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Pregnancy and birth cohorts in Europe: An overview

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Abstract

A birth cohort study is a form of study that uses expectant mothers and their subsequent newborns as research participants. Data is collected in order to identify health consequences and overall health outcomes of environment and lifestyle on pregnancy and childbirth. The main aim of this paper is to review and summarize all cohort studies that have been carried out or are still being conducted in Europe in last 80 years, as well as general information such as aim of the study, number of participants and duration of follow-up. Gathering information was made easier by websites such as Birthcohorts, CHICOS and LifeCycle, where many of the cohorts and their sources are listed. The remaining data was found by searching Google Scholar, PubMed and similar webpages, using keywords 'birth and pregnancy cohorts', 'infants', 'pregnancies', 'allergies' and 'childhood obesity'. Overall, 137 cohorts in 27 countries were found. Cohort studies are an efficient method for assessing cause and effect. The focus is on the general health and well-being of mothers and children and as such provides a good approach to establishing a link between risk factors and outcomes. In epidemiological research, especially those concerning some of the biggest problems of the 21st century, such as obesity, type II diabetes and coronary heart disease, cohort studies make a valuable contribution. In last 80 years the number of studies has been increasing and with it the number of new insights. Collaboration between different birth cohorts is crucial for further harmonization of collected data and their use in the public health systems worldwide.

Introduction

Recently, it has become increasingly apparent that new and modern lifestyles have considerably greater adverse and long-term health effects that it has been perceived previously. Health issues such as metabolic diseases, mental health, and respiratory system diseases and alike, which in most cases are preventable, are becoming more common due to the sedentary lifestyle, unhealthy dietary patterns, polluted environment and everyday stress. Although many studies investigate the causes and consequences of these problems, in recent decades the prevailing research models have become cohorts. Such studies have a sample that represents a specific segment of the population (share the same characteristics such as age, gender, place of residence etc.) as a study subject and they can be prospective and retrospective. Prospective studies look for outcomes of certain exposures, whereas retrospective studies look backwards comparing two groups of people, one under a certain exposure and the other unexposed. Birth cohort studies are especially suitable study methods for understanding the influence of the environment in which a child develops during pregnancy, on its development later in life and its overall health. The main advantage is that there are no limits to follow-ups and health outcomes can be monitored until adulthood or even further in life (Brandstetter et al., 2019). In addition, because of the large difference between children in different regions, even within the same country, a general approach is an excellent tool for

comprehensive research. Possible adverse outcomes of pregnancy are very important to identify early on in order to prevent them in the future or in other risk groups. In that way, many public health issues can be monitored and prevented. Most of European populations have a problem with low birth rates and an ageing population and it is becoming an increasing burden for the social and health systems. Childhood is the best period for action because it is the most effective time to promote good health and healthy life choices, which can then also be passed on to next generations (Golding, 2006; Larsen et al., 2013).

The number of cohort studies in Europe has been growing in the last 80 years. Generally, they start in the prenatal period and end after birth with one or several follow-ups of children. Although extremely useful, this research model is time and money consuming. Therefore, collaboration and data sharing between study groups is expected. The aim of this paper is to list all cohort studies of pregnancy and birth that have taken place in Europe, as well as to offer a general overview. Data shared between cohorts can reduce time and resources needed for the studies. The strength in drawing conclusions and causal effects on a larger number of participants is also one of the advantages of collaboration and data sharing. Not only that, the challenges and obstacles in individual research can provide useful information for improving future research models. (Larsen et al., 2013).

Materials and methods

Pregnancy and birth cohorts' data was collected from multiple sources. Online databases such as PubMed and Google Scholar were inspected, as well as Google with keywords 'birth cohort', 'pregnancy cohort', 'newborns', 'pregnancies', 'childhood asthma', 'childhood obesity', 'illness in early childhood', 'epidemiological study of newborns'. Pages https://www.birthcohorts.net/, http://chicosproject.eu/ and https://lifecycle-project.eu/ were reviewed. Birthcohorts.net is a database that collects information about birth cohorts worldwide. It was established to enable easier access to data and study designs and to promote collaboration between distinct study groups. Cohorts in this database have at least one year of follow-up, have been established before/during pregnancy or at birth and have at least 300 mother-child pairs (Birthcohorts, 2021). 'CHICOS: Developing a Child Cohort Research Strategy for Europe' is a project funded by the European Union's 7th Framework Programme for Research and Technological Development. The aim of CHICOS is to improve child health by evaluating existing data about mother-child cohorts, determining gaps in research and focusing on future studies (CHICOS project, 2021). The 'EU Child Cohort Network: A Europe-wide network of cohort studies started in early life' has been developed to bring together cohort studies in Europe. Its overall aim is to determine the effect of early-life environment and possible stressors on developing health problems later in life (LifeCycle, 2021). Each of the mentioned databases and articles is created according to certain own criteria. This review brings together data from databases and articles, with the intent of harmonizing and making data more accessible.

Inclusion criteria for cohorts were that the study population was based in Europe and that the subjects of studies were pregnant women and subsequently their children, or that newborns were included in the study. There was no time or size limit on found cohorts. Therefore, only studies that have an extended period of observation and continuity were taken into consideration due to the fact that it was sometimes hard to separate what is a continuous study and what is a one-time study of one cohort. Europe as inclusion criteria imply countries that are part of the continent using defined natural borders.

The majority of data and information on subjects was found on the Birthcohorts website, where the researchers submit information themselves. For other studies, official websites of research groups and their published articles were reviewed. Data collected from websites and articles comprise the name of the cohort, its country of origin, main aim, number of subjects in the cohort, other family members included in the study and duration of the follow-up period with parents and child.

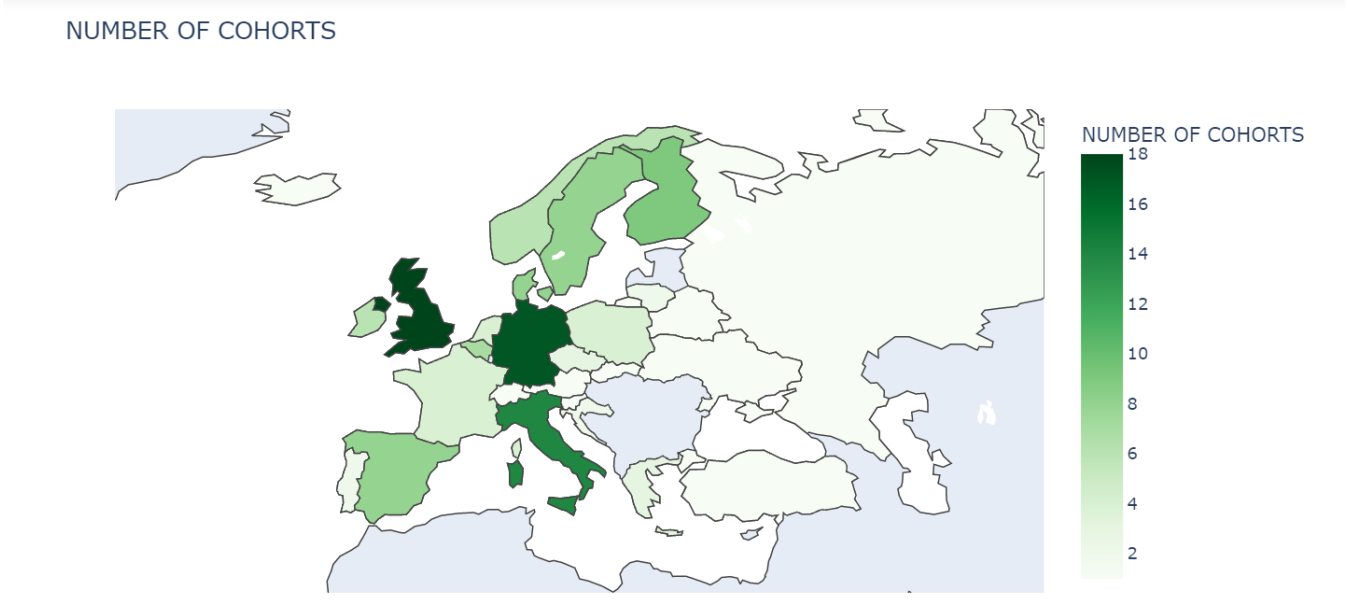

Figure 1.: Number of cohorts per country

Results and discussion

As expected, the most developed European countries have the largest and most extensive studies. Of all the cohorts, more than half (n = 113) are in the countries of Northwest and Central Europe. Italy, Germany and the United Kingdom have the greatest number of cohorts and the most diverse studies (Figure 1.). 127 studies consisting of 137 cohorts spread out in 27 countries were found (Table 1, at the end of the paper). 29 cohorts are a part of bigger consortium, where cohort studies are being conducted simultaneously in several partner countries (AMICS, ELSPAC, EuroPrevall study, CHOPIN, PHIME, SPACE studies). CHOPIN has cohorts in Belgium, Germany, Italy, Poland and Spain and is concentrated on early life nutrition and its possible influence on obesity later in life (Koletzko et al., 2009). PHIME focuses on early life nutrition but aims to investigate the level of heavy metals in blood and breast milk accumulated through the nutrition. Cohorts are in Croatia, Greece, Italy and Slovenia (Miklavčič et al., 2013). Both SPACE and AMICS are focused on the development of asthma and atopy in childhood. AMICS has two cohorts in Spain, and one in Germany and the United Kingdom (Fríguls et al., 2009; Iliadou et al., 2019). The EuroPrevall study is also investigating allergy but from a nutritional aspect. In addition, data related to the cost of food allergies and quality of life was also obtained. The study was conducted in the following countries: Germany, Greece, Iceland, Italy, Lithuania, the Netherlands, Poland, Spain and the United Kingdom. To improve epidemiological knowledge of factors influencing children's health in European countries, WHO started ELSPAC. ELSPAC consists of four studies: ALSPAC in the UK, FCOU in Ukraine, one on the Island of Man and one in the Czech Republic. Other cohorts collected data in Slovakia and the Russian Federation but encountered political and financial problems, while Greece and Estonia stopped collecting data because of the lack of funds (WHO, 1997, 1998, 1999).

The most common method of collecting data is via questionnaires. Interviews and educational assessments are used later in the child's life. Information includes the socio-demographic status of parents, their lifestyle and environmental exposures, as well as mother's pregnancy characteristics, depending on the main aim of the study. Most common participants are mother-child pairs. Half of them included fathers as well, but only a few included siblings, grandparents or other family members. Their inclusion is often associated with the main goal of a study, for example in allergies and atopic diseases

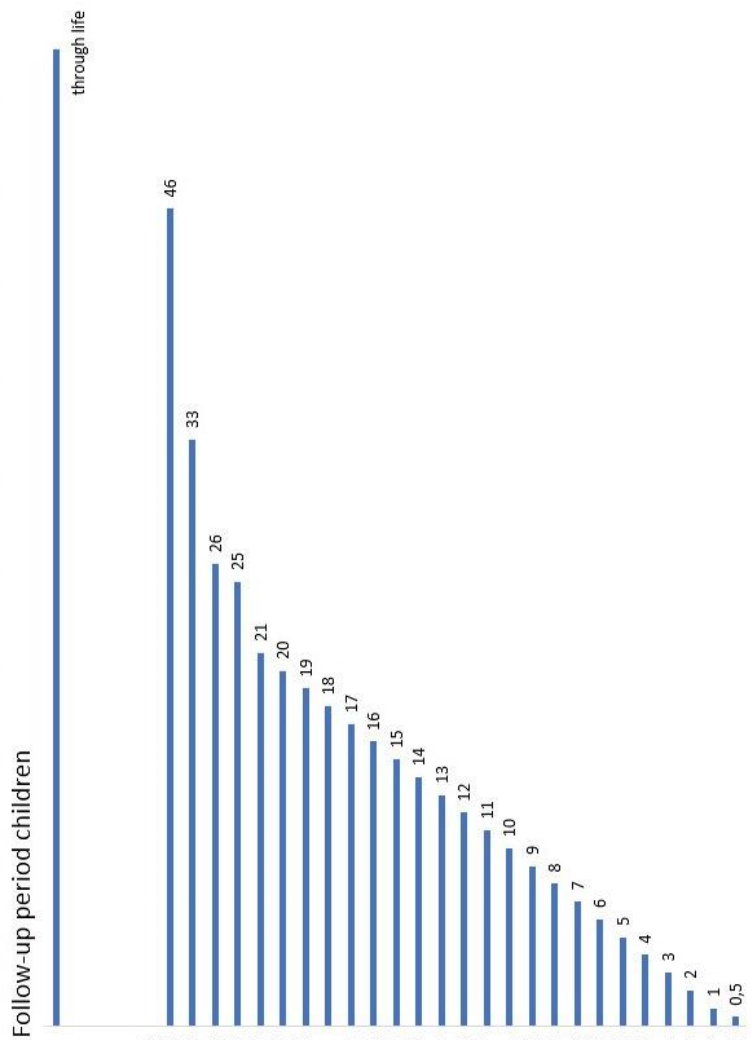

Figure 2.: Follow-up period children

research, family medical history and current living conditions are useful information for the evaluation of infants' health.

Most of the cohorts have specific enrolment criteria, such as mothers over 18 years of age that are native language speakers (for the comprehension of study procedures), healthy mothers without a history of chronic diseases, singleton pregnancy etc. If a study has a specific aim, the inclusion and exclusion criteria are formed accordingly. Examples include MUBICOS in Italy, a cohort study that researches only twins so their inclusion criteria are only twin pregnancies (Brescianini et al., 2013, 2016). When investigating allergies, cohorts

Figure 3.: Follow up period parents

like SPACE have their own inclusion criteria such as the parent's medical history of respiratory diseases or parental IgE results or for children, a manifestation of atopic diseases (Tsitoura et al., 2002). The most common criteria are still healthy mothers living in a specific area in which the study is taking place. For most of the studies, the enrolment period begins at pregnancy and follow-up continues at least a couple of years after birth (Figure 2.). Enrolment usually starts with the pregnancy or after the birth of a child (Figure 3.). Only a few studies differ, including the Southampton Women's Survey. In the survey, the parental data is collected before the pregnancy so that their associations to perinatal and infant outcomes can be evaluated (Inskip et al., 2006). In addition, the UppSTART study from Sweden recruits couples undergoing assisted reproductive techniques to determine if parental lifestyle has an influence on conception, pregnancy or assisted reproduction procedure-specific outcomes. UppSTART also investigates possible epigenetic alterations in infants conceived via assisted reproductive techniques, compared with infants conceived spontaneously (Iliadou et al., 2019). The Swedish BASIC study follows women's experiences during and after pregnancy. in order to offer timely and appropriate help to women who feel unwell. Biosamples from both mother and child are also collected for further analyses (BASIC, 2021).

Factors that have an influence on general health and the wellbeing of mother-infant pairs are cited as the main goal in almost half of the studies (n=61) (Figure 4.). The objective is generally to describe and understand how lifestyles, environment, education and other socio-economic factors affect the course of pregnancy and childbirth. The child's development and growth are examined later on. The respiratory system and its development, diseases and risk factors for their occurrence are among the most researched subjects. It has been noted that several factors have an impact on the development of childhood asthma. Besides genetic factors, environmental influence also has an important role in the etiology of a disease, the most prominent one being socio-economic status and housing. Blood samples, which are used for detecting the level of IgE, family history of atopic diseases, number of siblings or people in the household, parental education and indoor pollution (types of heating, pets, mold etc.), are correlated to the allergies of young children (Bisgaard, 2004; de Korte-de Boer et al., 2015; Martindale et al., 2005). Most of the cohorts that investigate atopic

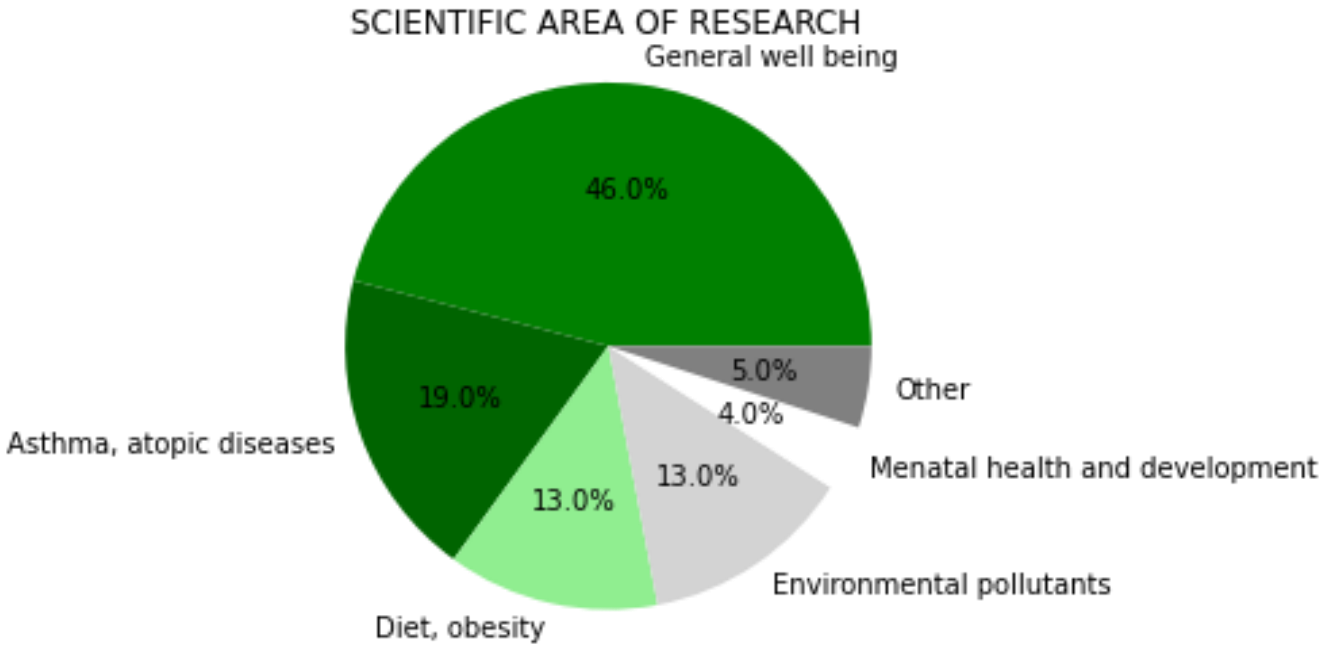

Figure 4.: Scientific area of research

diseases and allergies have the same pattern regarding cohort size due to the fact that children with a family history of atopic diseases have a larger risk for developing the same. It is for this reason that cohorts usually include other family members such as the Russian Moscow newborns 2011 eczema study. This cohort included both parents, grandparents, siblings and all first relatives. Data collected includes allergy manifestation to determine if there is gender or some other pattern of incidence of atopic diseases in newborns whose family has a history of such diseases (Treneva et al., 2015). Another major health concern is obesity whose percentage in the population is growing each year. That is why metabolic diseases, such as diabetes and metabolic syndrome, as well as nutrition and gut microbiome are very often part of a cohort's research. Many studies investigate different aspects of nutrition and diet-related issues. HELMI study focuses on factors that modify intestinal microbiome in infants and its relation to its health and well-being. This subject is becoming increasingly popular as there is more and more evidence of gut microbiome having potential long-term consequences on health in individuals (HELMi, 2019). CRIBS is focused on biological, environmental and behavioral risk factors for metabolic syndrome and study results serve as a base for the development of intervention strategies (Havaš Auguštin et al., 2020; Zajc Petranović et al., 2018). In addition to nutrition and allergies, studies concerning exposure to chemicals, pollutants and tobacco smoke have been investigated with a similar frequency. Environmental pollutants can have an immense impact on children's health, especially on development during the gestation period. Chemicals such as organochlorines, polycyclic aromatic hydrocarbons (PAHs), dioxins and heavy metals have an adverse effect on neurological development and the immune system. These pollutants are known to accumulate in marine food chains and are closely monitored in populations where the diet is based on seafood, namely the Mediterranean countries and the Faroe Islands. Both PHIME and CHEF research long-term, low-level environmental exposure to toxic and essential metals via food. CHEF also focuses on the health of children and adults with an emphasis on the impact of a seafood diet and on marine contaminants (Miklavčič et al., 2013). Particulate matter (PM) is measured as an air pollutant since it covers all liquid and solid particles suspended in the air. Dust, pollen, smoke, soot and liquid drops are all considered PM and are highly concentrated in industrial areas and heavy traffic areas. The Portuguese GISA study is a retrospective cohort study, which tries to assess the relationship between air pollution and low birth weight and preterm birth outcomes. Similarly, in the Czech Republic, PM in air was measured in a highly industrial region and its impact on the retardation of fetal growth was examined. Results were compared to those of a mountain region, without pollution (Dejmek et al., 2000). Problems concerning mental health and neurological development have also been analyzed and several studies focus only on this topic. CCCC 2000 investigates mental health problems and associated factors in infancy and their association with psychopathology in later childhood, as well as possibilities of intervention from infancy onwards (Skovgaard et al., 2005). FinnBrain investigates the effects of prenatal and early life stress exposure on child health and brain development. It has primarily neurodevelopmental focus and aims at identifying biomarkers related to early life and prenatal stress exposures as well as trajectories for common psychiatric and somatic illnesses such as depression, anxiety and cardiovascular illnesses (Karlsson et al., 2018). Very often all of the above-mentioned problems are interconnected, for instance many studies that investigate atopic diseases consider environmental pollution or nutrition as factors that could cause problems with the respiratory system. The GINI study investigates whether the development of allergic diseases can be influenced by early childhood nutrition (von Berg et al., 2003). Breastfeeding and dietary habits, including organic food and a vegetarian diet, are also mentioned in the KOALA birth cohort study which tries to identify factors that influence the clinical expression of atopic disease (Kummeling et al., 2005). The Swedish ALADDIN study also has a unique view on the allergy development in childhood. The population in this study practices anthroposophical lifestyle which is characterized by organic diet, home deliveries, restricted use of medicines and alike (Stenius et al., 2011). Besides metabolic syndrome, the CRIBS study also focused on psychological health and quality of life

of pregnant women (Delale et al., 2021), while the Kraków Cohort tries to connect all three key problems, nutrition during pregnancy, exposure to environmental pollutants and the manifestation of eczema in children (Jedrychowski et al., 2003).

In addition to regular cohort studies, fertility studies, biobanks, and prevention programs were also included in this review. Each collects a sizable amount of data, but only several cover a broader variety of research subjects. BabyCare in Germany is a program to prevent preterm birth with an extensive database which is used for follow-up surveys (Kirschner & Friese, 2012). Nascere in Friuli Venezia Giulia is not an official cohort study, but data routinely collected by the Regional Health Authority and is used for studies such as asthma, allergies, diet during pregnancy and mercury levels (Pitter et al., 2016). Some birth cohorts are a part of bigger cohort groups who include people of different age. Lifelines in the Netherlands is a large, multigenerational cohort study that has been on-going for 30 years, over three different generations and has over 167,000 participants (Lifelines, 2021). Likewise, Swedish LifeGene is both a cohort study and a database consisting of whole families of different age groups. The project offers an opportunity to involve couples prior to and during pregnancy, meaning children that are going to be born into the cohort are going to have complete pre- and perinatal data from both the mother and father (Almqvist et al., 2011).

Although pregnancy and birth cohorts are usually established to detect future outcomes, there are few that use older data and records for retrospective research. The Helsinki Birth Cohort Study includes people who were born 80 years ago. Old medical records are used to compare childhood data to health outcomes in old age such as coronary diseases, cancer and mental health (Maelstrom Research, 2021). The Newcastle 1000 Families started as a study of health in newborns, continuing over a few decades and now researches the health of its original newborns in their 70s. Similarly, PLASTICITY follows the lives of children born from 1971 to 1974 and aims to explore how the neonatal risk factors modulate neurodevelopmental and neurodegenerative processes such as learning disabilities, ADHD, ageing, the early onset mild cognitive impairment, dementia and like. It is believed that perinatal adverse events have an unexpectedly deleterious effect on the brain at a middle and older age (Hokkanen et al., 2013). These cohort studies are excellent for determining long-term consequences on health, but its problem is tracking down all of the participants after such a lengthy period (Thousand Families, 2009).

Most common restrictions and limitations in cohort studies are time-consuming methods and results which depend on the honesty of the participants and their willingness to respond to follow-ups. The number of children decreases with each follow-up in every cohort, which can alter results and make comparisons difficult. In addition, collecting biosamples is a challenging and demanding process, which must be specifically coordinated and conducted according to strict ethical guidelines. Nonetheless, study design of the birth cohort studies is suitable for estimating an association between risk factors during prenatal period and the possible health problems in newborns, potentially up to adulthood. New insights from these studies can be implemented in health interventions or used in specific medical cases. The biggest advantage is the wide range of information collected such as psychosocial, genetic and epigenetic, as well as exposure data. Problems arising from having such multitude of information is harmonizing data over multiple studies because each have their own methods. On the other hand, having a variety of methods can be advantageous in estimating which one is most suitable for different field of interest. There is also a discrepancy in number and multitude of cohorts between progressive countries from Northwest and rest of the Europe. While some of the countries are just beginning their research, the UK, Denmark and Germany, to name a few, have been doing researches for many years, some even decades. In such cases, collaboration and shared knowledge are useful to avoid problems that others have already encountered and to establish a good study design that will provide solid data that can be shared later without harmonization problems.

Conclusion

The main aim of this paper is to review and summarize all cohort studies that have been carried out or are still being conducted in Europe. More than 137 cohorts have been found in 27 countries. Exact number of studies is 127 due to the number of them had been or are being conducted internationally, meaning that they collect information from multiple cohorts in different European countries. General concern is well being of mother and child pairs. Numerous cohorts are trying to resolve common health problems in childhood, main being respiratory diseases. Occurrence of allergy in infants has been connected to family history of atopic diseases, number of siblings or people in the household, parental education and indoor pollution. New problem arising in recent years is obesity. Many cohorts are researching connections of pre and postnatal exposures that may have influence on obesity later in life. Mother's BMI and eating habits during pregnancy, smoking and socioeconomic status are implied to have an impact on child's weight later in life. Another problem that has arisen with modern lifestyle is pollution. Connection between PM and retardation of fetal growth have been made. Chemical pollution also has great impact on health, showing that they can alter neural development. Many studies have combined all of these problems and are trying to find connection between obesity, childhood respiratory problems and environmental pollution from the early age. It is known that obesity is a risk factor for asthma and that obese asthmatics have more severe symptoms, as well as polluted environment, indoors and outdoors, having impact on respiratory system and general health. However, early indications for these connections are still not well understood and therefore relevant research subject. Such problems are an excellent example of the benefits of cohort study design and collaboration among research groups. Birth cohorts are an important source of information, excellent for comparing regional differences between cohorts, discovering impacts on people's health and causes of diseases. Collaboration between different birth cohorts is crucial for further harmonization of collected data and their use in the public health systems worldwide for prevention and education.

Acknowledgements

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

The authors have no conflicts of interest to declare.

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Table 1. Pregnancy and birth cohorts in Europe and their characteristics. All data are participants on the baseline. Source: website birtcohorts.eu and stated references.

Country	Birth cohort name	Abbreviation	Participants				Scientific area
			Children	Mothers	Fathers	Other family members	
Austria	Study on the Prevention of Allergy in Children in Europe – Vienna (Halmerbauer et al., 2003)	SPACE- Vienna	4,309				Atopic disease
Belarus	The Promotion of Breastfeeding Intervention Trial (Patel et al., 2014)	PROBIT	17,046	17,046	17,046	+siblings	Breastfeeding
Belgium	Childhood Obesity - Early Programming by Infant Nutrition(Koletzko et al., 2009)	CHOPIN- Belgium	255	255	255		Childhood obesity
	FLemish Environment and Health Study I-VI (Birthcohorts, 2021; Schoeters et al., 2017)	FLEHS I	1,196	1,196			Determinants of exposure
		FLEHS II	255	255			
		FLEHS III	281	281			
		FLEHS IV **					
	Perinatal factors on the Occurrence of asthma and allergies (Hagendorens et al., 2005; Oostveen et al., 2010)	PIPO	1,128	1,128			Asthma
	3xG study (Gezondheid, Gemeenten, Geboorten) (3xg studie, 2021; Birthcohorts, 2021)	3xG study	301	301			Environmental pollutants and health outcomes
Croatia	Croatian Islands Birth Cohort Study (Birthcohorts, 2021; Sarac et al., 2019; Zajc Petranović et al., 2018)	CRIBS	500	500			Metabolic Syndrome
	Public health impact of long-term, low-level mixed-element exposure in susceptible population strata: Mediterranean Cohort- Croatia(Miklavčič et al., 2013)	PHIME- Croatia	234	234			health risk-assessment of long-term, low-level environmental exposure to toxic and essential metals
Czechia	Central European Longitudinal Studies of Parents and Children: The Next Generation	CELSPAC: TNG**	500	500			Pregnancy, childbirth and its development
	Czech Early Childhood Health (Birthcohorts, 2021; Dejmek et al., 2000)	CZECH	7,577	7,522			c-PAHs and fine particles and intrauterine growth
	European Longitudinal Study of Pregnancy and Childhood	Czech ELSPAC	7,589	5,151	4,653		Epidemiological factors influencing children's health
Denmark	Aarhus Birth Cohort (Birthcohorts, 2021; Mortensen et al., 2013)	ABC	100,000	100,000			Data resource for research; various aspects of pregnancy, birth, and neonatal care
	Copenhagen Child Cohort 2000 (Birthcohorts, 2021; Skovgaard et al., 2005)	CCC2000	6,090	6,090			Mental health problems
	Copenhagen Prospective Studies on Asthma in Childhood (Bisgaard, 2004; Bisgaard et al., 2013)	COPSAC2000	411	394	385		Atopic diseases
		COPSAC2010	743	733	733		Chronic inflammatory diseases (asthma, etc.)

	The Danish Allergy Research Centre cohort (Birthcohorts, 2021; Christiansen et al., 2017)	DARC	562				allergic diseases
	Danish National Birth Cohort	DNBC	95,000	100,418			Exposures in early life
	Healthy Habits for two	HHf2	11,144	11,980	11,500		Risk behaviours and their impact (campaign)
	Odense Child Cohort (Birthcohorts, 2021; Odense Child Cohort, 2021)	OCC	2,553	2,874	2,693		Determinants for health and disease
Faroe Islands	Children's Health and the Environment in the Faroes	CHEF 1	1,022	1,022			Exposure to environmental chemicals
		CHEF 3	656	656			
		CHEF 5	491	491	282		
Finland	FinnBrain Birth Cohort Study (Birthcohorts, 2021; Karlsson et al., 2018)	FinnBrain	4,040	4,011	2,800		Stress exposures on child (brain) development
	Health and Early Microbiota	HELMi	1,055	1,063	1,039		Intestinal microbiota development
	Helsinki Birth Cohort Study (Eriksson, 2006; Helsinki Birth Cohort Study, 2021)	HBCS	13,345				Health influences of early growth
	Kuopio Birth Cohort	KuBiCo	4,700	4,700			Multiple factors and health and disease
	LUKAS		442	442	418		Exposures and respiratory symptoms and development of the immune system
	The Northern Finland Birth Cohort Studies (NFBC, 2021)	NFBC 1966	12,231	12,055			Genetic, biological, social or behavioral risk factors for diseases
		NFBC 1986	9,479	9,362			
	Perinatal Adverse events and Special Trends in Cognitive TrajectorY	PLASTICITY	22,359				Perinatal adverse events and brain at middle and older age
	Steps to the Healthy Development and Well-being of Children	STEPS	1,827	1,797	1,658		Problems in child health and well-being
France	Endocrine disruptors: Longitudinal study on pregnancy abnormalities, infertility, and childhood	PÉLAGIE	4,000	4,000			Chemical exposure and defects and diseases
	Etude Longitudinale Francaise depuis l'Enfance	ELFE	20,000				Early life exposures and their outcomes
	Pollution and Asthma Risk: An Infant Study	PARIS	3,840	3,840			Respiratory and allergic symptoms and behavioural/environmental factors
	Study on the pre and early postnatal determinants of child health and development	EDEN	1,900	2,000	1,800		Pre- and post-natal determinant of the development and health
Germany	Asthma Multicentre Infants Cohort Study- Perinatal Asthma and Environment Longterm Allergy Study(Illi et al., 2014)	AMICS- PAULA	526	513			Asthma and atopy

	Baby Care Cohort (Kirschner & Friese, 2012)	Baby Care	12,555	12,555			Program for the prevention of preterm birth
	Berlin Pregnancy Cohort	BPC	623	978			Pregnancies at risk and allergy risk
	Bielefeld Birth cohort study (Spallek et al., 2017)	BaBi study	995	995			Health inequalities; mental development; allergies
	Childhood Obesity - Early Programming by Infant Nutrition (Koletzko et al., 2009)	CHOPIN- Germany	281	281	281		Childhood obesity
	Dortmund Nutritional and Anthropometric Longitudinally Designed Study	DONALD	1,300	1,300	1,300		Nutrition
	Duisburg (Birthcohorts, 2021; Wilhelm et al., 2008)		234	234			Exposure to environmental chemicals
	The EuroPrevall birth cohort- Berlin (Keil et al., 2010; McBride et al., 2012)		1,570	1,570	1,570	+siblings	Allergies
	German Infant Study on the influence of Nutrition Intervention (Birthcohorts, 2021; von Berg et al., 2003)	GINIplus	5,991				natural course of atopic diseases and metabolic disorders; mental health, nutrition
	Influence of life-style factors on the development of the immune system and allergies in East and West Germany	LISAplus	3,097				Atopic diseases
	Kids birth cohort study (Brandstetter et al., 2019)	KUNO	2,492	2,462	1,412		Various aspects of child health
	LIFE Child		3,500	2,500	1,000		Causes of important widespread diseases
	Lifestyle and environmental factors and their influence on Newborns Allergy risk	LINA	629	622			Allergies
	Loewen KIDS		783				Infections and the development of the Immune System
	Multizentrische Allergie Studie	MAS-90	1,314	1,314	1,314		Allergic disease
	Prenatal Identification of Children's Health	PRINCE	750	750			Factors during pregnancy can and children's health
	Study on the Prevention of Allergy in Children in Europe – Freiburg (Halmerbauer et al., 2003)	SPACE- Freiburg	862				Atopic disease
	Survey of Newborns in Pomerania	SNiP-study	4,840				Neonatal health
Greece	The EuroPrevall birth cohort- Athens (Keil et al., 2010; McBride et al., 2012)		1,080	1,080	1,080	+siblings	Allergies
	Mother Child Cohort in Crete	RHEA	1,590	1,610	37		Prenatal exposures and outcomes, mother's health
	Public health impact of long-term, low-level mixed-element exposure in susceptible population strata:	PHIME- Greece	484	484			health risk-assessment of long-term, low-level environmental exposure to toxic and essential metals

	Mediterranean Cohort- Greek Islands (Miklavčič et al., 2013)						
Iceland	The EuroPrevall birth cohort- Reykjavik (Keil et al., 2010; McBride et al., 2012)		1,341	1,341	1,341	+siblings	Allergies
Ireland	Babies After SCOPE: Evaluating the Longitudinal Impact using Neurological and Nutritional Endpoints	BASELINE	2,185				Development of diseases
	The Cork Nutrition Maternal-Infant Cohort Study	COMBINE	456	456			Nutrition and gut bacteria
	Growing Up in Ireland (Infant Cohort/Cohort '08) (Williams et al., 2012)	Cohort '08	11,100	11,100	11,100		Child well-being
	Lifeways Cross-Generation Cohort Study	Lifeways Cross-Gen.	1,074	1,061	325		Health information system
	Maternal health And Maternal Morbidity in Ireland (MAMMI, 2021)	MAMMI		2,503			Health problems during pregnancy and the first year after the birth
	Randomized control trial of Low glycemic index diet	ROLO	720	720			Low glycemic index diet and postnatal weight
Italy	Bologna Birth Cohort	Co.N.ER	654	651	593		Early life exposure and mother and child health
	Childhood Obesity - Early Programming by Infant Nutrition (Koletzko et al., 2009)	CHOPIN- Italy	415	415	415		Childhood obesity
	The EuroPrevall birth cohort- Milan (Keil et al., 2010; McBride et al., 2012)		1,486	1,486	1,486	+siblings	Allergies
	Genetica e Ambiente: Studio Prospettico dell'Infanzia in Italia	GASPII	708	693	693		Early life exposure and mother and child health
	Italian prospective Cohort of term and late preterm Newborns	ICON	2,314				Lower respiratory tract infection during childhood
	Mamma & Bambino		274	411			Early life exposure and mother and child health
	Public health impact of long-term, low-level mixed-element exposure in susceptible population strata: Mediterranean Cohort- Italy (Miklavčič et al., 2013)	PHIME- Italy	900	900			health risk-assessment of long-term, low-level environmental exposure to toxic and essential metals
	Multiple Births Cohort Study Pansieri 2020	MUBICOS	1,000	500	500		Heritability and gene-environment interaction in twins
	NAscere e creSCere in ITAlia	NASCITA	5,000				Health status of Italian children early on
	Nascita e INFanzia: gli Effetti dell'Ambiente	NINFEA	6,832	6,798			Exposures during pre-natal and early post-natal life
	Nascere in Friuli Venezia Giulia (prospective studies on children in Italian region of Friuli Venezia Giulia-FVG region) (Pitter et al., 2016)		All children that were born in this region and are in administrative data				Wellbeing and health of the children (Region-wide control for well-being and public health)

	Neonatal Environment and Health Outcomes	NEHO	860	860	860		environmental risk factors for placental function, pregnancy outcomes and newborns' health outcomes
	Piccolipiù		3,338	3,338	3,300		Environmental exposures and infant and child health and development
	Trieste child development cohort	Trieste cohort	900	900			Environmental, social, and genetic factors and neurocognitive development
Lithuania	The EuroPrevall birth cohort- Vilnius (Keil et al., 2010; McBride et al., 2012)		1,556	1,556	1,566	+siblings	Allergies
	Kaunas cohort	KANC	4,405	4,329	4,300		Risk factors for adversely pregnancy outcomes
Netherlands	Amsterdam Born Children and their Development	ABCD	6,161	8,266	2,270		Prenatal exposures and the child's health
	Dutch famine birth cohort study	DFBCS	741	741			Prenatal exposure to the Dutch famine and health
	The EuroPrevall birth cohort- Amsterdam (Keil et al., 2010; McBride et al., 2012)		976	976	976	+siblings	Allergies
	Generation R		10,000	97,780	6,500		Factors that influence the health of children in Rotterdam
	Groningen Expert Center for Kids with Obesity	GECKO Drenthe	2,997				Childhood obesity
	KOALA Birth Cohort Study (Birthcohorts, 2021; Kummeling et al., 2005)	KOALA	2,843	2,900	2,900		Allergies and asthma; growth and development
	Lifelines NEXT (Birthcohorts, 2021; Lifelines, 2021)		three-generation cohort: 15,000 children (aged 0-18 years) 140,000 adults (aged 18-65 years) 12,000 elderly (65+ years).				Early life factors and health (biobank)
	The LucKi Birth Cohort Study (Birthcohorts, 2021; de Korte-de Boer et al., 2015)	LucKi	5,000				Exposures; atopic diseases; obesity
	Maastricht essential fatty acid birth cohort (Birthcohorts, 2021; Wurff et al., 2015)	MEFAB	1,203	1,203			Early essential fatty acid status and development and health
	PRegnancy and Infant DEvelopment Study	PRIDE Study	3,200	5,300	2,100		Exposures and health outcomes
	Prevention and Incidence of Asthma and Mite Allergy (Birthcohorts, 2021; PIAMA, 2012)	PIAMA	3,963	4,146	4,116		Asthma, allergies and lung function
	Prevention of Asthma in Genetically Susceptible Children (Kuiper et al., 2005)	PREVASC	888	888			Asthma
	Rotterdam Periconception Cohort	Predict Study	1,500	2,000	1,500		Exposures and health outcomes
	Wheezing Illnesses Study in LEidsche Rijn (Birth cohorts, 2021; Katier et al., 2004)	WHISLER	2,500	1,000	1,000		Determinants for wheezing illnesses

Norway	ArcRisk-Norway: Northern Norway mother-and-child contaminant cohort study (Veyhe et al., 2012)	MISA – Arctic Norway	515	515			Pollutant levels in maternal blood during pregnancy and in mother's milk
	Environment and Childhood Asthma Study in Oslo (Lødrup Carlsen, 2002; Lødrup Carlsen et al., 2006)	ECA	3,754				Air pollution and asthma development
	Norwegian Human Milk Study	HUMIS	2,500	2,500	2,400		Levels of environmental toxicants in breast milk
	The Norwegian Influenza Pregnancy Cohort Study (NorFlu, 2021)	NorFlu	4,500	4,500			Effects of maternal influenza infection on the fetus
	Norwegian Microbiota Study (Eggesbø et al., 2011)	NoMIC	601	601			Gut microbiota in infancy and its development
	Norwegian Mother, Father and Child Cohort Study	MoBa	108,500	90,700	72,100		Causes of disease
Poland	Childhood Obesity - Early Programming by Infant Nutrition (Koletzko et al., 2009)	CHOPIN- Poland	275	275	275		Childhood obesity
	The EuroPrevall birth cohort- Lodz (Keil et al., 2010; McBride et al., 2012)		1,513	1,513	1,513	+siblings	Allergies
	Kraków Cohort		505	528			PAH exposure and birth outcomes
	Polish Mother and Child Cohort Study	REPRO_PL	1,800	1,800			Exposure and health outcomes
Portugal	Geração XXI (Alves et al., 2011; Birthcohorts, 2021)	G21	8,270	8,127	4,351		Child health and development
	Gestão Integrada Saúde e Ambiente	GISA	1,645	1,645			Environmental air pollution and birth weight and gestational age
Russian Federation	Russian Moscow newborns 2011 eczema	RuMos	393	393	393	2,748	Allergy manifestation in relatives of newborns and their tendency for atopic disease
Slovakia	Slovak PCB study		1,134	1,134			Pollutant exposure and neurobehavioral and immunologic development
Slovenia	Public health impact of long-term, low-level mixed-element exposure in susceptible population strata : Mediterranean Cohort- Slovenia (Miklavčič et al., 2013)	PHIME- Slovenia	584	584			health risk-assessment of long-term, low-level environmental exposure to toxic and essential metals
Spain	Asthma Multi-centre Infants Cohort Study (Friguls et al., 2009)	AMICS- Barcelona	487	480			Atopy and asthma
		AMICS- Menorca	482	475			
	Childhood Obesity - Early Programming by Infant Nutrition (Koletzko et al., 2009)	CHOPIN- Spain	452	452	452		Childhood obesity
	ECLIPSES		400	700	500		Environmental factors, during pregnancy and newborn cognitive development

	The EuroPrevall birth cohort- Madrid (Keil et al., 2010; McBride et al., 2012)		1,387	1,387	1,387	+siblings	Allergies
	Genetics, Environmental, Exposures and Infant Development in Andalucia (Aguilar-Lacasaña et al., 2021; Birthcohorts, 2021)	GENEIDA	800	800			Exposure to environmental pollutants and the fetal growth and development, neurodevelopment; biomarkers
	INfancia y Medio Ambiente	INMA	3,768	3,944	3,944		Environmental pollutants and children's' growth and development
	Nutrition in Early Life and Asthma (Birthcohorts, 2021; Suárez-Martínez et al., 2021)	NELA	738	738			Nutrition during pregnancy and early postnatal life and health outcomes
Sweden	All Babies in Southeast Sweden	ABIS	17,000	17,000	17,000		Environmental and genetic factors and Type 1 Diabetes, and other immune-mediated diseases
	Assessment of Lifestyle and Allergic Disease During Infancy (Stenius et al., 2011)	ALADDIN	330	330	330	+siblings	Exposure during pregnancy and infancy in children of families with an anthroposophic lifestyle
	Biology, Affects, Stress, Imaging and Cognition (BASIC, 2021)	BASIC	2,866	6,387			Women's experience during and after pregnancy
	Born into Life (Smew et al., 2018)		107	107			Maternal stress during pregnancy and fetal growth
	Children (Barn), Allergy, Milieu, Stockholm, Epidemiological study	BAMSE	4,089	4,089	4,089		Asthma, allergic diseases and lung function
	Helsingborg Birth Cohort 1964-1967	HbgBC	4,982	4,982			Health of Mothers and Offspring
	LifeGene (Almqvist et al., 2011; LifeGene, 2021)		50 799 participants				population and health registry
	The Uppsala-Stockholm Assisted Reproductive Techniques Study (Iliadou et al., 2019; UppStART, 2011)	UppSTART		514(129 pregnancies)	457		Epigenetic alterations in infants conceived via ART and those conceived spontaneously; lifestyle factors and ART procedure-specific outcomes and pregnancy outcomes
Switzerland	Bern-Basel Infant Lung Development Cohort	BILD	400	400			Physiological properties of the respiratory system; environmental and genetic risk factors and lung development
Turkey	Bogazici Mother-Baby Relationship Project	BABIP	150	150			Prenatal environment and fetal development and health

Ukraine	Family and Children of Ukraine (European Longitudinal Study of Pregnancy and Childhood)	FCOU	4,510	4,510	4,510		Epidemiological factors influencing children's health
United Kingdom	Asthma Multi-centre Infants Cohort Study (Fríguls et al., 2009)	AMICS- Ashford	642	634			Atopy and asthma
	Avon Longitudinal Study of Parents & Children/Children of the 90s (European Longitudinal Study of Pregnancy and Childhood)	ALSPAC	14,000	14,000	20,000	1,000	Epidemiological factors influencing children's health
	Baby Biome Study	BBS	3,401	3,401			Microorganisms, the immune system, and clinical, social, and behavioural factors during pregnancy and early life influence later health and disease
	Born in Bradford (BiB, 2018)	BiB	14,000	14,000	3,000		Reasons for ill health; improving child health and wellbeing
	The EuroPrevall birth cohort- Southampton (Keil et al., 2010; McBride et al., 2012)		1,140	1,140	1,140		Allergies
	Gateshead Millennium Study	GMS	1,029	1,011			Child health; growth and development in childhood
	Growing Up in Scotland (GUS, 2017)	GUS Birth cohort 1	5,502				Children's wellbeing in Scotland
		GUS Birth cohort 2	6,127				
	Growing Up in Wales: Environments for Healthy Living	EHL	420	420			Environmental and behavioural exposures on the health of offspring
	European Longitudinal Study of Pregnancy and Childhood: Isle of Man Birth Cohort Study (Birthcohorts, 2021; Goodfellow et al., 2013)	ELSPAC: Isle of Man	1,314	1,384	1,384		Epidemiological factors influencing children's health
	Isle of Wight Birth Cohort (Arshad et al., 2018)	IOWBC	1,536	1,509			Asthma and allergic diseases
	Leicester Respiratory Cohorts	LRC	10,350				Wheezing disorders and other common respiratory problems
	Merthyr Allergy Study		497	491			Allergies and infant feeding and various environmental factors
	Newcastle Thousand Families Study (Pearce et al., 2009)	1000 Families Study	1,146				Infections in infancy and other health outcomes, educational performance and family life
	Study of eczema and asthma to observe the effects of nutrition (Martindale et al., 2005)	SEATON	1,924	2,000			Mother's diet during pregnancy and child's risk for getting asthma and allergies
	Study on the Prevention of Allergy in Children in Europe (Halmerbauer et al., 2003; Tsitoura et al., 2002)	SPACE- Newport	430				Atopic disease
	Southampton Women's Survey	SWS	3,158	12,583	3,158		Maternal pre-conception and pregnancy factors and child's health
	Wirral Child Health and Development Study (Sharp et al., 2012)	WCHADS	1,233	1,233	1,014		Early social, emotional and biological risks and processes and childhood conduct problems

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