreases from 22.40% to 19.18% from 2006 to 2017. Looking at the regression focused on women, our results show that separated or divorced as well as low educated women present greater risk of poor mental health. The same happens with unemployed, retired and homemaker women. In addition, our findings indicate that low-income women have higher risk of poor mental health. Meanwhile, in the case of men, widowers and separated or divorced men show a larger risk of poor mental health as well as those with low education level. Besides, unemployed, retired and homemaker men present higher risk of poor mental health. In terms of income, we corroborate that low-income men show greater risk of poor mental health. In short, focused on our main objective, we argue that there is an association between low households' income and higher probability of poor mental health for both women and men.

Chapter 6

Examining the recent role of socio-economic inequalities on obesity among Spanish population

6.1. Introduction

Obesity is an important and significant issue in developed countries because it has consequences on individuals' health as well as on their socio-economic status (SES). The recent economic and financial crisis has implied significant decreases in employment rates and household economic resources for Spain as well as other countries. In other words, unemployment rates have increased due to the Great Recession. Hence, there is clear evidence of an association between health and economic crisis in Spain, which has had a deep impact on obesity (Cortès-Franch and González López-Valcárcel, 2014; Regidor *et al.*, 2014; Norte, Sospedra and Ortíz-Moncada, 2019). Nevertheless, economic issues are not the only ones that play an important role in the trend of increasing obesity. There are other determinants that imply obesity (Gutiérrez-Fisac *et al.*, 1999; Lopez-

Garcia *et al.*, 2013; Medvedyuk, Ali and Raphael, 2018; Miljkovic *et al.*, 2018; Oates *et al.*, 2018).

According to the literature, we find a large number of studies which analyse obesity, more specifically, focused on childhood obesity in high-income countries (Costa-Font and Gil, 2013; Walsh and Cullinan, 2015; Apouey and Geoffard, 2016; Bann *et al.*, 2018; Black *et al.*, 2018). In this regard, Costa-Font and Gil (2013) present robust evidence of both socio-economic and intergenerational gradients. That is, income and parental influences are relevant determinants of obesity among children in Spain. Meanwhile, Walsh and Cullinan (2015) suggest that most of inequalities in childhood obesity are explained by parental level variables in Ireland. On the one hand, Apouey and Geoffard (2016) indicate that the trajectory of the income gradient corroborates the education one, showing that higher incomes and parental education levels imply lower risk of obesity in children in France. On the other hand, Bann *et al.* (2018) show that lower socio-economic position is related to lower weights in the late 20th century birth cohorts but it is related to higher weight in the early 21st century in England, Scotland, and Wales. Moreover, Black *et al.* (2018) find inequalities between children attending schools in the most and least deprived areas in England, being the first ones the most disadvantaged. Nevertheless, it may be useful more research about this topic in deprived areas in order to decrease the growing health inequality gap for both adults and children.

Therefore, our objective is twofold. Firstly, we evaluate obesity according to the different SES levels of the respondents in terms of households' income in Spain as a whole and in the different Spanish regions. Secondly, we study the determinants of obesity inequalities, taking into account different characteristics of the Spanish population. As far as we know, this is the first paper that analyses the influence of several

socio-economic characteristics on obesity after the Great Recession in Spain, using the most current data provided by the Spanish National Health Survey (SNHS), which correspond to 2017. We follow the Corrected Concentration Index (CCI) and the recent Generalized Entropy (GE) measure (Aristondo, 2018) to estimate obesity inequalities. In addition, we carry out a multivariate logistic regression model. Our findings suggest that obesity is concentrated in low socio-economic groups. Besides, low income and education level, unemployment, reporting bad health status and not practising any physical activity at leisure time are determinants associated with obesity.

Our paper proceeds as follows. Section 6.2 describes both materials and methods used to analyse obesity inequalities as well as the association between personal and lifestyle characteristics and obesity. Section 6.3 shows the findings obtained from our study. Meanwhile, Section 6.4 points out our discussion remarks. Finally, we present the conclusions in Section 6.5.

6.2. Materials and methods

In this section, we describe both data and methodology used in the empirical analysis to present detailed information on our research design.

6.2.1. Data

We apply microdata provided by the SNHS using the latest available data collected by this survey, which correspond to 2017. Ministry of Health, Social Services and Equality in collaboration with the National Institute of Statistics provides this information, through

interviews across the country. It is focused on population living in family homes at both national and regional level. The main objective is to collect data about health status as well as its determinants of Spanish population. It is divided into three questionnaires: home, adult and child questionnaire. In our case, we use the adult one (population older than 15 years) because we add some variables such as occupation and employment situation in the analysis. Our first sample consists of 23,069 Spanish inhabitants. Nevertheless, we delete all missing values and, then, we examine data from 16,269 individuals from all the Spanish regions (47.63% males and 52.37% females).

6.2.2. Methods

As we mentioned above, our objective is twofold. First, we analyse the relationship between socio-economic inequality and obesity in all the Spanish regions in 2017 throughout the Concentration Index, a popular measure of inequality. This index is proposed by Wagstaff, Paci and Van Doorslaer (1991). It is derived from the Gini coefficient and it is commonly used to estimate socio-economic inequalities. More specifically, the Concentration Index measures to what extent health inequalities are related to SES. Concentration indices can also be plotted by concentration curves above the 45º line and it has two variables: one as the dependent (health variable) and the other one as the ranking (income variable). In our case, we use Equivalised Household Income as the ranking variable, which we describe later, to calculate both the Concentration Index and the concentration curves. Hence, this variable ranks the poorest individuals (with the lowest income) and the richest ones (with the highest income) at the bottom and the top

of the distribution, respectively. Then, we calculate obesity inequality based on the proportion of the health variable in each part of the ranking distribution.

The value of the Concentration Index varies from $+1$ to -1. We have a positive index (> 0) whether the highest proportion of obesity population is among the richest. In our case, it indicates that obesity is greater among individuals with high-income. In contrast, we obtain a negative value (< 0) when the largest proportion of obesity population is among the poorest. Thus, it shows that obesity is higher among individuals with low-income. However, we obtain a perfect equality when the value is equal to zero, distributing equally the health value across the income distribution. In other words, there is no evidence of socio-economic inequality along the health distribution. The Concentration Index can be calculated as follows:

$$Concentration\ Index = \frac{2}{\mu} cov(h_{it}, R_i) \tag{6.1}$$

where μ is the mean of health variable, $cov(h_{it}, R_i)$ is the covariance between the individual's health (h_{it}) and the individual's relative rank (R_i).

Nevertheless, the Concentration Index needs to be corrected whether the health variable is dichotomous. In our case, the dependent variable (obesity) is dichotomous because it takes two possible values such as obese and not obese. More specifically, an individual is obese whether their Body Mass Index (BMI) is equal to or higher than 30kg/m^2. By contrast, we do not consider an individual as obese when they present a BMI lower than 30kg/m^2. There are several ways to correct the Concentration Index. In this paper, we use the CCI suggested by Erreygers (2009) to compare groups of individuals whose average health levels may be different. The CCI can be calculated as:

$$CCI(h) = 4 \frac{\mu}{h^{max} - h^{min}} CI \tag{6.2}$$

where μ is the mean of the health variable, $h^{max}$is the upper end and h^{min} is the lower end of the health variable (obesity in our case), and CI is the conventional Concentration Index.

In addition, to improve our study, we follow Aristondo (2018) to develop an additional obesity inequality measure, the GE inequality index, that implies a higher sensitivity away from the middle of the distribution. The functional form of this index is:

$$GE(\theta) = \frac{1}{\theta(\theta-1)}\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^{\alpha} - 1\right] \quad (6.3)$$

where θ represents the weight given to distances between individuals' BMI at different parts of the BMI distribution, N is the number of individuals in the sample, y_i is the BMI corresponding to individual i and $\bar{y}$ is the mean BMI. The values of this measure vary between 0 and 1, being the worst obesity distribution when the value is closer to 1.

Looking at this inequality index, we establish three values (0, 1 and 2) for the parameter θ for robustness. We obtain the mean logarithmic deviation measure and the Theil index, for $\theta = 0$ and for $\theta = 1$, respectively.

In addition, we study the association between obesity and socio-economic variables in Spain in 2017 through a multivariate logistic regression model, differentiating between women and men. For all statistical tests, we use a 95% Confidence Interval (CI) and we consider significant three different *p* values: 0.01, 0.05 and 0.10.

6.2.3. Variables

Table 6.1 presents the definition of the variables considered in this study. We focus our study mainly on two variables: obesity and SES. Our dependent variable is BMI. Hence,

we analyse some explanatory variables related to personal and lifestyle characteristics, which can affect BMI.

Table 6.1. Definition of variables

Variable		**Definition**
Dependent variable		
Obesity		1 if the individual is obese (BMI ≥ 30kg/m^2), 0 otherwise
Independent variables		
Equivalised Net Household Income	Quintile_1	1 if the individual belongs to Quintile 1, 0 otherwise
	Quintile_2	1 if the individual belongs to Quintile 2, 0 otherwise
	Quintile_3	1 if the individual belongs to Quintile 3, 0 otherwise
	Quintile_4	1 if the individual belongs to Quintile 4, 0 otherwise
	Quintile_5	1 if the individual belongs to Quintile 5, 0 otherwise
Age	16-29	1 if the individual is 16-29 years old, 0 otherwise
	30-44	1 if the individual is 30-44 years old, 0 otherwise
	45-64	1 if the individual is 45-64 years old, 0 otherwise
	≥65	1 if the individual is 65 years old or over, 0 otherwise
Nationality		1 if the individual is Spanish, 0 otherwise
Marital Status		1 if the individual is single, 0 otherwise
Education level	Low	1 if the individual has finished early childhood education, primary or lower secondary school, 0 otherwise
	Medium	1 if the individual has finished upper secondary school or post-secondary non-tertiary education, 0 otherwise
	High	1 if the individual has finished short-cycle tertiary, university studies or equivalent, 0 otherwise
Employment situation		1 if the individual is unemployed, 0 otherwise
Socio-professional class	Class I	1 if the individual is executive and manager, 0 otherwise
	Class II	1 if the individual has intermediate occupations, skilled technical and self-employed, 0 otherwise
	Class III	1 if the individual is primary sector skilled worker, 0 otherwise
	Class IV	1 if the individual is unskilled worker, 0 otherwise
SAH		1 if the individual has bad or very bad, 0 otherwise
Mental health		1 if the individual has poor mental health, 0 otherwise

Variable		**Definition**
Physical activity (at leisure)		1 if the individual does physical activity during leisure time, 0 otherwise
Eating patterns	Fruit	1 if the individual eats fruit three or more times per week, 0 otherwise
	Meat	1 if the individual eats meat three or more times per week, 0 otherwise
	Eggs	1 if the individual eats eggs three or more times per week, 0 otherwise
	Fish	1 if the individual eats fish three or more times per week, 0 otherwise
	Carbohydrates	1 if the individual eats carbohydrates three or more times per week, 0 otherwise
	Cereals	1 if the individual eats cereals three or more times per week, 0 otherwise
	Vegetables	1 if the individual eats vegetables three or more times per week, 0 otherwise
	Legumes	1 if the individual eats legumes three or more times per week, 0 otherwise
	Dairy products	1 if the individual eats dairy products three or more times per week, 0 otherwise
	Junk food	1 if the individual eats sweets, sugar drinks or fast food three or more times per week, 0 otherwise
Smoking status		1 if the individual smokes currently, 0 otherwise
Alcohol consumption		1 if the individual drinks alcohol frequently, 0 otherwise

Note: BMI (Body Mass Index); SAH (Self-Assessed Health).

First of all, we define obesity as a BMI equal to or higher than 30 kg/m^2. In the multivariate logistic regression model, this variable is defined as a dummy, which takes the value 1 if BMI $\geq$ 30 kg/m^2, 0 otherwise.

Second, SES is measured as the Equivalised Household Income. It is calculated from the variable "net monthly income range" reported by the SNHS, which consists of 12 intervals. Therefore, we calculate a midpoint in all these intervals, which we assign to each individual in the interval. Nevertheless, the last interval is open (more than €6,000) and we calculate the midpoint according to the range to the previous interval (€1,499),

assigning a value such as €6,749.50. Therefore, Equivalised Household Income indicates that individuals have the same income values, allowing more appropriate comparisons. Then, we apply the Organisation for Economic Co-operation and Development-modified equivalence scale and we divide the socio-economic variable into five income quintiles, which are the variables incorporated in the analysis. The scale, first proposed by Hagenaars, De Vos and Asghar Zaidi (1994), assigns a value equal to 1 to the first adult member in the household, 0.5 to each additional adult and 0.3 to each child.

On the one hand, looking at personal characteristics of individuals surveyed, we study variables such as age, nationality, marital status, education level, employment situation, socio-professional class, Self-Assessed Health (SAH) and mental health. First, according to age, we divide population into four groups: from 15 to 29 years, from 30 to 44 years old, from 45 to 64 years, and 65 years or over. Second, looking at nationality, we focus mainly on Spanish population, taking a value equal to 1 and 0 otherwise. Third, in the case of marital status, we analyse those individuals who are single. In terms of education level, we find three groups according to the International Standard Classification of Education: low (individuals who have finished early childhood education, primary or lower secondary school), medium (individuals who have finished upper secondary school or post-secondary non-tertiary education) and high education level (individuals who have finished short-cycle tertiary, university studies or equivalent). Moreover, we select unemployed population when we analyse employment situation. According to the National Classification of Occupations CNO-2011, we distinguish four different socio-professional classes: class I (executives and managers), class II (intermediate occupations, skilled technical and self-employed population), class III (primary sector skilled workers) and class IV (unskilled workers). In the case of SAH, we

focus on two states: bad and very bad health. We consider poor mental health, which is obtained from a value equal to or greater than 3 according to the total score of 12 points (Sánchez-López and Dresch, 2008).

On the other hand, we analyse lifestyle characteristics such as physical activity, eating patterns, smoking status and alcohol consumption (Cantarero-Prieto, Pascual-Sáez and Blázquez-Fernández, 2018; Demir, Demir and Bilgic, 2019). First, we study physical activity, taking into account if individuals do not practising physical exercise at leisure time. Second, we focus on individuals' eating patterns, considering if a person eats three or more times per week food such as fruit, meat, eggs, fish, carbohydrates, cereals, vegetables, legumes, dairy products or junk food. Furthermore, in terms of smoking status, we examine individuals who currently smoke. In the case of alcohol consumption, we consider people who frequently drink alcohol.

Next, we show the prevalence of self-reported obesity looking at individuals' characteristics (Table 6.2), defining prevalence as the proportion of individuals who presents a given characteristic in a specific period. We divide it into total population, women and men. Therefore, according to the availability of data, we analyse 16,269 individuals when we consider total population, 8,520 individuals if we focus on women and 7,749 in the case of men. In terms of obesity, 18.46% of the total population assesses their weight as obese. In addition, we can argue that it may have more effect for men (19.14%) than for women (17.85%).

Table 6.2. Prevalence of self-reported obesity (Body Mass Index ≥ 30kg/m^2) according to individuals' characteristics

	Total	Women	Men
Obesity	3,004 (18.46)	1,521 (17.85)	1,483 (19.14)
Equivalised Net Household Income			
Quintile_1	956 (31.82)	520 (34.19)	436 (29.40)
Quintile_2	598 (19.91)	358 (23.54)	240 (16.18)
Quintile_3	518 (17.24)	272 (17.88)	246 (16.59)
Quintile_4	522 (17.38)	219 (14.40)	303 (20.43)
Quintile_5	410 (13.65)	152 (9.99)	258 (17.40)
Age			
15-29	139 (4.63)	70 (4.60)	69 (4.65)
30-44	566 (18.84)	260 (17.09)	306 (20.63)
45-64	1,140 (37.95)	515 (33.86)	625 (42.14)
≥65	1,159 (38.58)	676 (44.44)	483 (32.57)
Nationality			
Spanish	2,848 (94.81)	1,430 (94.02)	1,418 (95.62)
Marital Status			
Single	543 (18.08)	222 (14.60)	321 (21.65)
Education level			
Low	2,022 (67.31)	1,101 (72.39)	921 (62.10)
Medium	472 (15.71)	207 (13.61)	265 (17.87)
High	510 (16.98)	213 (14.00)	297 (20.03)
Employment situation			
Unemployed	340 (11.32)	179 (11.77)	161 (10.86)
Socio-professional class			
Class I	314 (10.45)	122 (8.02)	192 (12.95)
Class II	918 (30.56)	415 (27.28)	503 (33.92)
Class III	1,197 (39.85)	620 (40.76)	577 (38.91)
Class IV	575 (19.14)	364 (23.93)	211 (14.23)
SAH			
Bad	341 (11.35)	200 (13.15)	141 (9.51)
Very bad	98 (3.26)	69 (4.54)	29 (1.96)
Mental health			
Poor	737 (24.53)	471 (30.97)	266 (17.94)
Physical activity			
Physical activity at leisure time	1,482 (49.33)	825 (54.24)	657 (44.30)
Eating patterns			
Fruit	2,622 (87.28)	1,362 (89.55)	1,260 (84.96)

	Total	Women	Men
Meat	2,024 (67.38)	961 (63.18)	1,063 (71.68)
Eggs	983 (32.72)	486 (31.95)	497 (33.51)
Fish	1,236 (41.15)	662 (43.52)	574 (38.71)
Carbohydrates	2,107 (70.14)	1,066 (70.09)	1,041 (70.20)
Cereals	2,813 (93.64)	1,413 (92.90)	1,400 (94.40)
Vegetables	2,605 (86.72)	1,375 (90.40)	1,230 (82.94)
Legumes	847 (28.20)	426 (28.01)	421 (28.39)
Dairy products	2,778 (92.48)	1,411 (92.77)	1,367 (92.18)
Junk food	1,943 (64.68)	751 (49.38)	760 (51.25)
Smoking status			
Current	556 (18.51)	200 (13.15)	356 (24.01)
Alcohol consumption			
Frequently	690 (22.97)	137 (9.01)	553 (37.29)

Note: percentage in parenthesis. Class I (Executive and manager); Class II (Intermediate occupations, skilled technical and self-employed); Class III (Primary sector skilled worker); Class IV (Unskilled worker); SAH (Self-Assessed Health).

When we analyse the explanatory variables, we study the prevalence of these factors looking at the obese population into the three groups described (total, women and men). On the one hand, looking at personal qualities, we focus on Equivalised Net Household Income, showing that obesity affects more population from Quintile 1 than individuals from Quintile 5 for all groups. According to age, obesity affects 44.44% of women aged 65 and over, presenting this age interval the highest proportion of obese population. Meanwhile, for men, there is more obese population aged between 45 and 64 years (42.14%). In terms of nationality, obesity affects 94.02% and 95.62% Spanish women and men, respectively. In the case of marital status, it influences single men (21.65%) more than single women (14.60%). Besides, focused on education level, obesity affects 72.39% of low educated women, while this value decreases until 62.10% in the case of men. When we focus on employment situation, the values are 11.77% and 10.86% for unemployed women and men, respectively. In terms of socio-professional class,

obesity affects more population who belongs to Class III, 40.76% and 38.91%, for women and men, respectively. Looking at SAH, we can argue that obesity influences 17.69% women and 11.47% men. Finally, in the case of poor mental health, obesity affects 30.97% women as well as 17.94% men.

On the other hand, looking at lifestyle characteristics, in the case of physical activity, obesity affects 54.24% and 44.30% women and men, respectively, who do not practising physical exercise at leisure time. Besides, when we focus on eating patterns, we highlight that obesity impacts more on women and men who eat fruit (89.55% and 84.96%, respectively), cereals (92.90% and 94.40%, respectively) and dairy products (92.77% and 92.18%, respectively). According to smoking status, obesity affects 13.15% women who currently smoke, increasing the value until 24.01% in the case of men. In terms of alcohol consumption, obesity influences 37.29% men and 9.01% women.

6.3. Results

In this section, we present the findings obtained when we carry out the CCI to measure to what extent health inequalities are related to SES as well as those obtained for the GE index. In addition, we describe the results from the multivariate logistic regression model, showing the association between obesity and socio-economic variables in Spain in 2017.

Table 6.3 shows obesity prevalence in terms of SES as well as the CCI in the Spanish regions. Remember that we define prevalence as the proportion of population that presents a given characteristic in a specific period. Therefore, obesity ranges from 2.59% (Castilla y León) to 4.57% (Castilla – La Mancha) among the Spanish regions. In addition, we show that obesity prevalence is higher in lower SES quintiles in the whole

sample as well as in most of regions. Nevertheless, when we focus on regions such as Madrid, Navarra and País Vasco, higher SES quintiles present higher obesity prevalence. Looking at the first SES quintile (Q1), obesity prevalence varies from 2.56% (País Vasco) to 14.80% (Ceuta). Meanwhile, it ranges from 0.38% (Cantabria) to 5.24% (Navarra) for the fifth quintile.

In terms of the CCI, obesity is concentrated in low socio-economic groups in Spain and in most of regions, except for Madrid, Navarra and País Vasco. As we mentioned previously, these regions present larger obesity prevalence in greater SES quintiles. In addition, the CCI indicates that obesity inequality is concentrated among the poor, varying from -0.103 (Melilla) to -0.020 (Canarias), without considering the three regions which present positive sign.

Table 6.3. Socio-economic inequality in obesity prevalence according to the Spanish regions, 2017

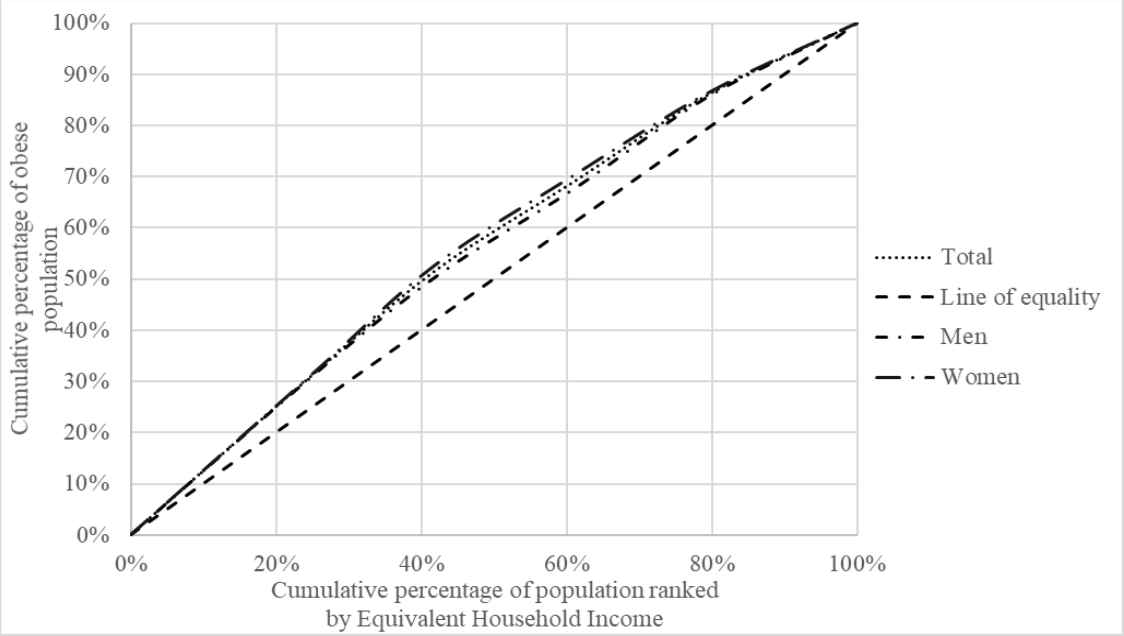
Spanish region	Overall	Socio-economic status (quintiles)					CI	CCI
		Q1	Q2	Q3	Q4	Q5		
Andalucía	4.21	10.07	4.48	2.80	2.00	1.73	-0.017	-0.056
Aragón	3.29	3.31	2.88	3.75	3.31	3.17	-0.006	-0.027
Asturias, Principado de	4.48	4.75	5.06	4.14	5.06	3.37	-0.018	-0.077
Balears, Illes	3.16	3.24	3.62	2.29	4.19	2.48	-0.008	-0.034
Canarias	4.05	9.38	3.62	3.41	2.99	0.85	-0.006	-0.020
Cantabria	3.79	4.17	3.79	6.82	3.79	0.38	-0.017	-0.064
Castilla y León	2.59	4.25	2.07	2.07	1.97	2.59	-0.010	-0.039
Castilla - La Mancha	4.58	6.98	5.79	4.01	3.42	2.67	-0.013	-0.034
Cataluña	3.15	4.14	2.81	2.81	3.61	2.40	-0.019	-0.046
Comunitat Valenciana	4.11	6.72	4.69	3.61	3.61	1.90	-0.013	-0.082
Extremadura	3.86	8.55	4.02	3.11	2.85	0.78	-0.013	-0.046
Galicia	3.95	6.41	5.26	3.05	3.58	1.47	-0.007	-0.025
Madrid, Comunidad de	3.27	3.27	2.45	3.57	3.42	3.64	0.016	0.069

Spanish region	Overall	Socio-economic status (quintiles)					CI	CCI
		Q1	Q2	Q3	Q4	Q5		
Murcia, Región de	3.56	6.11	4.32	2.84	2.63	1.89	-0.018	-0.068
Navarra, Comunidad Foral de	3.67	2.80	2.97	2.97	4.37	5.24	0.022	0.108
País Vasco	3.17	2.56	2.73	2.48	3.55	4.55	0.013	0.06
Rioja, La	3.56	4.70	2.25	3.89	3.89	3.07	-0.011	-0.048
Ceuta	4.57	14.80	1.35	2.24	2.24	2.24	-0.027	-0.085
Melilla	4.27	7.81	2.08	5.73	1.56	4.17	-0.027	-0.103
Spain (total)	3.69	5.88	3.68	3.18	3.21	2.52	-0.017	-0.065

Note: Q1 (Quintile 1); Q2 (Quintile 2); Q3 (Quintile 3); Q4 (Quintile 4); Q5 (Quintile 5); CI (Concentration Index); CCI (Corrected Concentration Index).

Figure 6.1 shows concentration curves for Spanish population as well as for women and men separately. It presents a 45º line, which indicates the line of equality when the Concentration Index is equal to zero. More specifically, these concentration curves present the association between the cumulative percentage of Equivalised Household Income on the horizontal axis and the cumulative percentage of obese population on the vertical axis. The concentration curves above the 45º line indicate "pro-poor" inequality. Therefore, our results show that inequality in obesity is biased toward poorer people as the concentration curve is above the line of equality. In other words, obesity prevalence is greater for poorer households among women, men and the whole population. Moreover, the socio-economic gradient is larger for women than for men, demonstrating that socio-economic inequalities are higher for women.

Figure 6.1. Concentration curves of obesity in Spain, 2017



Below, in Table 6.4, we present the obesity inequality measured as GE indices. We find that obesity inequality is quite similar among the different Spanish regions. Compared to the Spanish average, it clearly increases in several regions such as Navarra, Illes Balears and Ceuta, among others, for the three GE measures. By contrast, other areas are below the average of Spain such as Murcia and Galicia. The empirical results obtained for the obesity inequality measured by the GE indices show their robustness.

Table 6.4. Generalized Entropy inequality indices for obesity in Spain, 2017

Spanish region	**GE (0)**	**GE (1)**	**GE (2)**
Andalucía	0.043	0.041	1.081
Aragón	0.043	0.041	1.081
Asturias, Principado de	0.044	0.042	1.082
Balears, Illes	0.047	0.046	1.093
Canarias	0.043	0.042	1.083
Cantabria	0.043	0.041	1.081
Castilla y León	0.041	0.039	1.079

Spanish region	**GE (0)**	**GE (1)**	**GE (2)**
Castilla - La Mancha	0.043	0.041	1.082
Cataluña	0.041	0.040	1.080
Comunitat Valenciana	0.045	0.043	1.085
Extremadura	0.041	0.039	1.077
Galicia	0.040	0.038	1.075
Madrid, Comunidad de	0.043	0.041	1.083
Murcia, Región de	0.038	0.036	1.071
Navarra, Comunidad Foral de	0.048	0.046	1.091
País Vasco	0.041	0.040	1.082
Rioja, La	0.043	0.041	1.083
Ceuta	0.047	0.044	1.085
Melilla	0.046	0.043	1.086
Spain (total)	0.043	0.041	1.082

Note: GE (Generalized Entropy).

In the case of the multivariate logistic regression model, Table 6.5 shows our findings. We measure the magnitude of the effects throughout adjusted odds ratios (OR), establishing 95% CI and three different significance levels: 0.01, 0.05 and 0.10. The OR indicate the association between the average odds of reporting obesity at the outcome compared with the average odds when the individual does not report obesity. On the one hand, if we have an OR higher than 1, it implies an increase in the obesity variable when we measure the outcome (i.e., greater risk of obesity). On the other hand, whether we obtain an OR lower than 1, it presents a decrease in the obesity variable when we measure the outcome (i.e., lower probability of obesity).

Table 6.5. Multivariate logistic regression model relating obesity and socio-economic characteristics in Spain, 2017

Obesity	Women				Men		
	OR	**95% CI**			**OR**	**95% CI**	
Constant	0.042	(0.024 - 0.074)	***		0.055	(0.031 - 0.095)	***
Equivalised Net Household Income							
Quintile_1	1.512	(1.201 - 1.905)	***		1.257	(1.022 - 1.546)	*
Quintile_2	1.270	(1.004 - 1.607)	**		1.209	(0.971 - 1.505)	
Quintile_3	1.100	(0.871 - 1.388)			1.000	(0.813 - 1.231)	
Quintile_4	1.084	(0.859 - 1.369)			1.269	(1.047 - 1.538)	**
Quintile_5	1	-			1	-	
Age							
15-29	1	-			1	-	
30-44	1.736	(1.280 - 2.354)	***		2.066	(1.537 - 2.777)	***
45-64	2.470	(1.826 - 3.343)	***		2.816	(2.094 - 3.786)	***
≥65	2.860	(2.083 - 3.926)	***		2.755	(2.015 - 3.766)	***
Nationality							
Spanish	0.952	(0.737 - 1.227)			1.407	(1.061 - 1.867)	**
Marital Status							
Single	0.925	(0.776 - 1.112)			0.953	(0.815 - 1.115)	
Education level							
Low	1.490	(1.222 - 1.816)	***		1.158	(0.950 - 1.412)	
Medium	1.121	(0.901 - 1.396)			1.158	(0.963 - 1.394)	
High	1	-			1	-	
Employment situation							
Unemployed	1.179	(0.969 - 1.434)	*		1.121	(0.909 - 1.383)	*
Socio-professional class							
Class I	1	-			1	-	
Class II	1.292	(1.021 - 1.635)	**		1.161	(0.946 - 1.423)	
Class III	1.723	(1.355 - 2.191)	***		1.278	(1.028 - 1.591)	**
Class IV	1.933	(1.491 - 2.505)	***		1.228	(0.948 - 1.590)	
SAH							
Bad and very bad	1.228	(1.029 - 1.466)	**		1.449	(1.172 - 1.791)	***
Mental health							
Poor	1.119	(0.973 - 1.287)			0.922	(0.779 - 1.092)	
Physical activity							
Any physical activity	1.597	(1.415 - 1.802)	***		1.716	(1.516 - 1.941)	***
Eating patterns							

Obesity	**Women**				**Men**		
	OR	**95% CI**			**OR**	**95% CI**	
Fruit	0.891	(0.729 - 1.089)			0.967	(0.814 - 1.149)	
Meat	1.139	(1.005 - 1.291)	**		1.150	(1.005 - 1.315)	**
Eggs	0.977	(0.861 - 1.109)			0.969	(0.854 - 1.099)	
Fish	0.975	(0.865- 1.100)			0.96	(0.849 - 1.085)	
Carbohydrates	0.927	(0.814 - 1.056)			0.889	(0.778 - 1.016)	*
Cereals	0.873	(0.693 - 1.099)			0.848	(0.656 - 1.097)	
Vegetables	1.104	(0.899 - 1.354)			0.886	(0.752 - 1.045)	
Legumes	0.982	(0.861 - 1.119)			0.928	(0.816 - 1.057)	
Dairy products	1.083	(0.866 - 1.354)			1.124	(0.905 - 1.397)	
Junk food	0.854	(0.759 - 0.960)	***		0.857	(0.761 - 0.967)	**
Smoking status							
Current	0.574	(0.483 - 0.682)	***		0.733	(0.636 - 0.844)	***
Alcohol consumption							
Frequently	0.723	(0.594 - 0.881)	***		1.006	(0.888 - 1.141)	

Note: Statistically significant at 99% level (***), 95% (**), 90% (*). OR (Odds Ratios); CI (Confidence Interval); Class I = Executives and managers; Class II = Intermediate occupations, skilled technical, self-employed; Class III = Primary sector skilled workers; Class IV = Unskilled workers; SAH (Self-Assessment Health).

Looking at Equivalised Net Household Income, there is a clear association between lower SES and higher probability of obesity. We can argue that women from Quintile 1 (OR: 1.512 CI 95%: 1.201-1.905) as well as men (OR: 1.257 CI 95%: 1.022-1.546) present greater risk of obesity than those from Quintile 5, as do the remaining quintiles.

On the one hand, the model focused on women indicates that Spanish ones (OR: 0.952 CI 95%: 0.737-1.227) present lower probability of obesity compared to foreign women. Besides, women who report poor mental health (OR: 1.119 CI 95%: 0.973-1.287) suggest larger probability of obesity. Looking at alcohol consumption, women who frequently drink alcohol (OR: 0.723 CI 95%: 0.594-0.881) show lower risk of obesity.

On the other hand, in the case of men, our findings show that being Spanish (OR: 1.407 CI 95%: 1.061-1.867) implies larger probability of obesity compared to foreign

men. Besides, men who assess poor mental health (OR: 0.922 CI 95%: 0.779-1.092) display lower probability of obesity. Looking at alcohol consumption, men who frequently drink alcohol (OR: 1.006 CI 95%: 0.888-1.141) have greater risk of obesity.

In addition, we find some similarities between women and men. In the case of age, women and men behave similarly among all the intervals considered. Population aged between 30 and 44 years old, 45 and 64 years old and over 65 years presents higher probability of obesity compared to those between 15 and 29 years old. Looking at marital status, being single implies lower risk of obesity for both women (OR: 0.925 CI 95%: 0.776-1.112) and men (OR: 0.953 CI 95%: 0.815-1.115). According to education level, low educated women (OR: 1.490 CI 95%: 1.222-1.816) as well as men (OR: 1.158 CI 95%: 0.950-1.412) show greater risk of obesity than those with high education level, as do those with medium education level (OR: 1.121 CI 95%: 0.901-1.396) for women and (OR: 1.158 CI 95%: 0.963-1.394) for men. Regarding employment situation, unemployed women and men (OR: 1.179 CI 95%: 0.969-1.434 and OR: 1.121 CI 95%: 0.909-1.383, respectively) suggest higher probability of obesity. In the case of socio-professional class, class II, class III and class IV present higher risk of obesity compared to class I for both women and men. Similarly, reporting bad or very bad health status implies greater risk of obesity for both women (OR: 1.228 CI 95%: 1.029-1.466) and men (OR: 1.449 CI 95%: 1.172-1.791). Do not practising physical activity at leisure time suggests larger probability of obesity for women (OR: 1.597 CI 95%: 1.415-1.802) and men (OR: 1.716 CI 95%: 1.516-1.941). Moreover, women and men who currently smoke (OR: 0.574 CI 95%: 0.483 - 0.682 and OR: 0.733 CI 95%: 0.636-0.844, respectively) present lower risk of obesity.

In terms of eating patterns, women and men behave similarly. Women who eat fruit (OR: 0.891 CI 95%: 0.729-1.089) as well as men (OR: 0.967 CI 95%: 0.814-1.149) present lower probability of obesity, as do women and men who eat eggs (OR: 0.977 CI 95%: 0.861-1.109 and OR: 0.969 CI 95%: 0.854-1.099, respectively) as well as those who eat fish (OR: 0.975 CI 95%: 0.865-1.100 and OR: 0.960 CI 95%: 0.849-1.085, respectively). In addition, women and men who eat carbohydrates three or more times per week (OR: 0.927 CI 95%: 0.814-1.056 and OR: 0.889 CI 95%: 0.778-1.016, respectively) show lower risk of obesity, as those who eat cereals (OR: 0.873 CI 95%: 0.693-1.099, for women, and OR: 0.848 CI 95%: 0.656-1.097, for men). Similarly, eating legumes presents lower risk of obesity for women (OR: 0.982 CI 95%: 0.861-1.119) and for men (OR: 0.928 CI 95%: 0.816-1.057) as well as eating junk food for women (OR: 0.854 CI 95%: 0.759-0.960) and for men (OR: 0.857 CI 95%: 0.761-0.967).

By contrast, women (OR: 1.139 CI 95%: 1.005-1.291) and men (OR: 1.150 CI 95%: 1.005-1.315) who eat meat show higher risk of obesity as well as eating dairy products three or more times per week (OR: 1.083 CI 95%: 0.866-1.354 and OR: 1.124 CI 95%: 0.905-1.397, for women and men, respectively). Meanwhile, eating vegetables implies greater risk of obesity for women (OR: 1.104 CI 95%: 0.899-1.354) and lower probability of obesity for men (OR: 0.886 CI 95%: 0.752-1.045).

Next, in terms of significance, we can argue that the relationship between obesity and Equivalised Net Household Income is significant when we focus on Quintile 1 and Quintile 2 in the case of women as well as on Quintile 1 and Quintile 4 for men. In addition, we find that all age intervals are significantly associated with obesity for both genders, as does being unemployed. Besides, SAH, physical activity and smoking status are significantly related to obesity. In the case of eating patterns, meat and junk food are

significant for both genders, being carbohydrates only significant for men. Meanwhile, being Spanish is only significant for men and alcohol consumption is only significant for women. In the case of socio-professional class, all classes are significant for women, but only class III is significant for men. On the one hand, we do not find any significant association between obesity and marital status as well as between obesity and poor mental health. On the other hand, education level is not associated with obesity, except for low educated women.

6.4. Discussion

In this paper, we measure socio-economic inequalities in obesity and we examine what determinants can affect obesity among Spanish population. Previous research about this topic is extensive, but we use the most current data. In addition, the findings reported here are broadly in line with those from other researches.

Our results suggest that social inequalities on obesity vary across the different Spanish regions, but they are higher among population with lower SES in most regions. Costa-Font and Gil (2008) analyse income-related inequalities in the risk of obesity, concluding that there is evidence of significant socio-economic inequalities in the probability of being obese. Similarly, Font-Ribera *et al.* (2014) carry out a literature review focused on social inequalities in health among Spanish children and adolescents, indicating that there are inequalities in obesity. Meanwhile, Ventosa and Urbanos-Garrido (2016) examine how SES affects obesity, showing the existence of significant socio-economic gradient in the prevalence of obesity in Spain.

As expected, lower income is a key determinant of obesity. For example, García-Álvarez *et al.* (2007) study the influence of socio-economic determinants on the trends of overweight and obesity prevalence in 1992-1993 and 2002-2003 across individuals from 18 to 75 years old in Spain, more specifically, in Cataluña. Their findings show that socio-economic variable has an influence on overweight and obesity rates, being obesity higher in low socio-economic levels. More recently, Antelo, Magdalena and Reboredo (2017) show several determinants that imply being obese among children between 2 and 15 years old in Spain and one of these factors is income.

Lower education level is associated with higher risk of obesity. These data agree with other studies such as that developed by Gutiérrez-Fisac *et al.* (1999), who show some determinants associated with geographic changes in BMI and obesity in population aged 16 and over across the different Spanish regions. Their findings demonstrate that regional changes in obesity are associated with educational level. Besides, García-Álvarez *et al.* (2007) study the influence that socio-economic and education variables have on overweight and obesity rates. On the one hand, Font-Ribera *et al.* (2014) identify several social determinants related to obesity, being educational level one of the most important. On the other hand, López-Sobaler *et al.* (2016) show the relationship between socio-economic and lifestyle determinants with the conditions of general obesity in Spanish adults, finding that those individuals with lower education level present higher risk of obesity. In addition, Antelo, Magdalena and Reboredo (2017) argue that education level is a relevant factor that implies being obese.

In our study, the decomposition analysis demonstrates that being unemployed is also an important socio-economic factor that influences obesity. Font-Ribera *et al.* (2014)

also identify parental occupation as one of the most important determinants related to childhood obesity.

In addition, our results point out that reporting bad or very bad health status as well as poor mental health contributes to a higher risk of obesity. Similarly, Busutil *et al.* (2017) measure the impact of the BMI on the Health-Related Quality Of Life of the Spanish adult population, concluding that BMI is an explanatory factor of SAH. Overall, the higher the BMI the higher the self-perceived problems.

The sedentary behaviour is a very significant driver of obesity. For example, Gutiérrez-Fisac *et al.* (1999) find that illiteracy, sedentary lifestyle and energy intake explain 14% of the variation in obesity. Meanwhile, Lopez-Garcia *et al.* (2013) examine the prevalence of metabolically healthy obesity and its determinants among the population aged 18 years and over in Spain, showing that factors such as a vigorous physical activity are related to healthy phenotype among obese population. Besides, López-Sobaler *et al.* (2016) indicate that those individuals who do not have a healthy physical activity present greater probability of obesity. On the one hand, Marqueta de Salas *et al.* (2016) analyse the association between eating patterns and physical activity with overweight and obesity among the Spanish population, concluding that practising physical activity several times per week is associated with a significant decrease in obesity. On the other hand, Antelo, Magdalena and Reboredo (2017) show that physical activity is an important factor that implies being obese.

In our study, alcohol consumption is a risk factor for obesity, more specifically, for men. Our findings agree with those observed in other studies such as Lopez-Garcia *et al.* (2013), who conclude that moderate alcohol consumption is related to healthy phenotype among obese population.

Analysing the determinants of eating patterns, we show that individuals who eat several food (meat, vegetables and dairy products) three or more times per week present higher risk of obesity. Marín-Guerrero *et al.* (2008) study the relationship between eating patterns and obesity across individuals from 25 to 64 years old in Spain, showing that snacking is associated with obesity in women. In addition, those individuals who eat several times small amounts of food present higher risk of obesity. Additionally, Marqueta de Salas *et al.* (2016) also find that the daily consumption of vegetables is associated with a larger risk of overweight and obesity. Moreover, Ventosa and Urbanos-Garrido (2016) conclude that dietary habits do not show a significant mediating effect. In our study, meat and junk food are significant variables in terms of eating patterns. Furthermore, Antelo, Magdalena and Reboredo (2017) show that diet is a determinant which implies being obese.

6.5. Conclusions

This paper contributes to the existing research providing the most current analysis of the influence of SES levels on obesity as well as of the determinants of obesity inequalities in Spain, using data from 2017 provided by SNHS. Our main objective is to analyse obesity looking at households' income in Spain as a whole and in the different Spanish regions. In addition, we focus on the determinants of obesity inequalities. Thus, we present CCI of obesity to show that socio-economic gradient is more pronounced for obese population. In addition, we decompose several determinants that affect obesity.

Our empirical results suggest that obesity prevalence is larger in lower SES quintiles. In terms of CCI, which measures socio-economic inequalities, our findings

indicate that obesity is concentrated in low socio-economic groups in most of the Spanish regions. In short, obesity inequality is concentrated among the poorest population.

In the case of characteristics related to obesity, looking at Equivalised Net Household Income, our results present an association between lower quintile and higher probability of obesity, more specifically, for women. The same happens with women who report poor mental health. In the case of men, Spanish ones, those from socio-professional class III and who frequently drink alcohol present larger probability of obesity. We find the same results in several characteristics for both women and men. Low or medium educated individuals as well as unemployed ones present greater risk of obesity. In addition, looking at lifestyle factors, individuals who assess bad or very bad health status, and who do not practising physical activity at leisure time show larger risk of obesity.

Finally, in terms of eating patterns, women and men behave similarly. Individuals who eat meat three or more times per week present higher probability of obesity. The same happens with vegetables and dairy products, but the last ones only in the case of women.

Conclusiones

Esta tesis doctoral finaliza con este último apartado relativo a las conclusiones, en la cual se hace un resumen de algunas de las principales aportaciones realizadas a través de cada uno de los capítulos anteriores. Asimismo, también se consideran posibles futuras líneas de investigación derivadas de los diferentes análisis realizados a lo largo de este trabajo, las cuales podrían ser la extensión o continuación de determinados capítulos, siguiendo siempre la dirección que marca el ámbito de la Economía de la Salud actual.

Resultados y aportaciones principales

A lo largo de dicha tesis se plantea el estudio de las desigualdades en salud de la población desde distintas perspectivas, concretamente, seis, correspondiendo cada una de ellas a los diferentes capítulos que componen este trabajo. Principalmente, se han analizado cuestiones centradas en la salud y otras características socioeconómicas de la población. Más específicamente, se ha hecho especial énfasis en los efectos que determinados factores socioeconómicos y de estilo de vida de la población tienen sobre su propia salud. Cabe destacar que la mayoría de los capítulos de esta tesis se centran en la relación existente entre los ingresos y una determinada característica de salud de la población

como la tasa de cobertura de vacunación, la salud mental o la obesidad. Asimismo, los diferentes enfoques abordados a lo largo de esta investigación se han centrado tanto en ámbito nacional como internacional e, incluso, mundial.

En el primer capítulo, se hace una revisión sistemática de la literatura para conocer el estado actual de la desigualdad, pobreza y polarización en salud. Por su parte, en otros dos capítulos, se hace referencia a la desigualdad de la salud autopercibida por parte de la población, focalizando, por un lado, en la existencia de polarización en diversos países de la Unión Europea y, por otro lado, en la pobreza en salud para el caso español. Además, se ha analizado la desigualdad existente en términos de tasas de cobertura de vacunación infantil en función del nivel de ingresos de numerosos países del mundo. Asimismo, en los dos últimos capítulos, se muestra de que manera ha influenciado la última crisis económica vivida en España sobre la salud mental y la obesidad de la población.

De este modo, la investigación que se presenta en esta Tesis Doctoral brinda la oportunidad de analizar los efectos de la crisis económica sobre la salud de la población hasta 2015, 2016 o 2017, dependiendo del capítulo al que se haga referencia y las fuentes de datos disponibles en ese momento. De esta manera, es posible observar la influencia de las políticas públicas establecidas para paliar los efectos negativos de ese periodo de recesión económica. No obstante, los resultados obtenidos permiten afirmar la necesidad de diseñar nuevas estrategias de salud pública o, rediseñar y evaluar las ya existentes, destinadas a paliar las desigualdades en salud de la población.

Y es que dichas desigualdades en salud son evitables, ya que pueden paliarse en cierta medida mediante políticas públicas sanitarias y sociales. Más concretamente, es necesario establecer estrategias cuyo principal objetivo sea la reducción de las desigualdades mencionadas a lo largo de esta tesis doctoral, a través de un ámbito que no

siempre es lo suficientemente abordado como es el relativo a la promoción y prevención de la salud.

De nuevo, cabe destacar que este trabajo proporciona nueva evidencia empírica, así como distintos enfoques en términos de desigualdad en salud, así como sobre el impacto de la crisis económica en determinadas características socioeconómicas y de estilo de vida de la población. De este modo, para realizar los diferentes estudios incluidos en esta Tesis Doctoral, se han necesitado diversas fuentes de datos como son PubMed, Cochrane Library y *Web of Science*. Asimismo, se han utilizado numerosas bases de datos, entre las que se pueden distinguir el Banco Mundial y la Organización Mundial de la Salud (OMS), utilizadas por sus datos a nivel mundial; además de la información disponible en el Instituto Nacional de Estadística (INE) y Eurostat, para los análisis a nivel nacional e internacional, respectivamente. Las dos últimas fuentes de datos cuentan con numerosas Encuestas de Salud, siendo tres de ellas empleadas en esta tesis.

Asimismo, es importante señalar las limitaciones encontradas durante la realización del presente trabajo, las cuales han afectado a los diferentes capítulos que lo componen. En cuanto a las bases de datos consideradas para llevar a cabo la revisión de literatura, entre las limitaciones encontradas se puede destacar el periodo de tiempo establecido, así como la escasez de artículos en algunos temas tales como la polarización de la salud.

Por un lado, en lo referente a las distintas Encuestas de Salud consideradas, ya sean a nivel nacional o internacional, estas abarcan una gran cantidad de características acerca de la población y su salud. No obstante, es posible que los encuestados no respondan a determinadas preguntas consideradas en la encuesta, generando así valores perdidos en nuestra muestra. Más concretamente, esto sucede en la segunda ola (2011-

2012) de la Encuesta Nacional de Salud española, cuando se realiza la pregunta correspondiente al consumo de alcohol. Además, los resultados obtenidos se deben interpretar con la máxima cautela posible ya que la información proporcionada es la percepción de los propios entrevistados y, tal y como se ha mencionado previamente, esta variable es de carácter subjetivo. Sin embargo, en este caso cabe recordar que la salud autopercibida de la población se considera un buen indicador ya que tiene en cuenta no solo la ausencia de enfermedad, sino el nivel de bienestar de manera generalizada.

Por otro lado, en lo referente al Banco Mundial y la OMS, la limitación se ha encontrado a la hora de obtener la tasa de cobertura de vacunación infantil de determinados países, ya que estos no lo reportan. De ese modo, la muestra se ha visto reducida a aquellos países que sí informan a la OMS sobre las tasas de inmunización durante el periodo de diecisiete años considerado en nuestro estudio (2000-2016).

Por consiguiente, esta investigación se ha visto limitada en cuanto a los datos disponibles del periodo temporal, así como a determinadas características socioeconómicas de la población. Particularmente, en determinados capítulos, no ha sido posible realizar una evaluación anual y continua año tras año debido a que algunas de las encuestas consideradas utilizan datos transversales.

A continuación, se analizan más en detalle las principales conclusiones obtenidas en cada uno de los anteriores capítulos, así como las implicaciones de política sanitaria más relevantes de cada uno de ellos.

En el Capítulo 1, proporcionamos una revisión sistemática de la literatura de estudios recientes utilizando PubMed, Cochrane Library y *Web of Science*. En este artículo, se considera un horizonte retrospectivo hasta octubre de 2019 debido a que estamos centrados en la literatura más reciente, la cual se caracteriza, en la mayoría de

los temas, por una gran cantidad de artículos. En particular, revisamos estudios empíricos que analizan la desigualdad, la pobreza y la polarización, más específicamente, cuando están relacionados con la salud porque estamos interesados en el campo de la economía de la salud. Sin embargo, analizamos aquellos documentos que asocian estos tres temas con otras características sociales para mejorar este estudio. La comparación internacional entre estudios de desigualdad en salud, pobreza y polarización muestra similitudes, pero también diferencias. Este artículo arroja luz sobre varios problemas sociales asociados con la desigualdad, la pobreza y la polarización.

Por su parte, en el Capítulo 2 se analiza la evolución de la desigualdad y polarización de la salud en dos periodos de tiempo (2006-2009 y 2013-2015) y para 27 países de la Unión Europea a través de *European Health Interview Survey* (EHIS). De cierta manera, la elaboración de este estudio implica poder aportar nueva evidencia empírica de los últimos años sobre polarización de la salud. Más concretamente, contribuir al debate sobre si diferentes medidas de desigualdad o polarización pueden ayudarnos a explicar mejor los resultados en salud (Yao, Wan y Meng, 2019). Los hallazgos obtenidos en este trabajo muestran la existencia de desigualdades en la salud autopercibida de la población en numerosos países europeos. Comparando los índices de desigualdad y polarización, los países presentan el mismo ranking. De este modo, se puede afirmar que los países con mayor grado de desigualdad también muestran mayor nivel de polarización. Este capítulo indica la necesidad de desarrollar y poner en marcha políticas públicas para la corrección de estas desigualdades en salud. Esto significa que se debería limitar, en la medida de lo posible, las consecuencias en términos de desigualdad generadas por la Gran Recesión en el ámbito sanitario, al igual que en otros campos como, por ejemplo, el mercado de trabajo. Así, determinadas políticas de carácter

social se deberían rediseñar, ya que esta desigualdad trae como consecuencia la exclusión de los grupos más desfavorecidos.

El Capítulo 3 analiza la tendencia actual de la pobreza en salud, medida a través del estado de salud autoevaluado por parte de la población española. Dicho fenómeno de la pobreza en salud se ha considerado desde numerosos enfoques (Bhui, Warfa y Jones, 2014; Ellison y De Wet, 2016; Bosch *et al.*, 2019). En este capítulo, el estudio se aborda desde una perspectiva dinámica, desde 2008 hasta 2016, y los resultados muestran una tendencia negativa cuando se considera un umbral de pobreza de salud relativo a la "mala salud". Mientras tanto, el crecimiento es positivo si se considera que dicho umbral es "salud normal". De manera que, los hallazgos obtenidos podrían tener implicaciones significativas para las políticas de salud en España, en aras a una mayor descentralización de los recursos al ser el área geográfica que abarca este capítulo. En este sentido, resulta útil disminuir las desigualdades en salud, si, además, con ello se logra reducir o eliminar por completo tanto la exclusión social como la pobreza. Asimismo, es necesario que se realicen determinadas reformas en términos de igualdad en el acceso, así como en el uso de los servicios sanitarios, estableciendo las necesidades de atención médica en función de los diferentes grupos socioeconómicos existentes. Por otro lado, sería apropiado evaluar las tendencias sanitarias en nuestro país para garantizar así la atención continua de toda la población, tanto en periodos de crisis económica y financiera como en épocas de bonanza económica. También se debe hacer un gran esfuerzo para garantizar la equidad en la disponibilidad, uso y calidad de los servicios de salud, más específicamente, para la población más desfavorecida.

Por otro lado, el Capítulo 4 examina la relación entre el ingreso per cápita de diversos países del mundo y las tasas de cobertura de vacunación infantil de ocho vacunas

incluidas en el calendario global de inmunización, proporcionando nueva evidencia empírica a la literatura existente. Los resultados obtenidos en este capítulo muestran que existe una relación positiva a la vez que significativa entre el ingreso per cápita y las tasas de cobertura de vacunación infantil para la mayoría de las vacunas analizadas. Asimismo, cada país de los considerados en nuestro estudio converge hacia su propio estado estacionario, lo que implica que cada uno se comporta de acuerdo a sus propias características. De esta manera, los resultados descritos a lo largo de este capítulo pueden tener relevantes implicaciones en términos de políticas sanitarias debido a que los indicadores de los distintos niveles socioeconómicos presentan un impacto notable sobre las tasas de inmunización. De este modo, si se desea que se produzca un aumento en dichas tasas, serán necesarias inversiones tanto en capital físico como humano por parte de los gobiernos. No obstante, se debe tener en cuenta que esto depende de los recursos disponibles que existan en cada país. Por tanto, resulta necesario desarrollar políticas de salud destinadas a reducir la desigualdad de ingresos y lograr tasas de inmunización uniformemente altas.

En los dos últimos capítulos, los resultados muestran la necesidad de aplicar políticas de género para conciliar y regular la distribución del ingreso de las familias económicamente más vulnerables, así como la provisión de servicios sociales para ayudar a las personas dependientes.

El Capítulo 5 estudia el impacto que varios factores tienen sobre los problemas comunes de salud mental antes, durante y después de la Gran Recesión. Más concretamente, se observa cómo ese periodo de crisis económica ha influido sobre la salud mental de la población española, siguiendo las líneas de otras investigaciones (Farré, Fasani y Mueller, 2018; Thomson, Niedzwiedz y Katikireddi, 2018). Los

resultados muestran que tener bajos ingresos, un nivel educativo bajo y estar desempleado son determinantes que aumentan el riesgo de tener una mala salud mental. Además, estar separado o divorciado, jubilado o ser trabajador del hogar son otros factores asociados con mala salud mental. Los resultados obtenidos tienen implicaciones significativas para las políticas de salud debido a que algunas de las características personales y socioeconómicas consideradas en este capítulo tienen un claro impacto sobre la salud mental de la población. Por tanto, es necesario establecer políticas para mejorar la salud mental de los grupos de población vulnerables, como los considerados en este estudio. Y es que, a pesar de que este trabajo se centra, principalmente, en la crisis económica, cabe destacar que los bajos ingresos no son el único indicador socioeconómico de bajos niveles de calidad de vida. De modo que, en el futuro, se deben tener en cuenta medidas en términos de salud mental que recojan la sensibilidad de los cambios producidos en función del período económico (crecimiento o recesión económicos).

Finalmente, el Capítulo 6 muestra la influencia de diferentes niveles socioeconómicos sobre la obesidad, centrándose en el indicador relativo al ingreso neto equivalente del hogar. Además, analiza algunos de los factores que generan desigualdad en obesidad entre la población española. Los resultados empíricos obtenidos a lo largo de este capítulo muestran que la prevalencia de obesidad es mucho mayor en los niveles socioeconómicos más bajos. En otras palabras, las desigualdades en obesidad se concentran entre la población más pobre en cuanto a ingresos. Asimismo, se ha demostrado que los factores laborales y de estilo de vida explican, en cierta medida, las desigualdades socioeconómicas en salud. Todo ello tiene implicaciones importantes para las políticas de salud pública y ocupacionales, haciendo especial énfasis en los factores laborales y de estilo de vida para reducir las desigualdades socioeconómicas en la salud

autopercibida por parte de la población. Por tanto, estos resultados nos están señalando cómo son varias las características socioeconómicas que suponen un impacto significativo en la elevación de las tasas de obesidad.

Futuras líneas de investigación

A partir de los diferentes enfoques considerados a lo largo de esta tesis doctoral, así como de las metodologías y fuentes de datos utilizadas, los hallazgos de los anteriores seis capítulos ofrecen una visión global de las desigualdades en términos de salud durante los últimos años y, más concretamente, antes, durante y después la reciente crisis económica. No obstante, tras la elaboración de este trabajo, han surgido posibles futuras líneas de investigación en el campo de Economía de la Salud, el bienestar y la desigualdad para abordar más adelante, estando limitadas por la calidad y disponibilidad de los datos en el momento de su realización.

De acuerdo al Capítulo 1, para comprender mejor los efectos de las políticas en la desigualdad, pobreza y polarización en salud, como posible futura línea de investigación, se podría incluir nueva literatura a medida que se publiquen más artículos a lo largo de los años. Otras nuevas líneas de investigación podrían ser el análisis de otras variables de salud diferentes de la salud autopercibida, tales como la esperanza de vida (año de vida ajustado, discapacidad) o la mortalidad (mortalidad infantil), entre otras.

Mientras tanto, el Capítulo 2 se podría analizar la descomposición de las diferentes medidas de desigualdad, así como de polarización, en función de determinadas características socioeconómicas, culturales y/o ambientales. De este modo, sería posible

revelar cuáles son algunas de las razones por las que tanto la desigualdad como la polarización no sólo existen en Europa, sino que están ampliándose actualmente. Asimismo, se podría concluir cuales de los factores considerados explican los importantes cambios producidos en el nivel de desigualdad a lo largo del tiempo. Es decir, sería posible identificar si dichos determinantes afectan de manera directa, ya sea positiva o negativamente, sobre la salud de la población. En este caso, el análisis podría ser abordado tanto a nivel nacional como internacional. Además, en lugar de utilizar el estado de salud autopercibido como variable dependiente, se podrían considerar otras variables de salud proporcionada por la *EHIS*, tales como la esperanza de vida o la mortalidad, entre otras.

En el Capítulo 3, se resalta especialmente el hecho de que la salud es un tema complejo a la vez que multidimensional. Así, el conjunto de datos proporcionado por la *EU-SILC* y utilizado en este capítulo, es bastante amplio y recoge una gran cantidad de información relativa a la salud de la población de la Unión Europea. Por tanto, esta fuente de datos se puede considerar como una buena base para realizar una comparación adecuada y pormenorizada entre países. De este modo, los hallazgos obtenidos en términos de pobreza en salud en España podrían compararse con aquellos para distintas poblaciones de otros países europeos. Más concretamente, esto sería de especial interés al tener en cuenta que los países mediterráneos como España, Portugal, Italia y Grecia han sido los más afectados por la Gran Recesión. En resumen, una futura línea de investigación podría ser la que considere la comparación de la pobreza en salud en los cuatro países recién mencionados como consecuencia de la última crisis económica, así como la comparación con otros países de la Unión Europea.

El Capítulo 4 hace referencia, principalmente, a las tasas de cobertura de vacunación infantil de varias vacunas en numerosos países alrededor del mundo. Además,

estas se asocian con el ingreso per cápita de dichos países. Como posible futura línea de investigación se podría establecer para este capítulo el análisis del gasto sanitario de cada país, en lugar del ingreso. De este modo, sería posible comprobar, en cierta medida, el impacto que el gasto realizado por el gobierno de cada país tiene sobre la vacunación. En este sentido, también se podría valorar el hecho de incluir en el análisis otras variables que influyan en las tasas de inmunización en función de la clasificación de países por ingreso per cápita como, por ejemplo, el precio de las diferentes vacunas. Como otra línea de investigación alternativa se podrían tener en cuenta determinadas características de los padres (religión o estigma social) para comprobar cómo influyen sobre las tasas de cobertura de vacunación de los niños, ya que el rechazo de los progenitores ante la inmunización de sus hijos es un tema de gran actualidad con implicaciones también con respecto a su gradiente social.

En el Capítulo 5 se ha demostrado que algunas de las características que implican tener mala salud mental para la población, son un bajo nivel de educación e ingresos o el desempleo, entre otros. En este sentido, como posible futura línea de investigación, se podría comparar la situación actual de la salud mental en España con la que habrá en un futuro más cercano, por ejemplo, en 2022, cuando esté disponible la nueva ola de la Encuesta Nacional de Salud. De este modo, se podría observar si los patrones han cambiado con el devenir económico y social según distintas áreas geográficas. O bien, se podría igualmente extender mediante el uso de más encuestas y no sólo de microdatos de la Encuesta Nacional de Salud española. Asimismo, se podría analizar más en detalle el impacto de la Gran Recesión, ya sea en las diferentes regiones españolas o en varios países europeos.

Finalmente, el Capítulo 6 ha estudiado la relación existente entre la obesidad y los diferentes niveles socioeconómicos de la población española, basándose principalmente en los ingresos de sus hogares. Además, examina los determinantes de las desigualdades en obesidad, considerando diferentes características personales, socioeconómicas y de estilo de vida de la población. Y es que es cierto que la obesidad es un tema de salud de bastante importancia debido a su gravedad y al hecho de haber alcanzado incluso niveles epidémicos a nivel mundial. No obstante, hay otras enfermedades que también pueden ser clasificadas como tal. De este modo, resultaría de gran interés realizar un análisis similar, como futura línea de investigación, centrando el estudio en determinadas enfermedades crónicas, sedentarismo o trastornos de alimentación, entre otras. Por otro lado, como otra línea de investigación para estos próximos años, se podría considerar el estudio de patrones similares en otros países de la Unión Europea, haciendo especial hincapié en áreas desfavorecidas como se ha mencionado previamente.

En términos generales y pudiendo servir como referencia para todos los capítulos incluidos, se puede destacar que, como futura línea de investigación, sería interesante analizar un periodo de tiempo que comprenda la Gran Recesión pasados unos años, para comprobar qué efecto ha tenido la recuperación económica por parte de las familias, así como la reanudación del crecimiento económico para los diferentes países. También ser observaría hasta qué punto el "ascensor social" supone una transición hacia cotas distintas en términos de salud no solamente objetiva, sino también autopercibida (subjetiva).

Conclusions

This thesis concludes with the current section, where we have made a summary of some of the main contributions of each of the previous chapters. In addition, some possible future research lines derived from the different analysis carried out in these papers are also considered. These investigations could be an extension of all the chapters, always following the direction indicated by the field of Health Economics.

Results and main contributions

This thesis covers the study of health inequality among population from six different perspectives, more specifically, each one corresponding to the chapters considered here. It has been mainly analysed issues focused on health and other socio-economic factors. Special emphasis is placed on the effect that population characteristics, as socio-economic and lifestyle ones, have over their own health. It should be noted that most of these chapters are concentrated around the relationship between income and a variable associated with health such as childhood vaccination coverage rates, mental health and

obesity. Besides, the different papers are focused on both national and international level and, even, worldwide.

In the first chapter, a systematic literature review is made to know the current state of different topics which associated inequality, poverty and polarization with health. In other two chapters, a particular reference is made to self-assessment health inequality, focusing, on the one hand, on the existence of polarization across several European countries and, on the other hand, on health poverty in Spain. In addition, another chapter has analysed inequality in terms of vaccination coverage rates, according to income level in several countries around the world. The last two papers show how the economic and financial crisis has affected both mental health and obesity among Spanish population.

Therefore, this thesis provides the opportunity for analyse the effects of the economic crisis on population's health until 2015, 2016 or 2017, depending on the chapter considered. Thus, it is possible to show the impact of public policies established to relieve the negative effects during economic downturns. Likewise, the results obtained allow us to affirm the need to design new public health strategies or redesign and evaluate existing ones, which are aimed at alleviating health inequalities among population.

Inequalities considered in this thesis may be prevented because it can be relieved through public health as well as social policies. More specifically, it is necessary to establish some strategies to reduce inequalities, looking at health promotion and prevention.

It must be noted again that this thesis provides new empirical evidence on health inequalities from different points of view. In addition, it is shown the impact of economic crisis on several socio-economic and lifestyle factors. Therefore, to carry out these papers, we have needed different data sources such as PubMed, Cochrane Library and Web of

Science. Furthermore, we have used several databases and the following ones can be distinguished due to their data worldwide: the World Bank and the World Health Organization (WHO). Besides, the information available at the Spanish National Statistics Institute and Eurostat are considered to develop those chapters at national and international level, respectively. These two data sources present several health surveys, being three of them used in this thesis.

In addition, there have been limitations in terms of availability of data. Looking at the data sources considered to carry out the literature review, we have found limitations such as the period considered as well as the few articles that associated polarization and self-perceived health, among others.

On the one hand, according to the different health surveys analysed, either at national or international level, they cover a large number of population's health conditions. Nevertheless, respondents may not answer several questions considered in the survey and, as a consequence, we have "missing values" (missing information) in our sample. More specifically, this happens in the second wave (2011-2012) of the Spanish National Health Survey, looking at the question related to alcohol consumption. On the other hand, the findings need to be interpreted with caution because the information collected in this survey is subjective. In other words, individuals report their own perception of reality in terms of health status. However, in this case, self-perceived health status is considered as a good indicator due to it takes into account the absence of disease as well as the level of well-being of the population.

According to the World Bank and WHO, the limitation has been found when looking at the childhood vaccination coverage rates of several countries because they do not report these data to WHO. Therefore, the sample has been reduced, considering only

those countries that bring information about their immunization rates to WHO during the period considered from 2000 to 2016.

Thus, this research has been limited to the availability of data in terms of time as well as socio-economic characteristics. In some chapters, it has not been possible to carry out an annual and continuous analysis because several surveys only consider cross-sectional data.

Next, it is examined more in detail the main conclusions of each chapter described previously as well as their most relevant health policy implications.

In Chapter 1, we provide a systematic literature review of recent studies using PubMed, the Cochrane Library and Web of Science. In this article, we consider a retrospective horizon until October 2019 because we are focused on the most recent literature, which, in most topics, is characterized by a large number of papers. In particular, we review empirical studies analysing inequality, poverty and polarization, more specifically, when they are related to health because we are interested in the field of health economics. Nevertheless, we analyse those papers that associate these three topics with other social characteristics to improve this study.

Looking at the Chapter 2, we analyse the evolution of health inequality and polarization in two different periods (2006-2009 and 2013-2015) across 27 European countries, using data from the European Health Interview Survey (EHIS). The elaboration of this study implies being able to provide new empirical evidence on health polarization over the last years. More specifically, this paper contributes to the debate on the best way to explain health outcomes, which can be through inequality or polarization measures (Yao, Wan y Meng, 2019). The results obtained in this paper show the existence of self-assessed health status inequalities among population from several European countries.

When we compare both inequality and polarization indices, countries present the same ranking. Thus, we can affirm that countries with greater inequality level exhibit larger polarization degree. This chapter shows the need to develop and implement public policies to correct health inequalities. In addition, the unequal consequences generated by the Great Recession in health field should be limited as much as possible. It must be so with other areas such as labour market. In short, several social policies shall be redesigned because health inequality lead to the exclusion of the most disadvantaged and vulnerable groups.

Chapter 2 analyses health poverty trend measured throughout self-assessment health status among Spanish population. The phenomenon of health poverty has been considered through different approaches (Bhui, Warfa and Jones, 2014; Ellison and De Wet, 2016; Bosch *et al.*, 2019). In this paper, the study of the dynamics of health poverty is continuous from 2008 to 2016. The findings show a negative trend if we consider a poverty threshold such as "poor health". Meanwhile, the results present a positive growth path whether we examine a poverty threshold such as "fair health". Therefore, these findings may have significant implications for health policies in Spain, which is the geographical area analysed in this chapter. On the one hand, it is useful to reduce health inequalities, especially whether, as a consequence, social exclusion as well as poverty can be considerably reduced or eliminated. In addition, several changes in terms of equality in access and use of healthcare services are required, establishing on healthcare needs for different socio-economic groups. On the other hand, it would be appropriate to evaluate Spanish health trends to ensure the continuous attention of the whole population in times of economic and financial crisis as well as economic booms. A great effort should be also

made to guarantee the availability, use and quality of healthcare services, more specifically, according to most disadvantaged population.

In turn, Chapter 3 examines the relationship between per capita income and childhood vaccination coverage rates of eight vaccines included in the global immunization schedule, providing new empirical evidence across 135 countries around the world. The findings show that there is a positive and significant association between per capita income and immunization rates for most vaccines analysed. In addition, each country converges towards its own stationary state, which implies that each one behaves according to its own characteristics. Thus, the results described may have significant implications for health policies due to socio-economic status indicators have a notable impact on vaccination coverage rates. Improving immunization rates needs investments in both human and physical capital by governments. Nevertheless, it should be considered that this situation depends on the available resources in each country. Therefore, it is necessary to develop health policies set aside for reducing income inequality and achieving uniformly high immunization rates.

In the last two chapters, the results show the need to implement gender policies to reconcile and regulate the distribution of the income of economically more vulnerable families, as well as the provision of social services to help dependents.

Chapter 4 studies the impact of several factors on common mental health diseases before, during and after the Great Recession. More specifically, it is shown how the economic and financial crisis has affected mental health among Spanish population, following other research lines (Farré, Fasani and Mueller, 2018; Thomson, Niedzwiedz and Katikireddi, 2018). Our findings indicate that low income, low education level and being unemployed are determinants which increase the risk of poor mental health. In

addition, being separated or divorced, retired or being housekeeper are other factors associated with poor mental health. The results may have significant implications for health policies because some personal and socio-economic characteristics considered here have a significant effect on population's mental health. Therefore, it is necessary to implement policies aimed at improving mental health among vulnerable populations. This paper is focused on the Great Recession, but low income is not the only indicator of low living standards. Hence, according to the economic period (economic growth or economic recession), stronger or weaker measures in terms of mental health must be considered.

Chapter 5 shows the influence of different socio-economic levels on obesity, focusing mainly on the Equivalised Net Household Income. Besides, it examines some of the factors which produce obesity inequality among Spanish population. The results present that obesity prevalence is higher in lower socio-economic levels. In other words, obesity inequality is concentrated among poorest population in terms of income. Likewise, it has been shown that to some extent labour as well as lifestyle factors explain socio-economic inequalities in health. Our findings may have relevant implications for public and occupational health policies because several labour and lifestyle characteristics considered in our study imply a significant impact on obesity. This chapter focuses mainly on Equivalised Net Household Income, but other factors may affect obesity and some of them have been examined here.

Futures research lines

According to the different approaches as well as methodologies and databases which have been considered in the course of this thesis, the findings obtained from the five chapters

show a global vision about health inequality over the last years. More specifically, before, during and after the Great Recession. In addition, some future lines of research in the field of Health Economics arise from the contribution of this thesis. All future research lines are associated with well-being and inequality. Besides, they could be limited by the quality and availability of data.

Looking at Chapter 1, to better understand policy effects on health inequality, poverty and polarization, as a possible future research line, it could be included new literature as more papers are published over the years. Other new research lines could be the analysis of other health variables, different to self-perceived health status, such as life expectancy (adjusted life year, disability free) or mortality (infant mortality), among others.

Meanwhile, in Chapter 2, as a possible future research, we could investigate the decomposition of the different inequality and polarization measures by socio-economic, cultural and/or environmental conditions. Thus, it would be possible to observe the reasons why both, inequality and polarization, exist in Europe. In addition, it could be concluded which factors explain the changes in their disparity degree over time. In other words, it would be possible to identify whether these determinants directly affect, either positively or negatively, individuals' health. In this case, the analysis could be at a national or international level. Besides, another health variable provided by EHIS could be considered such as life expectancy or mortality, among others.

In Chapter 3, it should be noted that health is a complex issue as well as multidimensional. Thus, data provided by European Union Statistics on Income and Living Conditions (EU-SILC), which have been used in this paper, are quite extensive and they collect a large amount of information related to population's health in European

countries. Therefore, it provides a good base for cross-country comparison. In this case, the results obtained in terms of health poverty among Spanish population can be compared to other European countries. More specifically, this issue would be of special interest and relevance whether we consider Mediterranean countries such as Spain, Portugal, Italy and Greece due to these ones have been the most affected by the Great Recession.

Chapter 4 alludes mainly to childhood vaccination coverage rates of several vaccines in 135 countries around the world. In addition, these rates are associated with per capita income. As a future research line, we could include health expenditure of each country instead of per capita income. Thus, it may be possible to verify what contribution governments make in terms of vaccination. For this reason, we could add other variables that influence immunization coverage rates according to the countries classification by per capita income such as the price of the vaccines. As an alternative research line, some parental characteristics (religion or social stigma) could be taken into account to verify how they influence childhood vaccination coverage rates because rejection of parents to immunise their children is a highly topical theme of great importance.

In Chapter 5, certain characteristics that imply having poor mental health were considered. In other words, it has been shown that some factors which negatively affect population's mental health are low income, low education level or unemployment, among others. As a possible future line of research, we would require new data in following years to show if something has changed across the time, for example, in 2022, when the next wave of the Spanish National Health Survey will be available. Therefore, we could see whether mental health patterns have changed. This research could be extended through the use of other surveys. In addition, a future research line could be needed to analyse

more in detail the impact of Great Recession either in the different Spanish regions or in several European countries.

Finally, Chapter 6 has examined the relationship between obesity and different socio-economic levels among Spanish population, based mainly on per capita households' income. In addition, it studies several determinants of obesity inequality, considering different personal, socio-economic and lifestyle characteristics. Currently, obesity is a very important health issue due to its severity. Nevertheless, there are other diseases which can be classified in the same way. Thus, it would be of great interest to perform a future research focusing on certain chronic diseases, sedentary lifestyle or eating disorders, among others. Furthermore, as an alternative line of future research could be the study of similar patterns in other European countries, focused on deprived or disadvantaged areas as we mentioned previously.

In general, for all the chapters considered in this thesis, it would be interesting to analyse a period which would cover the effects of the whole economic crisis. In other words, a future line of research could be the study of the Great Recession after a few years, to show the effect the economic recovery has had. Therefore, it could be shown the impact that it will present on households as well as on the economic growth in many countries.

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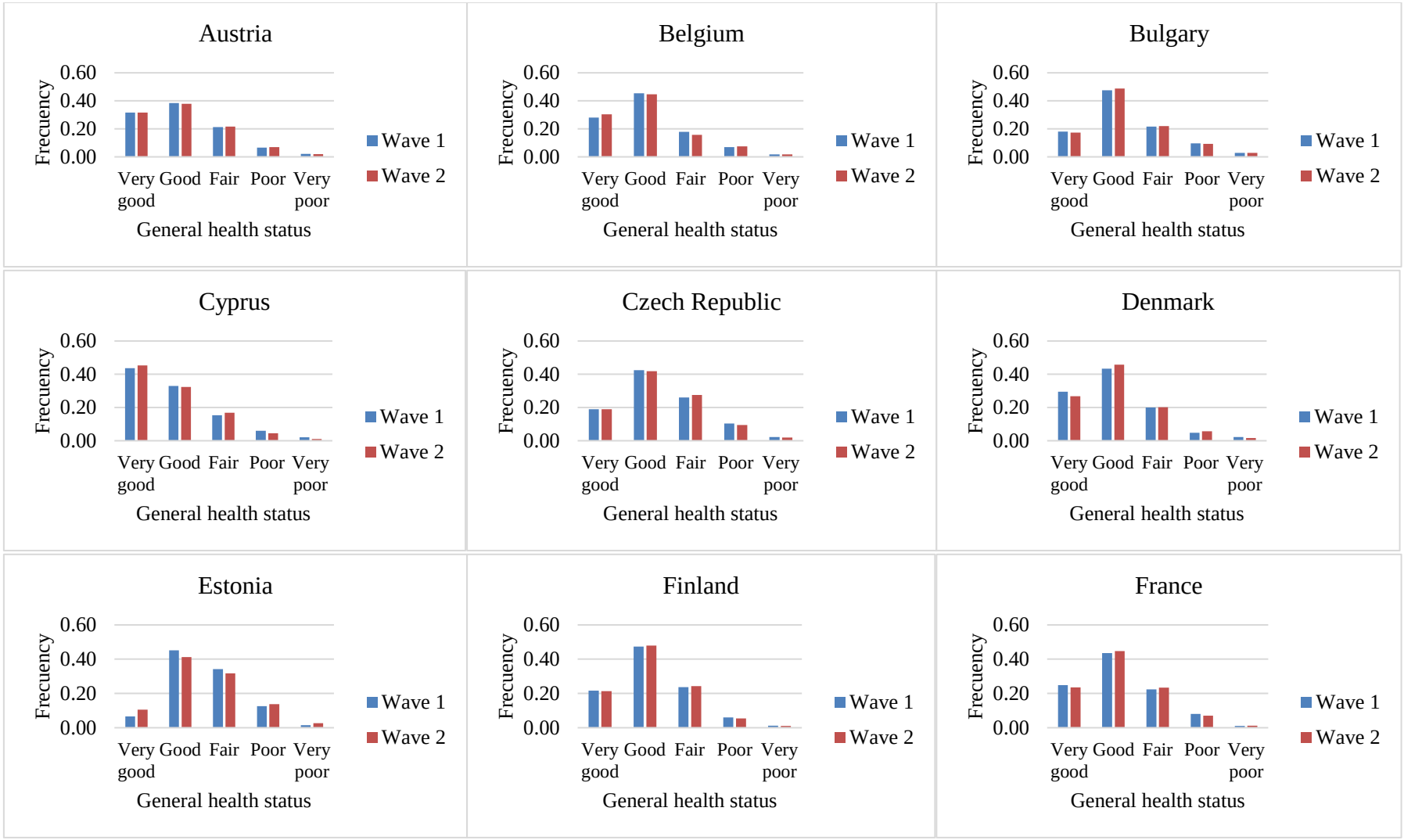
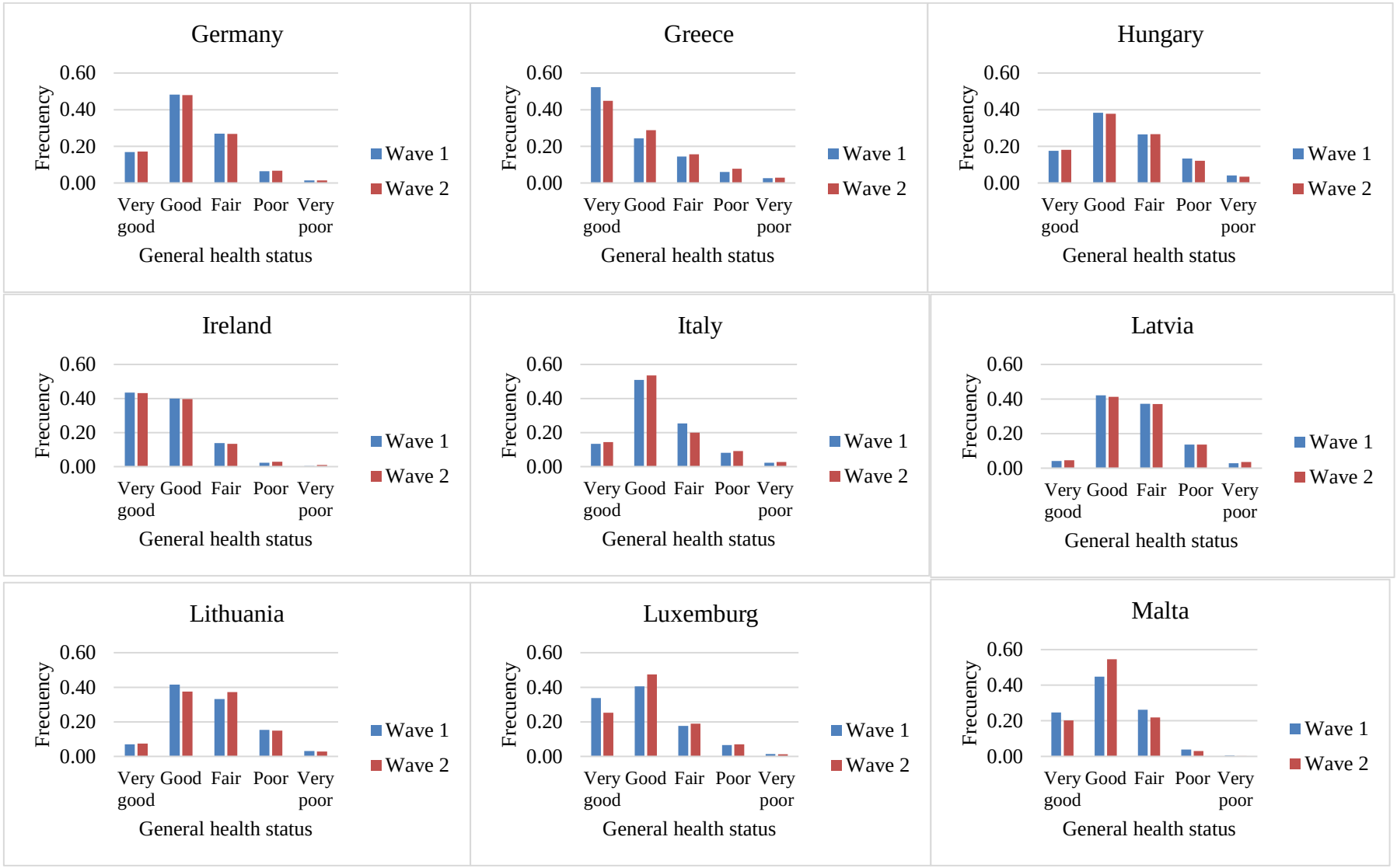
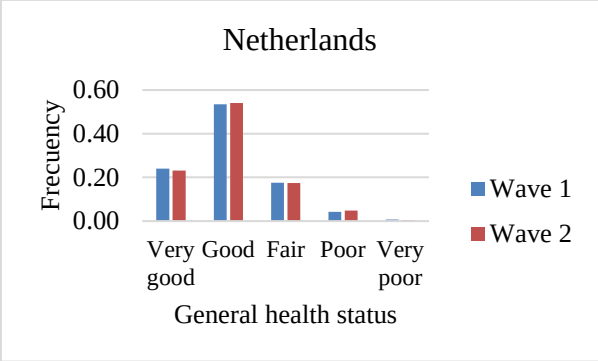
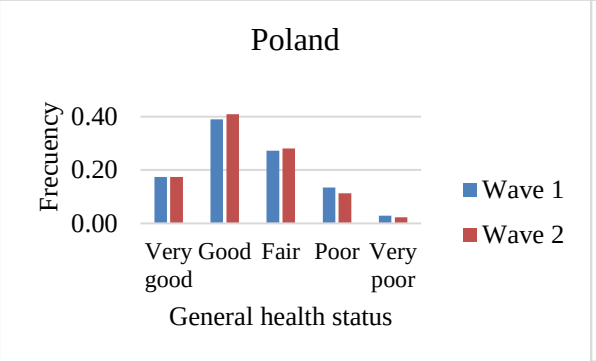
Appendix

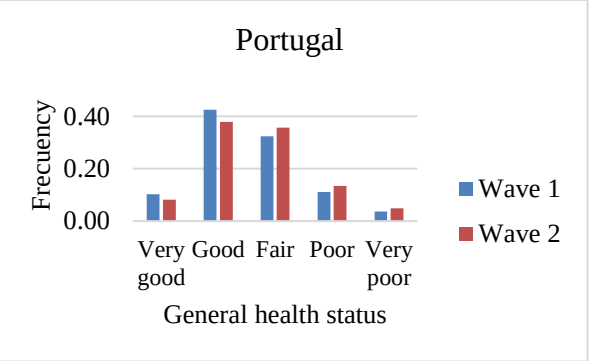
Figure A2.1. Cumulative absolute frequencies of self-assessed health by country and year

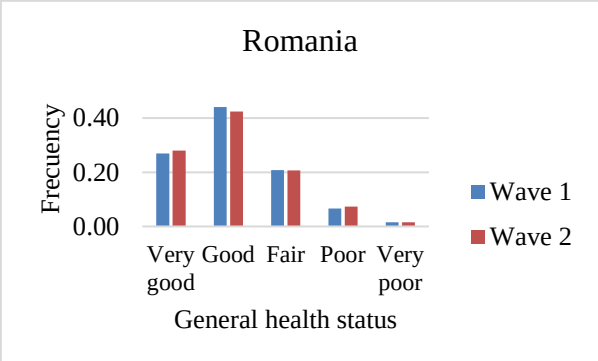


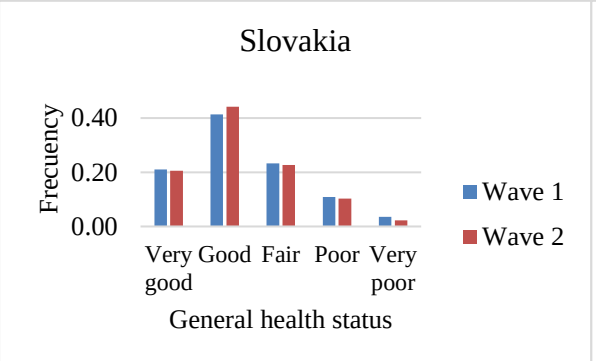

Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxemburg
Malta
Frecuency
0.60
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2

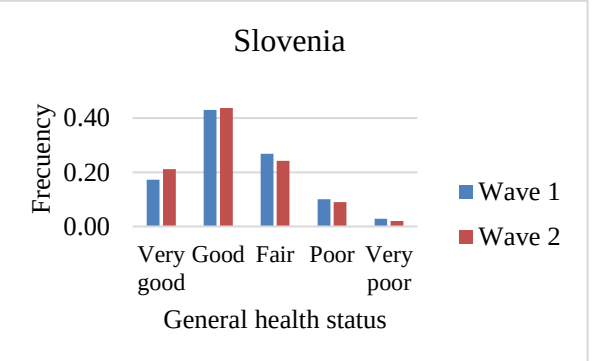

Netherlands
Frecuency
0.60
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2

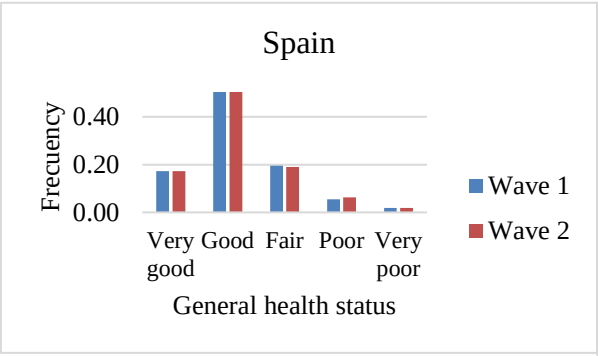

Poland
Frecuency
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2

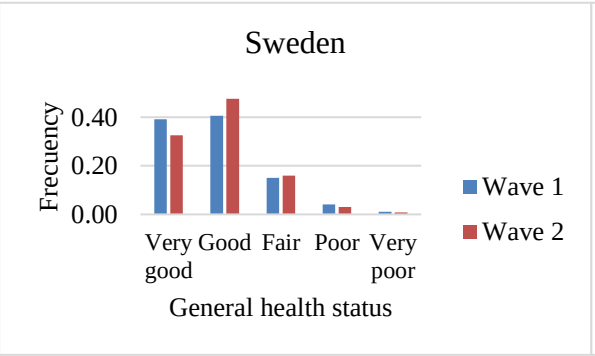

Portugal
Frecuency
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2


Romania
Frecuency
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2


Slovakia
Frecuency
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2


Slovenia
Frecuency
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2


Spain
Frecuency
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2


Sweden
Frecuency
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2

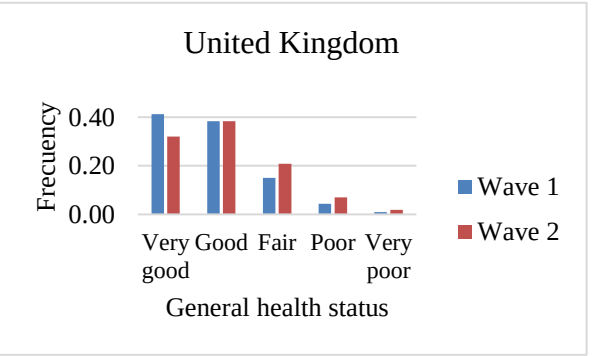

United Kingdom
Frecuency
0.40
0.20
0.00
Very good
Good
Fair
Poor
Very poor
General health status
Wave 1
Wave 2

Table A4.1. Countries classification by per capita income (2017)

LOW INCOME			
Benin	Ethiopia	Malawi	Senegal
Burkina Faso	Gambia, The	Mali	Sierra Leone
Burundi	Guinea	Mozambique	Tanzania
Central African Republic	Haiti	Nepal	Togo
Comoros	Liberia	Niger	Uganda
Congo, Dem. Rep.	Madagascar	Rwanda	Zimbabwe
LOWER-MIDDLE INCOME			
Angola	Egypt, Arab Rep.	Kyrgyz Republic	Philippines
Armenia	El Salvador	Lao PDR	Sri Lanka
Bangladesh	Georgia	Lesotho	Sudan
Bhutan	Ghana	Mauritania	Swaziland
Bolivia	Guatemala	Moldova	Tajikistan
Cabo Verde	Honduras	Mongolia	Tunisia
Cambodia	Indonesia	Morocco	Uzbekistan
Cameroon	Jordan	Nicaragua	Vietnam
Congo, Rep.	Kenya	Pakistan	Yemen, Rep.
Cote d'Ivoire	Kiribati	Papua New Guinea	
UPPER-MIDDLE INCOME			
Albania	Costa Rica	Kazakhstan	Russian Federation
Algeria	Croatia	Lebanon	Serbia
Argentina	Dominican Republic	Macedonia, FYR	South Africa
Azerbaijan	Ecuador	Malaysia	St. Lucia
Belarus	Equatorial Guinea	Mexico	St. Vincent and the Grenadines
Belize	Gabon	Namibia	Suriname
Botswana	Grenada	Panama	Thailand
Brazil	Guyana	Paraguay	Tonga
Bulgaria	Iran, Islamic Rep.	Peru	Turkey
China	Jamaica	Romania	Turkmenistan
Colombia			
HIGH INCOME			
Antigua and Barbuda	Estonia	Lithuania	Spain
Australia	Germany	Malta	Sweden
Bahamas, The	Hungary	Netherlands	Switzerland
Barbados	Ireland	Norway	Trinidad and Tobago
Belgium	Israel	Poland	United Kingdom
Brunei Darussalam	Japan	Saudi Arabia	United States
Chile	Korea, Rep.	Slovak Republic	Uruguay
Czech Republic	Latvia	Slovenia	

Source: World Bank (2017).