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This chapter examines the contribution of epidemiological research to our understanding of developmental psychopathology. I first review some basic information about the field of epidemiology: the goals and scope of epidemiological research, a brief history of the discipline, and how epidemiological approaches differ from other study designs in developmental psychopathology. The bulk of the chapter is devoted to consideration of the types of research questions in developmental psychopathology that can be uniquely addressed using epidemiological research designs and a review of hallmark findings produced by developmental epidemiology. The chapter ends with a discussion of how epidemiological approaches can be incorporated into one's own research program, with an eye towards encouraging researchers to capitalize on the increasing armamentarium of publicly available epidemiological datasets that can be used to advance our understanding of developmental psychopathology. This chapter builds on seminal reviews of this topic by Jane Costello and Adrian Angold (Angold & Costello, 1995; Costello & Angold, 1995; Costello, Egger, & Angold, 2005; Costello, Foley, & Angold, 2006) that describe

the central methods of developmental epidemiology and their application to questions in developmental psychopathology.

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## What Is Developmental Epidemiology?

Epidemiology is the study of the distribution and determinants of health and disease in populations (Susser, 1973). Central to this approach is the notion that an individual's risk for disease is based not only upon risk and protective factors at the individual level but also is a function of disease risk in the society in which they are embedded (Rose, 1992). Epidemiology thus seeks to understand not only why a particular individual develops an illness but also why a particular population experiences a specific distribution of risk for that illness. The history of epidemiology has witnessed several major shifts in the predominant paradigms used to study the distribution of disease in populations. The discipline of epidemiology began during the Industrial Revolution as massive societal change related to urbanization produced overcrowding, poor sanitation, and marked disparities in health across social classes. At this time, epidemiologists focused on social and economic factors driving risk for disease and implemented structural solutions such as closed sewage and draining systems and regular garbage collection. As advances in microbiology

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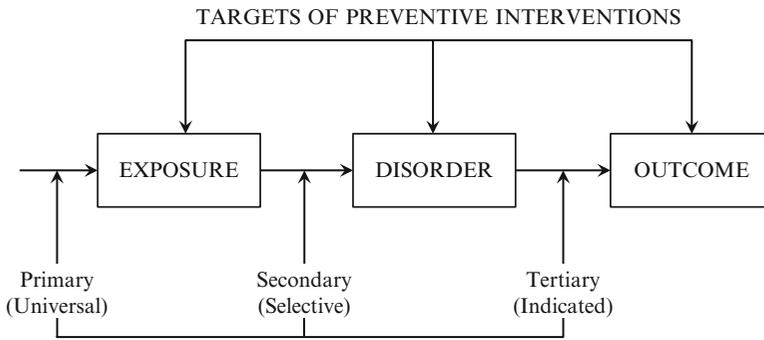
improved understanding of how specific agents (i.e., germs) were involved in the etiology of specific diseases, epidemiology became more narrowly focused on mechanistically identifying microbial causes of infectious diseases and controlling them with vaccines or medication. During the period of infectious disease epidemiology, consideration of social and economic factors as determinants of disease faded. Following World War II, however, the focus of epidemiology shifted again to a risk factor approach based on the notion that combinations of factors acted in concert to shape the probability of illness, particularly of chronic diseases including mental disorders. With the advent of modern epidemiological study designs—particularly cohort and case–control studies—individual-level factors associated with increased probability of disease were identified (e.g., cigarette smoking and lung cancer), and attempts to control risk factors through lifestyle (e.g., smoking cessation) and environmental change (e.g., reduce passive smoke exposure) were implemented (Susser & Susser, 1996). Over the past two decades, a modern era of epidemiology has emerged that considers risk factors operating at multiple levels, including macrosocial, individual, and biological, and seeks to identify the mechanisms through which risk factors ultimately increase the probability of disease (Krieger, 1994; Susser, 1998). Although the field previously involved a predominant focus on factors operating at only one of these levels, current approaches to epidemiology are explicitly multilevel and concerned with identifying *causes* of health states (Krieger, 1994; Susser, 1998), with the ultimate goal of preventing disease onset.

Modern epidemiology thus shares the fundamental multilevel and mechanistic perspectives of developmental psychopathology. So what is unique about an epidemiological approach? At the most basic level, epidemiology is concerned with identifying exposure–disease relationships. This does not differ fundamentally from the goals of developmental psychopathology, but the methods employed in epidemiology differ in important ways from those used in other study designs. I focus here on several key aspects of

epidemiology that are distinct from other methods used to study child and adolescent mental health, as a thorough review of study designs and measures of association in epidemiology is beyond the scope of this chapter. Readers are referred elsewhere for greater detail about epidemiological methods and their application to the study of psychopathology (Rothman, Greenland, & Lash, 2008; Susser, Schwartz, Morabia, & Bromet, 2006).

First, epidemiology is explicitly interested in characterizing the *distribution* of diseases in populations. This task typically involves the counting of cases to determine the proportion of individuals in the population that meet criteria for a particular disorder (i.e., prevalence) and, in longitudinal studies, the number of new cases that develop over a period of time (i.e., incidence rate). Major advances in the surveillance of child and adolescent mental disorders have occurred over the past four decades, following the advent of diagnostic interviews that combine information from multiple informants to generate youth psychiatric diagnoses (Angold & Costello, 1995). Efforts to count cases of youth mental disorders occurred first in regional studies (Cohen et al., 1993; Costello, Mustillo, Erkanli, Keeler, & Angold, 2003) and more recently national studies (Kessler, Avenevoli, Costello, Georgiades, et al., 2012). Epidemiology is also focused on identifying *disparities* in health outcomes. The distribution of youth mental disorders varies by sex, age, race/ethnicity, nativity, socioeconomic status, and sexual orientation. Epidemiology is explicitly concerned with identifying socially disadvantaged subgroups of the population that experience disproportionate risk for particular adverse health outcomes in order to better target preventive interventions.

Second, epidemiologic studies seek to identify factors that *explain* nonrandom distribution of disease across population subgroups, across space, and across time with the goal of preventing the onset of ill health. Whereas psychology and clinical medicine focus predominantly on the treatment of health problems, the goal of identifying risk factors in epidemiology is to inform efforts to *prevent* disease onset by altering the



**Fig. 5.1** Epidemiology explicitly includes disease *prevention* as a goal. Figure 5.1 depicts the targets of the three major classes of preventive interventions in epidemiology: primary, secondary, and tertiary. Adapted from Costello and Angold (1995)

distribution of risk factors in the population (Rose, 1992). Primary, or universal, prevention is the mainstay of epidemiology and involves efforts to lower the incidence of a disease by shifting the distribution of risk factors in the population in a way that reduces risk exposure and thus the number of new cases (see Fig. 5.1). Secondary, or indicated, prevention aims to reduce disease onset among individuals who have already been exposed to causal risk factors or are already showing signs or symptoms of disease. Finally, tertiary prevention is concerned with reducing the amount of disability associated with a disease among already diagnosed cases. A combined primary and secondary prevention approach is being used in the Durham Family Initiative (DFI) to prevent the occurrence of child maltreatment in Durham County, North Carolina. Based on evidence that risk factors for child maltreatment operate at the level of children, parents, families, neighborhood, and community levels, the DFI has created a preventive system of care that seeks to reduce risk factors at each of these levels through universal screening, early intervention for high-risk families, neighborhood- and community-level interventions, and collaboration among government agencies to provide these services (Dodge et al., 2004).

Finally, epidemiology is concerned with *populations*. A first step in any epidemiologic research study is to identify the source population or the population of individuals that will be the focus of study (e.g., children born in New York City in the year 2000). Because it is rarely

feasible to recruit every person from the source population into a study, participants are sampled from the source population to create a study population. Epidemiologic studies frequently rely on probability sampling, which means that every person in the source population has a known probability of being included in the study (Lohr, 1999). Sampling weights are typically constructed that correct for nonresponse and differential selection probabilities, allowing accurate inferences to be made about the source population based on observations in the study population. For example, Patricia Cohen's study of child mental health first enumerated all households in two counties in upstate New York (Cohen et al., 1993). A multistage random sample was created by first randomly selecting households and, second, randomly selecting one child aged 1–10 years within households for families with more than one child in the eligible age range. Epidemiology is also concerned with exposure–disease associations that can be measured *only* at the level of the population, such as the population attributable risk proportion, described in more detail below.

Developmental epidemiology applies these principles to examine variation in the distribution and determinants of health, particularly mental health outcomes, across development. Developmental epidemiology shares fundamental assumptions with developmental psychopathology. Both perspectives emphasize the reciprocal and integrated nature of our understanding of normal and abnormal development;

normal developmental patterns must be characterized to identify developmental deviations, and abnormal developmental outcomes shed light on the normal developmental processes that lead to maladaptation when disrupted (Cicchetti, 1993; Sroufe, 1990). Both approaches conceptualize development as cumulative and hierarchical, meaning that it is influenced not only by genetics and the environment but also by previous development (Lewis, 1997; Sroufe, 2009; Sroufe, Egeland, & Kreutzer, 1990). Acquisition of competencies at one point in development provides the scaffolding upon which subsequent skills and competencies are built, such that capabilities from previous periods are consolidated and reorganized in a dynamic, unfolding process across time. Developmental deviations from earlier periods are carried forward and have consequences for the successful accomplishment of developmental tasks in a later period (Cicchetti & Toth, 1998). Finally, both perspectives consider the dynamic interplay between risk and resilience factors operating at multiple levels (Cicchetti & Toth, 2009). This includes a focus on neurobiological, psychological, and social development and the importance of social context in shaping each of these aspects of development (Cicchetti, 1996; Lynch & Cicchetti, 1998).

Incorporating a developmental perspective into epidemiological approaches is critical for understanding how developmental processes influence psychopathology at the population level for several reasons. First, the prevalence and distribution of mental disorders varies across development. For example, the prevalence of major depression is only 2.8 % in children under the age of 13 and increases to 5.6 % in adolescents aged 13–18 (Costello, Erkanli, & Angold, 2006). By adulthood, the lifetime prevalence of depression is 16.2 % (Kessler et al., 2003). The incidence of depression remains relatively low prior to puberty and rises most dramatically between ages 15 and 18 (Hankin et al., 1998; Kessler et al., 2003). Although the prevalence of childhood depression is similar for boys and girls, females are more likely than males to develop depression beginning at age 13 and continuing through adolescence and adulthood

(Hankin et al., 1998; Kessler et al., 2003; Nolen-Hoeksema & Twenge, 2002). Second, the developmental timing and persistence of symptom expression has implications for what we classify as a mental disorder. Drawing on epidemiologic data from numerous sources, Moffitt (1993) proposed a widely accepted developmental taxonomy of antisocial behavior in which antisocial behavior that is evident in early childhood and persistent across the life course is pathological, whereas antisocial behavior that is limited to adolescence is considered developmentally normative and, potentially, adaptive. Third, risk factors for specific mental disorders change with development. For example, a wide range of early childhood risk factors, including perinatal insults, motor deficits, and caretaker instability, are associated with onset of major depression during childhood and adolescence but are not associated with depression onset in adulthood (Jaffee et al., 2002). Finally, the manifestation of disorders and expression of symptoms also change with development. For example, children with separation anxiety disorder are more likely to experience nightmares about separation and excessive distress upon separation from caregivers than adolescents, whereas adolescents are more likely than children to experience physical complaints related to school attendance (Francis, Last, & Strauss, 1987).

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### What Can We Learn from Developmental Epidemiology?

For the most part, the types of research questions that are investigated using developmental epidemiology methods are similar to the questions examined with other developmental psychopathology methods. However, through the use of population-based sampling, developmental epidemiology studies can provide unique information about developmental psychopathology that is not available through other means. This section focuses specifically on the types of information we can glean from developmental epidemiology studies that are difficult to obtain using other study designs.

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## Prevalence, Comorbidity, and Distribution of Psychopathology

The most basic type of information provided by developmental epidemiology studies relates to the prevalence of mental disorders and other conditions in the population. Until very recently, information about the prevalence of mental disorders in children was based on findings from regional studies, such as the Great Smoky Mountain Study (Costello et al., 1996) and the Methods for the Epidemiology of Child and Adolescent Mental Disorders (MECA) Study (Shaffer et al., 1996). The US National Comorbidity Survey Replication Adolescent Supplement (NCS-A), conducted by Ronald Kessler, Kathleen Merikangas, and colleagues, is the first nationally representative survey of youth mental disorders among 13–17-year-olds. The results of this survey are just becoming available. They suggest that the prevalence of mental disorders in US adolescents is high, with 40.3 % of adolescents meeting criteria for a past-year disorder, a prevalence estimate that closely resembles lifetime prevalence in adults (Kessler, Avenevoli, Costello, Georgiades, et al., 2012). The prevalence of mental disorders decreases sharply, however, when a threshold of functional impairment must be crossed to meet the diagnostic criteria for a disorder. Indeed, NCS-A data indicate that 8.0 % of adolescents meet the Substance Abuse and Mental Health Services Administration definition of serious emotional disturbance (SED) in the past year and that the majority of adolescent disorders (58.2 %) are mild in severity (Kessler, Avenevoli, Costello, Green, et al., 2012).

Patterns of disorder comorbidity can also be investigated using epidemiological data. Although comorbidity has frequently been studied in clinical samples, representative estimates of disorder co-occurrence and the temporal sequencing of comorbid disorders in the population must be obtained using epidemiological samples. Understanding the temporal progression of disorder onset can aid in identification of causal pathways of risk among disorders over the life course and provides valuable information for

targeting intervention efforts to prevent the subsequent development of comorbid disorders. The Great Smoky Mountain Study has been used to identify patterns of both concurrent and sequential comorbidity in children and adolescents (Costello, Mustillo, et al., 2003). Findings from this study suggest that youths who met criteria for a mental disorder at one point in time were more than three times as likely to meet criteria for a disorder at a subsequent time as compared to children with no previous diagnosis. Controlling for concurrent comorbidity, prior diagnosis of anxiety disorder was associated with the later onset of depression and substance abuse, previous major depression predicted subsequent anxiety disorders, attention-deficit/hyperactivity disorder was associated with onset of oppositional defiant disorder, and conduct disorder predicted the later onset of substance abuse (Costello, Compton, Keeler, & Angold, 2003). Both concurrent and sequential comorbidity were more prominent among girls, particularly for internalizing disorders. This pattern is consistent with findings from other epidemiological studies of disorder comorbidity in children and adolescents (McGee, Feehan, Williams, & Anderson, 1992).

Epidemiological studies also provide important information regarding the distribution of psychopathology in the population or the degree to which disorder prevalence varies across sociodemographic groups. Identifying such differences is critical for understanding health disparities, identifying high-risk groups to target with preventive interventions, and as a first step in determining the mechanisms through which vulnerability to psychopathology is conferred differentially across groups. Although prevalence differences are frequently inferred using data from convenience, clinical, or school samples, limitations in sample selection and population representativeness of such designs preclude firm conclusions regarding the distribution of psychopathology in the population. Epidemiological data can be particularly useful in resolving discrepancies observed in such studies. For example, despite mixed findings from convenience and clinical samples (Meyer, 2003), epidemiological studies from the past decade consistently suggest that the prevalence of mental

disorders is elevated among sexual minorities in the USA and other developed countries. The prevalence of mood, anxiety, and substance use disorders as well as suicide attempts is higher among individuals who identify as lesbian, gay, or bisexual (LGB) as compared to heterosexuals (Cochran & Mays, 2000a, 2000b). These disparities emerge early in the life course. Population-based studies of adolescents reveal markedly higher rates of psychiatric disorders and suicide attempts among LGB youths relative to their heterosexual peers (Fergusson, Horwood, & Beautrais, 1999; Russell & Joyner, 2001). Identification of these disparities has sparked theoretical advances in the conceptualization of minority stress as it applies to LGB populations (Meyer, 2003) and in the identification of mechanisms underlying the relationship between sexual orientation and psychopathology across development (Hatzenbuehler, 2009), as well as innovations in the development of preventive interventions for LGB youths (Ryan, Russell, Huebner, Diaz, & Sanchez, 2010).

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### Identifying Risk and Protective Factors

Epidemiological studies are frequently used to identify risk and protective factors for psychopathology. Although many study designs in developmental psychopathology can be used to identify relationships between specific exposures and mental health outcomes, epidemiological studies can be particularly useful in examining the influence of timing, duration, and magnitude of exposure on psychopathology. To accurately quantify such relationships, it is necessary to have a sufficient number of respondents within different levels of exposure. For example, to examine the influence of timing of child maltreatment on risk of major depression it is necessary to have a dataset that includes an adequate number of respondents who experienced maltreatment at specific age periods of interest as well as a sufficient number of non-maltreated children. This type of data structure is typically available only in large population-based studies.

### Timing of Exposure

A central tenet in the study of development is that timing of exposure matters. The primary developmental tasks occurring at the time of exposure to a risk factor are thought to be the most likely to interrupted or disrupted by the experience. In a set of pioneering studies in psychiatric epidemiology, Susser (Susser et al., 1996) identified prenatal maternal malnutrition as a risk factor for offspring schizophrenia using data on pregnancies that occurred during the Dutch Hunger Winter during World War II. The risk of schizophrenia was found to be elevated only among offspring whose mothers experienced extreme malnutrition during the first trimester of pregnancy (Susser & Lin, 1992). The relationship between childhood poverty and educational attainment also varies according to timing of exposure, such that poverty experienced in the first 5 years of life has a more marked influence on the probability of finishing high school than poverty experienced in later developmental periods (Duncan, Yeung, Brooks-Gunn, & Smith, 1998). The degree to which timing of exposure to adverse childhood experiences influences subsequent risk for psychopathology is currently a topic of considerable interest that epidemiologic studies are well suited to investigating.

### Duration of Exposure

Certain risk and protective factors may influence psychopathology only if they are experienced for a sufficient duration of time. Research consistently suggests that childhood poverty has a particularly detrimental influence on developmental outcomes when it is experienced chronically over time. Children raised in persistent poverty are more than twice as likely to experience detriments in cognitive ability, poor school achievement, and elevations in behavior problems as compared to children who experience transient poverty (Duncan, Brooks-Gunn, & Kato Klebanov, 1994; Korenman, Miller, & Sjaastad, 1995).

## Magnitude of Exposure

Epidemiological studies can also be utilized to study the impact of magnitude or severity of exposure on mental health outcomes. For example, Jaffee, Caspi, Moffit, Polo-Tomás, and Taylor (2007) used data from the Environmental Risk (E-Risk) Longitudinal Twin Study to examine predictors of resilience (defined as low levels of antisocial behavior) in maltreated children and to evaluate whether these factors were associated with resilience at all levels of exposure to stress. High IQ and positive temperament were associated with resilience, but only for children with relatively low stress exposure; no association between high IQ and positive temperament with resilience was observed for children who experienced five or more cumulative stressors (Jaffee et al., 2007). These findings are consistent with other studies suggesting that once the number of stressors crosses a threshold, very few children exhibit resilient functioning (Forehand, Biggar, & Kotchick, 1998). In another study of resilience, numerous putative protective factors were examined as predictors of resilience (defined as low levels of externalizing behaviors) among respondents with exposure to early childhood adversity in the Christchurch Study. High IQ, low affiliation with delinquent peers, and low novelty seeking predicted resiliency in adolescents exposed to childhood adversity, and these resiliency factors had accumulating effects such that resilience was most commonly observed among adolescents who possessed all three of these factors (Fergusson & Lynskey, 1996).

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## Population-Level Inferences

Certain types of relationships are observable only at the population level, and epidemiological studies are uniquely positioned to elucidate these relationships. One example of an effect measure used in epidemiology to characterize a population-level phenomenon is the population attributable risk proportion (PARP). PARP represents the proportion of cases of a particular disease or disorder

in the population that are statistically explained by a particular exposure. In epidemiology, a PARP is interpreted as the proportion of cases of disease in the population that could be eliminated or prevented if a particular exposure were eradicated, assuming stable distributions of other risk factors in the population (Rockhill, Newman, & Weinberg, 1998). The PARP is a joint function of the strength of association between an exposure and outcome and the prevalence of the exposure in the population. The PARP is therefore a valuable effect measure for estimating population burden. Traditional measures of exposure–outcome relationships are inadequate for characterizing population burden. For example, even if the relationship between a particular exposure and outcome is quite strong, that exposure will not play a substantial role in explaining cases in the population if it is rare. In contrast, an exposure that has a weak association with an outcome but has high prevalence may explain a high proportion of cases in the population. The relationship between trauma types and post-traumatic stress disorder (PTSD) provides an illustrative case. Although rape is an event associated with an extremely high conditional risk of PTSD and sudden unexpected death of a loved one is associated with a low conditional risk of PTSD, data from the NCS-A suggest that unexpected death of a loved one explains a substantially greater proportion of adolescent PTSD cases in the population than rape because it is more than three times as common (McLaughlin, Koenen, Hill, Petukhova, & Kessler, 2013).

PARPs and other population-based effect measures can also provide useful information for targeting preventive interventions. For example, data from the National Comorbidity Survey Replication (NCS-R) and the NCS-A were recently used to examine the relationships between type and number of adverse childhood experiences (e.g., maltreatment, parental psychopathology, domestic violence) and subsequent first onset of mental disorders in adolescents and adults. PARPs were calculated in each of these studies, and the results were consistent across the adolescent and adult data in suggesting that slightly less than one-third of mental disorder onsets in the US population

(28.2 % and 32.0 %, respectively) are associated with exposure to childhood adversities (Green et al., 2010; McLaughlin et al., 2012). The large PARPs associated with these exposures suggest that adverse childhood experiences are very important either as determinants of mental disorder onsets (causal risk factors) or as markers of other determinants (risk markers) and as such represent promising targets for preventive interventions. Another example comes from the Dunedin Multidisciplinary Health and Development Study, a population-based birth cohort. Kim-Cohen and colleagues (2003) estimated PARPs of adult mental disorders associated with child and adolescent disorders. Approximately three-quarters (73.9 %) of adult mental disorder cases had met the criteria for a mental disorder before age 18 and, one-half (50.0 %) had met the criteria for a disorder prior to age 15 (Kim-Cohen et al., 2003). PARPs ranged from 23.0 to 46.0 % across adult diagnoses, indicating that more than one-quarter of adult mental disorders are attributable to prior child–adolescent disorders. These findings suggest that early effective treatment of juvenile diagnoses may have meaningful preventive effects on disorder progression and subsequent disorder onsets.

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### Age–Period–Cohort Effects

Time is a central construct in all studies of development. Yet, understanding the influence of time on disorder risk is a complicated undertaking. In epidemiology, attempts are frequently made to deconstruct the effects of time into age effects, period effects, and cohort effects. Age effects reflect the influence of aging and development on risk for a disorder; this is the typical way in which time is conceptualized in developmental psychopathology. As described earlier, the process of development has numerous implications for psychopathology propensity and manifestation. The prevalence of various disorders varies with age, as do risk factors and characteristic symptom expressions of psychopathology. But time can influence psychopathology in other ways. Period and cohort effects are used to examine how the time period in which one is born and lives influences health

(Holford, 1991). A period effect is the result of a widespread change in exposure at the population level that influences all individuals alive at that time, regardless of age. Examples of period effects are the occurrence of a natural or man-made disaster, introduction of an environmental pollutant, or widespread changes in social norms. Period effects are not typically studied in relation to psychopathology, because it is difficult to imagine that there are exposures that have similar mental health effects on individuals of all ages. As a result, cohort effects are more frequently used in developmental epidemiology to examine the influence of historical changes in risk and protective factors on mental health outcomes according to one's year of birth. Although different definitions of cohort effects have been proposed, recent conceptualizations describe cohort effects as the result of changes in the distribution of exposures at the population level that differentially influence people according to age; in other words, cohort effects represent an interaction between age and period of birth in shaping disease susceptibility (Keyes, Utz, Robinson, & Li, 2010).

The use of age–period–cohort effect analysis methods has proven to be particularly useful in understanding variation over time in substance use and substance disorders. For example, using data from 1979 to 2005, Kerr and colleagues (Kerr, Greenfield, Bond, Ye, & Rehm, 2009) document a divergence in historical trends of alcohol use according to age. Although the average alcohol volume consumed and frequency of binge drinking has declined over time for individuals aged 26 and older, average alcohol volume consumed and frequency of binge drinking has increased over time for individuals aged 18–25 (Kerr et al., 2009). Increased alcohol consumption and binge drinking among adolescents and young adults was specifically observed among those born after 1975. Social factors that contribute to substance use have also been studied using age–period–cohort methods. A recent study documented substantial variation across time in adolescent social norms regarding approval of marijuana use and a strong association between such norms and adolescent marijuana use (Keyes et al., 2011). The odds of adolescent marijuana use were more than 3.5

times higher in cohorts where fewer than half of adolescents disapproved of marijuana use compared to cohorts where most adolescents disapprove of its use, controlling for one's own attitudes towards marijuana use. Although cohort-specific approval of marijuana use was strongly related to adolescent patterns of use, period-specific approval was not. These findings suggest that adolescent substance use behavior is influenced mostly by social norms of similar-aged peers rather than broader societal norms regarding substance use (Keyes et al., 2011).

Importantly, interpretation of age–period–cohort effects remains challenging. Strong collinearity among age, period, and cohort creates difficulty in estimating standard statistical models to quantify effects, although new methods have been developed that mitigate the influence of collinearity on age, period, and cohort estimates (Keyes & Li, 2010; Yang & Land, 2008). Caution is especially warranted in interpreting age–period–cohort effects that are based on retrospective reporting in cross-sectional surveys. For example, findings from several epidemiological surveys of adults suggested that the lifetime prevalence of major depression was higher in younger birth cohorts than in older birth cohorts (i.e., increasing over time) and that the average age of depression onset was becoming increasingly younger (Burke, Burke, Rae, & Regier, 1991; Kessler et al., 2003). The existence of this “epidemic” of depression was, in turn, widely publicized in the media. However, recall bias is a concern when adults are asked to report retrospectively about child and adolescent episodes of depression, and recall failure of episodes among older individuals might contribute to the appearance of higher prevalence in younger cohorts in the absence of a real cohort effect. To address this issue, Costello and colleagues (Costello, Erkanli, & Angold 2006) conducted a meta-analysis of epidemiologic studies of children and adolescents from successive birth cohorts with observations of over 60,000 youths. Their analysis revealed no changes in the prevalence of depression across birth cohorts, suggesting that previously reported findings of such a cohort effect were likely due to recall bias in older adults (Costello, Erkanli, et al., 2006).

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## Geographic, Social, and Contextual Influences

Health and developmental outcomes exhibit marked geographical variation, and epidemiology has long acknowledged the importance of place as a determinant of risk exposure and health status. Research examining the influence of neighborhoods on health has increased dramatically in the past two decades. The upsurge in research on this topic is attributable to advances in multilevel modeling and statistical approaches that allow for simultaneous estimation of individual- and neighborhood-level effects and account for nonindependence of observations from multiple individuals living in the same neighborhood, as well as renewed interest in the social determinants of health (Diez Roux, 2001). At the most basic level, the physical characteristics and location of one's neighborhood may influence health and development through exposure to hazards such as lead and other toxins, pollutants, graffiti, and ambient noise, as well as by determining access to healthy food and social services and the availability of alcohol and illicit drugs (Aneshensel & Sucoff, 1996). The place in which one lives also determines numerous aspects of social context including education and employment opportunities, formal and informal institutions, presence of stable adult role models, social norms, and exposure to crime, violence, and delinquent behavior (Sampson, Morenoff, & Gannon-Rowley, 2002). Research on neighborhoods and individual outcomes naturally lends itself to an epidemiological approach, because respondents must be drawn from a sufficiently large number of areas to obtain adequate variability in neighborhood characteristics; at the same time, measurement of individual-level characteristics must be performed to simultaneously estimate the effects of both neighborhood and individual-level factors on the outcome of interest. Epidemiological study designs that examine neighborhood effects on child health and development include national or regional studies that sample respondents from a large number of areas, as well as neighborhood-based designs that identify neighborhood characteristics of interest and sample individuals living in

neighborhoods with those particular characteristics (e.g., proportion of residents living in poverty) (Leventhal & Brooks-Gunn, 2000). Neighborhoods are almost always defined using geographic boundaries defined by the Census Bureau. Ecological designs that link aspects of place to aggregate population-based measures of health, such as rates of mortality or premature birth, can also be used to examine geographic variation in health. These have less commonly been used to study questions in developmental psychopathology.

Existing evidence suggests that neighborhood characteristics are, indeed, important determinants of child mental health and developmental outcomes. Even after controls for individual- and family-level factors are considered, youths residing in low SES neighborhoods (based on average income, educational attainment, and/or employment status of adults in the neighborhood) exhibit lower achievement scores and cognitive ability (Chase-Lansdale & Gordon, 1996; Sampson, Sharkey, & Raudenbush, 2008), higher levels of externalizing behavior problems in early childhood (Duncan et al., 1994), and greater engagement in delinquent and criminal behavior in adolescence (Peebles & Loeber, 1994) than youths from more affluent neighborhoods. Rates of exposure to child maltreatment, a potent risk factor for child and adolescent psychopathology, are also elevated in socioeconomically disadvantaged neighborhoods as well as in neighborhoods characterized by residential instability, overcrowding, and greater access to alcohol and illicit drugs (Coulton, Crampton, Irwin, Spilsbury, & Korbin, 2007; Freisthler, Needell, & Gruenewald, 2004). Other neighborhood characteristics that have been linked to psychopathology and substance use include residential instability, ambient hazards and dangers, physical disorder (e.g., broken windows, graffiti), and density of alcohol outlets (Aneshensel & Sucoff, 1996; Keyes et al., 2012; Kuntsche, Keundig, & Gmel, 2008). Recent research has identified specific social processes through which neighborhoods influence child developmental outcomes. The degree of social cohesion among neighborhood members and their willingness to intervene for the common good—a construct known as collective efficacy—has been

shown to mediate the effects of concentrated poverty and neighborhood disadvantage on crime, violence, children's antisocial behavior, and composite measures of child mental health (Sampson, Raudenbush, & Earls, 1997; Xue, Leventhal, Brooks-Gunn, & Earls, 2005).

A primary methodological question raised in research on neighborhoods and health involves the role of selection; it is difficult to disentangle whether associations between neighborhood characteristics and developmental outcomes reflect actual neighborhood effects or whether differential selection of individuals into neighborhoods explains these associations (Sampson et al., 2002). Advanced statistical methods have been developed to try to model selection effects (Sampson, Sharkey, & Raudenbush, 2007), but they remain a persistent challenge in neighborhood research. The Moving to Opportunity (MTO) Study, an experimental study that randomized families living in public housing in high-poverty neighborhoods to receive relocation and rent assistance in order to move to a low-poverty area, provides more rigorous evidence for the importance of neighborhoods on child development and health outcomes. Longitudinal follow-up of these families found that parents who moved to low-poverty neighborhoods reported less distress than those who stayed in high-poverty neighborhoods, and boys who moved to low-poverty neighborhoods exhibited lower symptoms of anxiety and depression than those who did not move (Leventhal & Brooks-Gunn, 2003).

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## Policy-Level Influences

One of the more exciting recent developments in developmental epidemiology involves the use of epidemiological data to investigate the influence of public policies on child health and developmental outcomes. National tracking surveys (i.e., cross-sectional surveys that are repeated at regular intervals such as the National Health Interview Survey [NHIS] and the Youth Risk Behavior Surveillance System [YRBSS]) provide an excellent opportunity to examine the associations of public policies with mental health and health

behaviors at the population level. An important consideration in this type of research is to ensure that the dataset selected to examine health outcomes can be aggregated at the appropriate level for the policy being examined. If a state-level policy is of interest, a dataset must be used that classifies respondents based on state of residence; if county-level policy is the focus, aggregation of respondents at the county level must be possible. Policies at the school, county, and state levels have been shown to have important influences on child mental health and development. For example, a recent study suggests that school-level policies and other aspects of the social environment are associated with suicide attempts among LGB adolescents. Hatzenbuehler (2011) determined the proportion of schools in each county in Oregon that had implemented antidiscrimination and anti-bullying policies that specifically protected sexual minority youths and had gay-straight alliances on campus; this measure of school policy was combined with several other markers of the social environment (e.g., proportion of same-sex couples in each county) and linked to individual-level mental health data from the Oregon YRBSS, aggregated at the county level. The findings indicated that LGB adolescents are at elevated risk for suicide attempts in counties with a smaller proportion of schools that have protective policies and gay-straight alliances (Hatzenbuehler, 2011). Epidemiological research has also documented relationships between the amount of state excise taxes on cigarettes and child exposure to smoke within the home (Hawkins, Chandra, & Berkman, 2012), between state-level alcohol taxes and the prevalence of alcohol dependence (Henderson, Liu, Diez Roux, Link, & Hasin, 2004), and between state-level school nutrition and physical education policies and the prevalence of child/adolescent obesity (Riis, Grason, Strobino, Ahmed, & Minkovitz, 2012). Studies that directly examine public policies in this way have the advantage of providing clear guidance regarding policy interventions that might ameliorate developmental outcomes at the population level.

Epidemiological data that is collected over multiple time points can also be used to monitor

changes in population-level health following changes in public policy. An innovative example of this type of research is a study conducted by Costello and colleagues (Costello, Compton, Keeler, & Angold, 2003) using data from the Great Smoky Mountain Study, which began annual data collection in 1993. During this ongoing data collection, a change in public policy resulted in the opening of a casino on an American Indian reservation that included children in the Great Smoky Mountain Study (Costello, Compton, et al., 2003). The casino opening resulted in an income supplement for all families living on the reservation, as well as increased employment opportunities. A meaningful proportion of families living in poverty at the beginning of the study were no longer poor 8 years later. Before the casino opened, children living in families that would be moved out of poverty had similar levels of psychopathology as children living in families that would remain persistently poor; both of these groups had higher psychopathology than children living in nonpoor families. Following the casino opening, children living in families that were no longer poor experienced a decrease in externalizing symptoms such that they had lower levels of symptoms than children whose families remained poor and similar levels of symptoms to children in families that were never poor (Costello, Compton, et al., 2003). No changes in internalizing symptoms were observed as a result of the intervention. These findings provided strong evidence for social causation theories of the relationship between poverty and mental illness, particularly for child externalizing behavior.

National tracking data can be used in a similar fashion to monitor changes in mental health at the population level following major events, such as natural or man-made disasters. If survey data are not collected in close enough proximity to an event to determine changes in psychopathology following that event, study designs can draw on the measures used in national tracking surveys to use in original data collection. For example, the NHIS has administered the Strengths and Difficulties Questionnaire (Goodman, 1999) to parents in every year since 2001 to estimate the prevalence of serious emotional disturbance

(SED) among US children. This same measure was administered to a population-based sample of adults following Hurricane Katrina. This study estimated that 15.1 % of youths aged 4–17 in hurricane-affected areas had SED following the storm compared to 4.7 % in hurricane-affected areas prior to the storm based on NHIS data from the previous year using the same measure (McLaughlin et al., 2009). Information of this sort can be useful to policy makers for mental health service planning purposes.

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## Service Utilization

Epidemiological data can also be utilized to examine the use of mental health services among children and youths in order to generate estimates of unmet need for treatment and identify factors that influence service utilization. Data from the Great Smoky Mountain Study indicate that service use is strongly associated with need; children and adolescents with SED are nearly 10 times as likely to receive mental health services than youths without a disorder (Burns et al., 1997). However, only 40 % of youths who meet criteria for a mental disorder and experience significant functional impairment (thus qualifying as having SED) received mental health services in the 3 months preceding the survey, and only 20 % received services in the specialty mental health sector (Burns et al., 1995). Among children and adolescents who receive mental health treatment, the vast majority obtain it in the education sector, typically from guidance counselors and school psychologists (Burns et al., 1995, 1997). Youths who have public insurance (i.e., Medicaid) are more than four times as likely to receive mental health services than those without insurance coverage, although children and adolescents with private insurance are no more likely than youths without coverage to receive services (Burns et al., 1997). Together, these findings suggest substantial unmet need for mental health services among youths with functionally impairing mental disorders, the substitution of school-based services for services in the specialty mental health sector, and potential problems with access to treatment for uninsured youths and those with private insurance.

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## Using Epidemiological Data

This section focuses on how researchers in developmental psychopathology can use epidemiological data in their own research. An increasing number of developmental epidemiology datasets are publicly available and can be either downloaded or requested for use by researchers for little or no cost. These datasets provide researchers the opportunity to utilize population-based data and to incorporate epidemiological research methods into an existing program of research. Table 5.1 provides a description of publicly available epidemiological datasets that are well suited to addressing research questions in developmental psychopathology. Although this list is far from exhaustive, the highlighted datasets include a selection of different study designs (e.g., cross-sectional, longitudinal), different sampling strategies (e.g., nationally representative, birth cohort), and a focus on diverse sets of risk and protective factors for psychopathology. Many of these datasets—and others not included in this review—are available from the Inter-University Consortium for Political and Social Research (ICPSR) at the University of Michigan: <http://www.icpsr.umich.edu/icpsrweb/ICPSR>.

There are several advantages to incorporating publicly available epidemiological datasets into one's research program. The most obvious benefit is the savings in terms of time and expense associated with collecting data. Of course, not all research questions can be investigated using epidemiological data. But many can, and using existing data is typically more efficient than obtaining funding and collecting data on one's own. Moreover, most publicly available epidemiological datasets include large numbers of participants (typically 10,000+), providing greater power to examine risk and protective factors and other exposure–outcome relationships than is often possible when collecting one's own data. Another advantage of using epidemiological data is that the sampling frame and sampling strategies are articulated (typically in the study documentation), allowing you to make more accurate inferences about the study population than is possible when using convenience or clinical samples or other study designs that do not involve

**Table 5.1** Characteristics of a sampling of publicly available developmental epidemiology datasets

Study name	Study design	N	# of waves	Age range	Sampling strategy	Mental health outcomes	Notable exposures
National Longitudinal Study of Adolescent Health (Add Health) <sup>a</sup>	Cohort	Wave 1: 90,118 (in school), Waves 2–4: 20,745 (in home) 14,000+	4	Wave 1: Grades 7–12 Wave 2: Grades 8–12 Wave 3: 18–26 Wave 4: 24–32	Stratified, random sample of all high schools in the United States at wave 1; Stratified random sample of respondents for in-home interviews for waves 1–4	Depressive symptoms, alcohol and drug use, symptoms of alcohol and drug abuse, suicidal ideation, suicide attempts, and healthcare utilization	Sexual behaviors, social networks, romantic relationships, sexual attraction, sexual orientation, timing and frequency of exposure to physical and sexual abuse, numerous aspects of social context, biomarkers including BMI, C-reactive protein, glycosylated hemoglobin, blood pressure, and DNA
Avon Longitudinal Study of Parents and Children (ALSPAC) <sup>b</sup>	Birth cohort	14,000+	10+ and ongoing	Data available beginning at birth and through age 15	Attempted to enroll all pregnant women in Avon County, UK with expected delivery dates between 4/1/1991 and 12/31/1992 using numerous sampling methods	Depressive symptoms and MDD, anxiety symptoms disorders, attention and hyperactivity, oppositional and antisocial behavior, psychosis, borderline personality disorder symptoms, eating disorders, and self-harm	Parenting, temperament, personality, social cognition and communication, diet and lifestyle, daycare, schooling, achievement, cognitive ability, physical health, housing, pollutants, parent-reported stressors, bullying, peer and romantic relationships, serum collection of C-reactive protein and interleukin-6, and DNA
Project on Human Development in Chicago Neighborhoods <sup>c</sup>	Cohort	6,000+ at wave 1	3	Wave 1: age 6 months, 3, 6, 9, 12, 15, or 18 years	Multistage clustered area probability survey	Antisocial behavior, substance use, depressive symptoms, generalized anxiety disorder, conduct disorder and oppositional defiant disorder, and suicidal behavior	In-depth information on structural conditions and organization of neighborhoods, including organizational and political structure, cultural values, informal social control, formal social control, social cohesion, relationships among neighbors, crime, violence, graffiti, social norms, alcohol and drug use, and use of police force. Good information on family and developmental factors
National Health Interview Survey (NHIS) <sup>d</sup>	Repeated cross sectional	75,000+ annually (10,000+ children of adult respondents)	11 since expanded child mental health questions added	18+ (with numerous questions about children of adult participants)	Multistage area probability survey	ADHD, mental retardation, developmental delay, autism, and emotional and behavioral problems (measured using the Strengths and Difficulties Questionnaire <sup>e</sup> beginning in 1991; items from the Child Behavior Checklist <sup>f</sup> are used for children aged 2–3)	Parent and child physical health status, parent and child injuries, parent mental health, child mental health service utilization, family SES, health insurance coverage, and healthcare access and utilization
Monitoring the Future <sup>e</sup>	Repeated cross sectional	50,000+ annually	37 and ongoing	8th, 10th, and 12th graders	Multistage clustered area probability survey	Use of illicit drugs, alcohol, and tobacco	Sexual risk behaviors, parental monitoring, beliefs about substance use, exposure to drug education, engagement in school activities, exposure to crime and violence, and religious beliefs.

(continued)

**Table 5.1** (continued)

Study name	Study design	N	# of waves	Age range	Sampling strategy	Mental health outcomes	Notable exposures
National Survey on Drug Use and Health	Repeated cross sectional since 1991	70,000+	24 and ongoing	12+ years	Multistage area probability survey	Use of illicit drugs, alcohol, and tobacco, past-month distress, and suicidal ideation	Neighborhood environment, illegal activities, drug use by friends, social support, extracurricular activities, exposure to substance abuse prevention and education programs, and perceived adult attitudes towards drug use
Youth Risk Behavior Surveillance Survey (YRBSS)	Repeated cross sectional; biannually conducted since 1991	10,000+	23 and ongoing	Grades 9–12	Three-stage cluster sample design	Alcohol and other drug use, tobacco use, and suicidal behavior	Risk behaviors that contribute to unintentional injuries and violence, sexual behaviors, sexual orientation, unhealthy dietary behaviors, inadequate physical activity, and bullying
National Comorbidity Survey Replication Adolescent Supplement (NCS-A) <sup>c</sup>	Cross sectional	10,484	1	13–17 years	Dual-frame household and school samples: (1) adolescent residents of households participating in the NCS-R selected using a multistage clustered area probability sample; (2) probability sample of schools in NCS-R primary sampling units, probability samples of students within schools	DSM-IV diagnoses assessed using the Composite International Diagnostic Interview Schedule for DSM-IV (CIDI) including mood (major depression/dysthymia, bipolar disorder), anxiety (panic disorder, GAD, social phobia, specific phobia, PTSD, separation anxiety disorder), behavior (conduct disorder, ODD, ADHD, IED), substance disorders (alcohol and drug abuse and dependence), and suicidal behavior	Childhood adversities (maltreatment, domestic violence, parental separation), traumatic events, family socioeconomic status, peer and family relationships, romantic relationships and sexual behavior, physical health, cognitive function, academic achievement, and parent mental health
Collaborative Psychiatric Epidemiology Surveys (CPES) <sup>e</sup>	Cross sectional	20,013	1	18+ years	Multistage clustered area probability	DSM-IV diagnoses assessed using the Composite International Diagnostic Interview Schedule for DSM-IV (CIDI)	Oversample of Black, Hispanic, and Asian Americans; discrimination experiences, acculturation, and ethnic identity
National Epidemiological Survey of Alcohol and Related Conditions (NESARC) <sup>g</sup>	Longitudinal	Wave 1: 43,093 Wave 2: 34,653	2	18+ years	Multistage clustered area probability	DSM-IV diagnoses assessed using the Alcohol Use Disorder and Associated Disability Interview Schedule—DSM-IV Version (AUDADIS); extensive assessment of alcohol and drug use disorders	Sexual orientation, discrimination, childhood adversity (wave 2), trauma exposure (wave 2), and social support

<sup>a</sup>More details available at <http://www.cpc.unc.edu/projects/addhealth>

<sup>b</sup>More details available at <http://www.bristol.ac.uk/alspac/>

<sup>c</sup>Data available at the Inter-University Consortium for Political and Social Research: <http://www.icpsr.umich.edu/icpsrweb/ICPSR/>

<sup>d</sup>More details available at <http://www.cdc.gov/nchs/nhis.htm>

<sup>e</sup>Goodman (1999)

<sup>f</sup>Achenbach and Edelbrock (1979)

<sup>g</sup>More details available at <http://niaaa.census.gov/data.html>

probability sampling. Finally, as reviewed in the previous sections, epidemiological studies are well suited to addressing a variety of research questions that are difficult to investigate using other study designs, especially research questions that require data collected at multiple levels of analysis (e.g., biological, psychological, and social/contextual). Leveraging publicly available data provides an opportunity to incorporate these types of research questions into one's own research program.

Using publicly available data is not without disadvantages, however. Using a dataset that was not designed or collected specifically to answer your research question of interest presents several challenges. Most notably, the measures used to assess a given construct of interest are likely to be shorter or more cursory than what would be included in a study designed specifically to address your research question. In general, epidemiological datasets are not constructed to answer one specific research question; rather, they are collected to provide a general population-based resource for addressing numerous questions about a particular outcome or set of outcomes (e.g., mental disorders). As a result, many studies focus on breadth rather than depth when assessing risk and protective factors. This requires adaptability on the part of the researcher in terms of determining how available measures can be used to address one's research question. It is also important to acknowledge that beginning to use an existing dataset involves a significant time commitment. Although the investment of time is often less than what would be required to collect a new dataset of one's own, ample time is needed to familiarize oneself with the data structure, variables, and idiosyncrasies of a new dataset. This investment of time is most useful when a dataset can be used to address multiple questions of interest in one's research program.

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## Selecting a Study

In addition to the general advantages and disadvantages of using publicly available epidemiological data, each of the primary epidemiological study design types involve specific

methodological benefits and costs that are important to consider before selecting a dataset. This section reviews the advantages and disadvantages of using cohort, cross-sectional, and case-control studies to investigate questions in developmental psychopathology.

Cohort studies are typically the design type of choice in developmental epidemiology because they are prospective and can directly examine developmental changes in psychopathology and in exposure-outcome relationships. A classic cohort study enrolls individuals with and without a particular exposure (e.g., maternal smoking during pregnancy) and follows them over time to ascertain disease outcomes as a function of exposure. Most cohort studies in developmental epidemiology use a more general approach of recruiting a large sample and following respondents over time, rather than selecting on the basis of a specific exposure. An example of this type of cohort study is the National Longitudinal Study of Adolescent Health (Add Health). More specifically, many developmental epidemiology cohort studies are birth cohorts. Birth cohorts recruit as many respondents as possible who were born in a particular place at a particular time and follow them longitudinally. Examples of birth cohort studies include the Dunedin Multidisciplinary Study of Health and Development, the Avon Longitudinal Study of Parents and Children, and the Christchurch Study.

Cohort studies involve numerous methodological advantages. These include the ability to estimate the risk ratio, which is the risk of disease among individuals exposed to particular risk factor divided by the risk of disease among the unexposed. The risk ratio is the gold standard measure of effect in developmental epidemiology (Tu, 2003). Critically, cohort studies also allow the temporal ordering of risk and protective factors relative to disorder outcomes to be established. They also provide the opportunity to model developmental trajectories to estimate how symptoms and disorders vary over time within individuals and how risk and protective factors influence these developmental trajectories. Cohort studies are thus particularly well suited to studying the course of mental disorders, identifying risk factors for

disorder persistence, and examining the temporal sequencing of comorbid disorders. Together, these advantages make cohort studies the mainstay of developmental epidemiology.

Cohort studies are not without disadvantages, however. First, cohort studies are not well suited to studying rare outcomes (e.g., body dysmorphic disorder), because there are typically not enough cases available in a given sample to provide reliable estimates of association. Attrition is a major challenge in cohort studies. Participant loss to follow-up threatens the careful probability sampling involved in epidemiological studies and influences the types of inferences that can be made about the study population. Attrition is a particular problem when it occurs differentially (i.e., when it is not random). If participants with a specific mental disorder (i.e., depression) or with a specific risk factor (i.e., child maltreatment) are more likely to drop out of the study, this introduces bias in estimating prevalence and the associations between risk factors and outcomes. For example, the association between child maltreatment and substance disorders will be underestimated if participants who have a history of maltreatment and a substance disorder are more likely to drop out of the study than participants with maltreatment exposure who do not have a substance disorder. An additional challenge in cohort studies involves measurement of constructs across development. Often, different measures are used to assess the same construct in childhood as compared to adolescence or adulthood. For example, depressive symptoms are typically assessed using different instruments at different developmental periods. This introduces challenges in modeling change over time and may require the use of latent variable approaches. Finally, some prominent birth cohort studies (e.g., the Dunedin Multidisciplinary Study of Health and Development) were started before reliable and valid measures had been created to assess many constructs of interest in developmental psychopathology. As such, assessment of childhood characteristics in these studies is frequently based on measures that might be outdated as compared to current gold standards.

One additional limitation of cohort studies, from the perspective of the investigators collecting the data, is that they are costly and time consuming. Many years of follow-up are typically needed to track participants through risk periods of interest, requiring substantial investments of time and money. Accelerated cohort designs, also called cross-sequential cohorts, present a solution to this issue. Accelerated cohorts enroll separate cohorts of participants (i.e., groups of participants born in the same year) into the study at baseline. Participants are then followed across time and complete additional assessments at regular intervals. Comparison of developmental changes across cohorts provides the ability to determine whether these effects are similar across birth cohorts or whether they differ according to year of birth or time of measurement. This type of study design also allows greater efficiency in studying developmental change than in a typical cohort design, because developmental changes can be examined over a longer time period than the actual follow-up period of the study. The Great Smoky Mountain Study (Costello et al., 1996) is an example of an accelerated cohort design. Three cohorts of children were recruited at baseline, aged 9, 11, and 13 years. Children were reassessed annually, and data from this study have produced numerous important findings regarding incidence, prevalence, comorbidity, and developmental changes in psychopathology from middle childhood through adolescence (Costello, Mustillo, et al., 2003). An additional advantage of this study design is the ability to examine age–period–cohort effects, described earlier in the chapter. A disadvantage with this study design is that there are fewer participants at the tails of the age distribution (i.e., the oldest and youngest age groups) at any given time point.

Cross-sectional studies are also frequently used to answer developmental epidemiology research questions. In a cross-sectional study, participants complete study assessments at a single point in time and are not followed longitudinally. Cross-sectional studies are often used for estimating disorder prevalence, distribution, and

comorbidity. An example of a cross-sectional epidemiological study designed to study these constructs is the NCS-A (Kessler et al., 2009). Cross-sectional studies can also be used to study relationships of risk and protective factors with mental disorders and are particularly well suited to studying exposures that do not change with time (e.g., sex, race/ethnicity). If data are carefully collected regarding disorder age of onset and timing of exposure, it may also be possible to estimate associations between temporally prior risk and protective factors and subsequent disorder onset using survival analysis or other regression-based techniques. This approach has frequently been used in cross-sectional epidemiological datasets by Ronald Kessler and colleagues to study exposure–disorder relationships, for example, the relationship between temporally prior mental disorders and subsequent onset of secondary comorbid disorders (Kessler, Avenevoli, McLaughlin, et al., 2012). From a data collection perspective, cross-sectional studies are less time consuming and costly than cohort studies. As a result, cross-sectional epidemiological studies often include much larger samples than cohort studies. Another primary advantage of cross-sectional studies is that attrition is not a concern. Probability sampling techniques and weighting can be applied to ensure that inferences based on the study sample are generalizable to the source population of interest. Some cross-sectional epidemiological surveys are repeated at regular intervals, typically annually, resulting in numerous unique samples of the population across time. Examples of repeated cross-sectional surveys include the Monitoring the Future Study (<http://www.monitoringthefuture.org>), the NHIS (<http://www.cdc.gov/nchs/nhis.htm>), and the YRBSS (<http://www.cdc.gov/HealthyYouth/yrbss/index.htm>).

The primary disadvantage in using cross-sectional studies is that the temporal ordering of exposures and disorder onset cannot be firmly established. Retrospective recall is required to estimate the developmental timing of events, and numerous recall biases may influence the validity of these estimates. Although procedures have

been developed to improve the accuracy of these reports (Knauper, Cannell, Schwarz, Bruce, & Kessler, 1999), recall bias is difficult to eliminate completely. It is important to note, however, that retrospective recall is required even in prospective studies. In the absence of daily monitoring of participants, which is not a method typically employed in epidemiological studies, respondent reports of events occurring over some previous time period must be used to assess most constructs of interest. Cohort studies provide the advantage of reducing the period of time for which participant recall is required. An additional disadvantage of cross-sectional studies is incidence-prevalence bias. Cross-sectional studies typically focus on prevalent cases (e.g., current cases of major depression). Because prevalent cases often differ in important ways from incident cases, identification of risk factors among prevalent cases may confound factors associated with disorder onset with factors associated with disorder persistence.

Case–control studies are also frequently used in epidemiological studies. Case–control studies involve selecting participants with and without a specific disease or disorder (cases and controls, respectively) and collecting an exposure history to determine exposure–outcome relationships. Case–control studies are less frequently used in developmental epidemiology and are typically conducted to answer a focused research question. For example, this type of study design has been used to investigate risk factors for autism, including maternal autoimmune disorders (Croen, Grether, Yoshida, Odouli, & Van de Water, 2005; Smeeth et al., 2004). Case–control studies are advantageous for studying rare outcomes more cheaply and efficiently than cohort studies but have numerous methodological disadvantages. Recall bias is a prominent concern, particularly if recall bias differs among cases and controls. This is a likely possibility in many cases, particularly if parents of children with and without a disorder are being interviewed about past exposures. Parents of children with a mental disorder may be more invested in accurately recalling past exposures or may have better memory for events that

could be related to their child's condition. Case-control studies that use existing medical record or archival data that were collected prior to the ascertainment of cases and controls can overcome this methodological weakness. A second primary concern is that cases and controls are often selected using different methods and therefore represent different source populations. Finally, the measure of effect used in case-control studies, the odds ratio, often overestimates the risk ratio—the gold standard association between an exposure and outcome (Tu, 2003). Nested case-control studies eliminate most of these disadvantages. Nested case-control studies involve selecting cases and controls from an ongoing cohort study and using exposure data collected at a previous time point as part of the cohort study. In this type of study, the odds ratio is a valid estimate of the risk ratio because cases are included in the sampling frame for selection of controls, and recall bias is not a concern. For example, data from longitudinal population registers in Denmark were used to examine risk factors for suicide in youth aged 10–21. A nested case-control study was conducted by examining all completed suicides over a 16-year period (cases) and a sample of controls matched on age and sex. Using previously collected data in the registry, investigators identified parental and respondent mental illness as the factors most strongly associated with youth suicide (Agerbo, Nordentoft, & Mortensen, 2002). Because case-control studies are typically initiated to study a fairly specific research question, no such studies are included in Table 5.1.

## Conclusion

Developmental psychopathology is centrally concerned with the dynamic interplay between risk and protective factors operating at multiple levels to influence developmental outcomes. This includes a focus on neurobiological, psychological, and social development and, in particular, the importance of social context and social ecology in shaping each of these aspects of development. Developmental epidemiology

methods are uniquely suited to addressing these types of complex multilevel questions. Indeed, epidemiological approaches offer the ability to simultaneously explore risk and protective factors operating within individuals, families, schools, neighborhoods, and society. Developmental epidemiology methods can also be leveraged to identify the forces driving population-level patterns of youth mental disorder prevalence and comorbidity, service use, and mental health disparities across population subgroups, space, and time. An increasing number of epidemiological studies of child and adolescent mental illness have been conducted that are freely available to researchers in developmental psychopathology, providing unique opportunities to investigate the multitude of interacting determinants of child mental health and development in the population.

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