Risk-taking Behavior in Adolescents: 
The Paradigm$^a$

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INTRODUCTION

The majority of adolescents emerge from the second decade of life relatively un-scarred by serious social, psychological, or physical disability.$^{1-4}$ Risk behaviors are largely responsible for the negative health outcomes among the remaining significant minority of adolescents. The primary immediate threats to adolescent health are preventable behaviors such as substance use, dangerous vehicle use, and sexual behavior. Unhealthy eating behaviors have generally not been considered under the risk construct; however, there are many similarities between the traditional behaviors classified as risky and eating behaviors. These behaviors have a developmental trajectory as well. Typically, they increase in prevalence over the adolescent years,$^5$ with rates of substance use, unhealthy eating behaviors, and injury-related behaviors peaking in late adolescents and declining in young adulthood.$^6-8$ These potentially health-damaging behaviors, established during adolescence, often have lasting deleterious effects throughout the life span. There is considerable debate about whether these behaviors are risk-taking behaviors or just risky behaviors with negative health outcomes. A critical question continues to be debated: Does the risky nature of the behaviors initiated during adolescence in conjunction with their volitional nature imply that there is a conceptual link among the behaviors? A number of investigators and theorists argue that adolescent risk taking is a valid construct, although they disagree about its conceptual basis.

Since the focus of these proceedings is Adolescent Nutritional Disorders, whenever possible the issues specifically related to eating and the associated behaviors will be highlighted. It is hard to pinpoint an absolute reason why adolescents are at increased risk for risky behavior and the associated negative nutritional outcomes. As with all health problems, there is a complex relationship among the host, the agent, and the environment that are associated with an increased likelihood of engaging in risky behaviors.

This paper reviews the theoretical constructs that provide a framework for under-

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$^a$Partial support for development of this paper was provided by the Maternal and Child Health Bureau, Health Resources and Services Administration, Department of Health and Human Services (MCJ000978, MCJ063A80A, and MCJ060564) and the William T. Grant Foundation.
standing the covariation of risk-taking behaviors, the nature of adolescence itself, the prevalence of adolescent sexual activity, substance use, injury-related behaviors, eating behaviors, and delinquency, and the mechanisms by which these behaviors co-vary. In addition, we present data from our longitudinal study of risk taking during adolescence.

**RISK-TAKING BEHAVIOR: A DEFINITION**

Two assumptions have driven much of the work on risk taking in adolescents. First, teenagers engage in a series of "risky" behaviors and feel invulnerable to the consequences of these behaviors as compared to adults.

Second, all risk-taking behaviors occurring through the second decade of life are driven by similar mechanisms and the behaviors themselves are similar.

Risk-taking behaviors can be distinguished from developmentally appropriate exploratory behavior by their potentially serious, long-term, and negative consequences. Whereas adolescent exploratory behavior in a safe or positive context enhances competence and confidence, risk-taking behaviors jeopardize health and well-being. Some risk-taking behaviors are defined by their adolescent age of onset. For example, sexual activity, certain eating behaviors, driving a car, drinking alcohol, or leaving home may be considered risk-taking behaviors at age 13, but may not be at age 21. Some behaviors are risky regardless of age such as unhealthy eating behaviors, promiscuous sexual behavior, cocaine use, or driving under the influence of alcohol.

For the purposes of this paper, risk-taking behaviors will refer to volitional behaviors including sexual activity, eating behaviors, substance use, delinquency, and injury-related behaviors. Negative health outcomes of these behaviors include sexually transmitted diseases, unplanned pregnancy, school failure, habituation, premature cardiovascular disease, hypertension, obesity and its associated medical sequelae, physical and psychological disability, and death. Psychopathologic health-jeopardizing behaviors (e.g., suicidal behaviors and serious eating disorders) are not volitional in the traditional sense, and are therefore not considered risk-taking behaviors for the purposes of this paper.

The paradigm of risk is described in the following section using three general explanatory approaches: dispositional, ecological, or biological bases for risk-taking behavior. These distinctions are not clearly demarcated since theories often borrow from more than one of these approaches.

**RISK TAKING AS A DISPOSITIONAL TRAIT**

Dispositionally based theories of risk taking focus on individual differences associated with a tendency to engage in risky behaviors. These theories view risk taking as deviant. The hypothesized deficits leading to deviancy include poor self-esteem, depression, inadequate social skills, impulsivity characteristic of attention deficit disorder, or a general propensity for unconventionality and deviance.
With each of the proposed causal factors, there is some evidence that the factor is associated with risky behaviors under a specific condition. There is also an emerging body of evidence that may contradict some of the evidence. For example, in the area of self-esteem, poor self-esteem appears to be associated with a number of risky behaviors and forms the basis of many intervention programs. However, a careful examination of the relationship of self-esteem and risk leads to a body of evidence that risk taking itself can raise self-esteem \(^{14,15,18}\) or that certain risky behaviors, for example, sexual behavior, are correlated with a higher level of self-esteem.\(^{22}\)

Individual-difference models maintain that certain dispositional characteristics may not be deficit models but reflect underlying differences in the organism (e.g., sensation seeking). Theories of sensation seeking\(^{23-26}\) state that individuals differ in terms of their underlying needs for stimulation (or sensation or thrill seeking), which underlies much of risk-taking behavior. Sensation seekers are willing to take risks for the sake of increases in stimulation and arousal. Sensation seeking has been associated with substance use, sexual behavior, dangerous sports, and motor-vehicle use. A new body of evidence indicates that these biological differences may also be protective if the environmental context is supportive.\(^{27}\)

### RISK TAKING FROM AN ECOLOGICAL PERSPECTIVE

In contrast to an individually oriented theory of risk taking, an ecological theory considers the human organism within its social and environmental context. These theories propose that contextual factors such as economic status, cultural background, and the general social environment provide social norms, models, opportunities, and reinforcements for adolescent participation in risky behaviors.

An ecological paradigm is used by Bronfenbrenner to describe the social world of adolescents.\(^{28}\) The most proximal contexts are referred to as microsystems, and include those elements of the social environment with which adolescents interact directly, such as peers, family members, and social institutions such as schools or churches. More distal social contexts such as the community, the mass media, and social policies are called exosystems. The most distal social contexts are referred to as macrosystems, which reflect things such as cultural, economic, and political contexts. Many of the conceptual models of risk taking described in the literature can be overlaid onto this general ecological model. Each of the four system levels described by Bronfenbrenner is described below.

#### Microsystems and Mesosystems: Peers and Parents

Among all the microsystems of potential relevance, the role of peer influences in adolescent risk taking has generated the most interest. "Peer pressure" has been implicated as an etiologic factor in adolescent substance use, sexual behavior, and antisocial behavior,\(^{29,30}\) and intervention programs designed to teach adolescents how to resist peer pressure have been developed and widely implemented.\(^{31-33}\) During adolescence, peers assume an increasing influence as adolescents begin to establish an identity outside of the family group.\(^{30}\) Conformity increases during the adolescent
period, peaking during early adolescence and decreasing thereafter. Social learning theory would suggest that peers may promote risky behaviors by providing models. Beyond modeling, peers may also provide opportunities for risky behavior to occur. Research supports an association, both cross-sectionally and longitudinally, between the adolescents' behavior and the behavior of their peers. The initiation of risk behaviors may emerge from a desire to conform to an existing peer group, or adolescents who are inclined to taking risks may specifically choose peers who are similarly inclined.

Parents are important elements of the microsystem for adolescents. The linking of parents and adolescent risk taking has focused on the role of parenting styles, monitoring, and modeling. Two dimensions of parenting styles appear to be important in adolescent risk taking: the level of demand that parents place on their adolescents (e.g., limit-setting and responsibility), and the degree of emotional responsibility. In support of this approach, some research indicates that adolescents whose parents are authoritative (demanding and responsive) are less likely to use substances than either those with authoritarian (demanding but unresponsive) or permissive (non-demanding but responsive) parents. Adolescents with neglecting and rejecting parents are the most likely to engage in substance abuse.

Parents may also influence adolescent risk taking as a function of their monitoring of their child's behavior. Lack of supervision has been used, for example, to explain the reported relationship between family structure and risk taking. Adolescents from single-parent families are more likely to initiate intercourse and less likely to use contraception than their peers from intact families, and are more likely to engage in various forms of substance use. Younger adolescents (ages 13 to 14 years) who take care of themselves after school show a twofold increase in substance use compared to their supervised peers. There is also evidence that family structure does not act as an independent variable and that adolescents who are emotionally autonomous (independent of family structure) engage in more risks.

Lack of parental supervision could be an explanation for the increase in adolescent risk taking over the past four decades. Significant changes in family structure have taken place in the United States. Consider, for example, the image of the "typical family," with a working father, a housewife mother, and two or more school-age children. In 1955, 60% of the households in the United States fit this description; in 1985, only 7% of families fit the description. Significant increases in the divorce rate, the number of children born to unmarried females, and the percentage of mothers in the labor force have changed the nature of the typical family. By mid-1985, nearly 70% of mothers with children between the ages of 6 and 17 years were in the labor force, leaving three-quarters of the 13-14-year-old children in the United States in self-care or with a younger sibling for more than 10 hours a week. Other authors argue that other things, such as political and cultural changes, are more critical in the increase in risk taking.

Beyond lack of supervision, parents may influence adolescent risk as a function of modeling. The strongest evidence for the effects of modeling have come from research on parental and adolescent tobacco use, which show a significantly higher rate of smoking among adolescents whose parents also smoke. Adolescent children of substance-abusing parents are also more likely than children of abstainers to abuse substances, although alternative models, such as genetic predisposition, have also been offered to explain this.
Parental influence may also be viewed in relation to how it compares to peer influence. Jessor has argued that it is the relatively greater influence of peers compared to parents that is associated with a greater tendency toward risk-taking behaviors. This explanation is supported by research showing the relative dominance of peer influence over parental influence to be predictive of marijuana use, problem drinking, and early sexual intercourse. The concept of the "mesosystem," represents an interrelationship between various microsystems, such as peers or parents. The relative influence of parental versus peer values can be viewed as an effect of the mesosystem.

**Exosystems: Neighborhoods, Communities, and the Media**

Exosystems reflect social contexts (often referred to as the social environment) that influence adolescent behavior. Media and community norms are examples. There is some evidence to support the effects of role models for risk-taking behavior that are regularly presented by the media. Controversy remains about the role of the media and the direct effects of these media presentations on risk taking. The pervasive nature of the media makes it difficult to conduct controlled research that would allow for clarification of the role of the media. Most of the research base is concentrated in the area of television violence and childhood aggression. More recently, investigators have explored the role of the media on its portrayal of dieting behaviors and body types. The direction of the effects of the media remains uncertain.

The social context model focuses on the neighborhood and the community. Communities show marked variation in their rates of adolescent alcohol use, illicit substance use, and early sexuality and childbearing. Some theorists suggest that certain environments are risk-promoting by providing adolescents with access to, and motivation for, engaging in risk taking. Access to risk taking is increased in communities that permit cigarette vending machines and food vending machines or that lower required ages to purchase alcohol. In some communities, such as economically depressed, inner-city neighborhoods, behaviors such as substance use may emerge as a function of the availability of substances in these communities, and the establishment of economic opportunities by selling drugs. Communities may also influence risk behaviors as a function of how well they link the achievement of desired future goals to the absence of risk behaviors. This may be absent in environments where adolescents see few examples of adults who have achieved these desired goals. These theories may help explain why covariation exists in some individuals but not in others. Adolescents who see few opportunities to participate in conventional adult roles may be particularly likely to embark on a lifetime risk-taking syndrome.

**Macrosystems: The Impact of Culture**

From the macrosystem perspective, risk-taking behavior rates vary in different cultural, economic, and political contexts. For example, despite similar ages of sexual debut, the United States has the highest rates of adolescent childbearing and abortion in the developed world. This is thought to be related to differing normative views about adolescent sexuality and contraception. Similarly, rates of contraceptive use have been found to vary significantly by ethnicity and religious affiliation.
though the former may be confounded by factors related to socioeconomic status, another macrosystem variable.

Eating behaviors vary markedly by culture—black youth eat more fat food and food with higher sugar control than does white youth. The history of research on race ethnicity and poverty points to a frequent confounding of the two. While we generally consider impoverished environments to be associated with higher levels of adolescent risk taking, we actually know little about risk taking in poor adolescents. Cultural factors, while viewed as critical, also have not undergone the level of study that is required. For example, little research has explored the meaning of risk taking in different cultures.

**BIOLOGICAL MODELS OF RISK-TAKING BEHAVIOR**

Biological models of risk-taking behavior have considered the roles of genetic factors, neuroendocrine processes, including hormonal influences, and the timing of pubertal events. The first two of these are hypothesized as having direct effects on behavior. Genetic predisposition has been implicated in adolescent alcohol abuse. The biological children of alcoholic parents are more likely to later abuse alcohol than are the children of nonalcoholics, even when they are separated from their parents. Neuroendocrine factors are viewed as the etiological agent in some sensation-seeking theories. The most familiar model positing direct effects of biology on behavior comes from theories about the role of sex hormones in behavior. Udry and his colleagues have demonstrated the importance of testosterone levels to heterosexual intercourse and the onset of other risk behaviors in males. In females, the link between testosterone and sexual behavior appears to be mediated by the social environment. The effects in nonwhites have yet to be established.

Biological factors may also have indirect effects on risk taking. This has been most clearly addressed in the area of hormonal influences. The onset of puberty, which is often seen as the onset of adolescence, is driven by hormonal changes. Puberty is associated with major and rapid transformations in body shape, size, and appearance. The youngster who looked like a child now looks like an adult. These physical changes may be associated with differences in how the social environment responds to the adolescent, including different expectations for behavior, and some research supports this, showing an association between pubertal onset and changes in family interactions, parental feelings, and peer expectations.

The adolescent’s response to the physical changes of puberty have also been implicated in risk taking. In particular, decrements in self-esteem and depressive responses to puberty in females, combined with possible neuroendocrine changes, have been hypothesized to contribute to the increased incidence of depression during the adolescent years. There is also research indicating that pubertal onset is associated with changes in peer relationships, patterns of intimacy, and opposite sex interests. To the degree that these factors also predict risk taking in adolescents, this would support a role for the indirect effects of biological factors.

The timing of pubertal maturation has also been postulated as indirectly influencing risk taking. Normal ranges of pubertal onset for females are between the ages of 8 and 13 years; for males, the range is between 9.5 and 13.5 years. The
biopsychosocial model\textsuperscript{10} considers the onset and timing of pubertal development in terms of its effects on psychological and social factors such as self-perceptions, perceptions of the social environment, and personal values. According to the model, the biological changes trigger the psychological and social changes, which themselves have both direct and indirect effects on risk taking; the impact of these effects on the adolescent will depend in part on the age of the adolescent.

Some elements of the model can be supported. For example, the effects of early maturation in females include greater dissatisfaction with one's physical appearance, greater general unhappiness, lower self-esteem, and lower levels of educational achievement.\textsuperscript{77,79} Socially, early-maturing girls have greater social prestige and popularity among older males.\textsuperscript{84} The adult physical appearance of these girls, and their popularity with older boys, is accompanied by earlier heterosexual interests and behavior, including an earlier age for the onset of sexual intercourse.\textsuperscript{77,79} Early-maturing boys also appear to be prone to early onset of risky behaviors.\textsuperscript{70,77}

The biopsychosocial model (see Fig. 1), although not fully tested, recognizes the importance of direct and interactive effects of multiple factors. The model integrates the biological aspects of development with the social environment and the dispositional characterization of the organism. It is a disposition model in that individual differences such as self-esteem are viewed as moderating the response to puberty. It is most definitely an ecological model, in that changes in the social environment are viewed as important cofactors in the onset of risk taking, interacting with individual differences. It is a biological model; the effects of the social and environmental changes are activated by pubertal change. Additionally, the model is appealing from a developmental perspective, viewing risk taking within the context of the developmental changes of adolescence. We turn now to a discussion of important developmental issues.

**THE NATURE OF ADOLESCENCE**

Adolescence is a period of risks and opportunities. The dramatic biological changes that accompany this transition are essentially the same as they have been for the past several centuries, but the social context in which they occur is very different from earlier times and continues to change rapidly. Changes in the family, economic structure, the media, and the community have all affected the way adolescents live and interact with peers and with the rest of society. Within this social context, adolescents need to find ways to develop a vision of the future, to formulate an image of what adulthood offers and demands, and to work out a perception of opportunity and paths toward practical implementation of such opportunity.

*Developmental Issues of Adolescence*

Adolescence does not occur in a vacuum. It is highly dependent upon what precedes it and likewise adulthood is highly influenced by what occurs during adolescence. The environmental context is critical to understand the process of adolescence. Adolescence is a developmental transition in which there is considerable
change, both within the individual and within the social context. In fact, there are two developmental transitions during the second decade of life: the first being the transition into adolescence from childhood and the second being the transition from adolescence into adulthood. These dramatic biologic, psychosocial, and environmental changes are elucidated below.

**Biological Development during Adolescence**

Biological development characterized by the rapid hormonal, physiological, and somatic changes of puberty is dramatic and interwoven with the other aspects of maturation. With the exception of sexual differentiation during fetal growth and hormonal changes during senescence, there is no other period in the life-span development in which such significant hormonal and biological changes take place. The onset and duration of these changes have broad and different ranges both between and within genders. There are also geographical and racial differences.

The somatic manifestations of puberty begin in females between the ages of 8 and 13, with completion at 13 to 18 years.\(^8^1\) For males, the initial somatic changes occur between the ages of 9.5 and 13.5, with completion at 13.5 to 19 years of age.\(^8^2\) Endocrine studies have documented that the changes in the central nervous system that control the onset of puberty begin around 7 years of age.\(^8^3\)

**Psychosocial Significance of Puberty**

Perhaps more important than the actual somatic changes themselves are the responses of the self and others to physical changes. Adolescents are acutely aware of the changes taking place within their bodies.

Two aspects of psychological functioning may be influenced by puberty: pubertal status and pubertal timing. Pubertal status is defined by the changes that all individuals experience as they undergo the physical changes. Pubertal timing is the timing of the changes relative to same-aged peers. Pubertal status changes have been studied as a direct-effect phenomenon and an indirect-effect phenomenon mediated by social and psychological responses of the individual or of others in the social environment.

Pubertal development influences adolescents’ satisfaction with their appearance. For boys, physical maturation leads to improved body image, probably because increased size and muscular development enhance their social status. For girls, physical maturation leads to greater dissatisfaction with their appearance.\(^8^4,8^5\)

There is some evidence that hormonal changes are related to emotional states such as anger and depression.\(^8^6\)

Some investigators have also found relationships between timing of puberty and psychosocial functioning. Most of these studies have attempted to look at the effects of early or late timing and compare with those adolescents who are progressing “on time.” (It should be noted that the definitions of early and late are not consistent across studies. In addition, most of the research has been done in the female population because of the well-defined self-report marker of menarche for pubertal maturation in females.) Early physical maturation in girls is associated with greater dissatisfaction with physical appearance, greater unhappiness, lower self-esteem, and lower levels of educational achievement.\(^8^0,8^7,8^8\) Although their accelerated maturation gives these girls greater social prestige and popularity among older males, it is accompa-
nied by a decrease in recognition from other females. Later physical development in girls is associated with better affective adjustment.

Less is known about the effects of pubertal timing because of the lack of validated and reliable measures for males. Most investigators have portrayed late-developing boys at a social disadvantage: they complete their physiological development after all other chronologically similar age peers. Late-developing males are more likely to have ectomorphic body types and a negative self-concept, particularly around body-image types. In addition, these boys have a greater incidence of major identity crises. Behaviorally, these boys also have been described as impulsive and rebellious.

There are some data that raise the issue of the adverse effects of both early development for males and females.

Several investigators continue to investigate the specific effect of hormones on behavior. Pubertal hormones appear to affect the behavior of boys, especially aggression. Udry and his colleagues have been attempting to identify the contribution of pubertal hormones to adolescent risky behavior (in particular, onset of sexual behavior). Testosterone appears to increase the interest in sexual behavior for both sexes; however, males are more likely to actually initiate sexual behavior. More recent work by most investigators postulates a model that looks at the mediation of social and psychological factors by biological mechanisms.

**Psychosocial Development**

In psychosocial dimensions, normal adolescent development encompasses increasing independence, autonomy from the family, greater peer affiliation and importance, sexual awareness, identity formation, and increasing cognitive capacity with the ability to process complex information.

In early adolescence, the peer group begins to fulfill the needs of separation. This increased identification has special relevance for risk taking because peer pressure is well established as a factor in the onset of risk behaviors (e.g., sexual behavior and substance use). Peer pressure as early as 10 years of age is operational in encouraging young people to participate in dangerous activities including sexual behavior and aggressive behaviors in males such as fighting.

In middle to late adolescence when issues associated with mastery, autonomy, and individuation are operational, many activities associated with dangerous outcomes are pursued, including substance use and motor vehicle use. In order to achieve mastery, adolescents may attempt to test or verify their physical strength and limits by engaging in risky behaviors.

Cognitive functioning undergoes a major developmental shift during adolescence with the onset of more complex abstract processing of information and formal operations. There is increasing evidence that brain growth continues into adolescence. Although the number of neurons does not increase, there is proliferation of the support cells that brace and nourish the neurons. In addition, myelination continues at least until puberty, establishing faster neural processing. The number of interconnections between adjacent neurons decreases in the second decade of life, probably reflecting the disappearance of redundant or inappropriate neural connections. This fine-tuning of the neural system coincides with the development of formal operational thought. Although many adolescents will have the ability to reason abstractly and consider
cause-and-effect relationships, they also have had little experience in applying these skills to decisions in a more autonomous manner. For the young adolescent, this translates into a belief in the power and possibilities of thought itself, in which possibility is secondary to reality. One effect of this cognitive immaturity is what Elkind calls cognitive egocentrism, which includes the inability to recognize one's similarities with other people.\textsuperscript{101} If the adolescent believes that he or she is not subject to the same laws of chance as others, perceptions of invulnerability result, affecting the adolescent's perceptions of the risk associated with specific behaviors.\textsuperscript{102}

There is an increasing ability for adolescents to think hypothetically, apply formal logic, and use abstract concepts.\textsuperscript{103} Thinking becomes more relative and less absolute, as well as more self-reflective.\textsuperscript{104} Adolescents are also increasingly capable of considering an extended time perspective rather than being tied to the here and now.

Cognitive capacity as measured by tests is quite different from typical performance.\textsuperscript{103} Laboratory studies optimize conditions so that maximal performance levels can be attained; everyday situations are usually more time-pressured and often personally stressful. Perhaps for this reason, spontaneous processing, compared to that in the laboratory, is typically less systematic and reflective and depends extensively on prior knowledge. In particular, thinking on unfamiliar or emotionally arousing topics is likely to be less sophisticated.\textsuperscript{105} Unfortunately, many of the health-related decisions that adolescents confront, such as those surrounding substance use, driving, and sexual behavior, involve such "hot" cognition. Under such conditions, adolescents are less likely to exercise their capacity for abstract, formal reasoning.

Decision-making ability changes as young people proceed through adolescence: there is an increase in awareness of possible risks, consideration of future consequences, and there is a tendency to consult with independent experts. By middle adolescence, most adolescents are able to reason as well as adults with similar reasoning flaws.

Environmental Context

As one examines the specific cognitive changes, psychosocial changes, and biological changes that characterize the adolescent period within the changing environmental context, the emergence of risk taking is not surprising. With the developmental task and biological change providing the push and cognitive abilities being immature (and less practical) accompanied by lack of experience with the behaviors, the adolescent period emerges as a critical developmental period in the life cycle for the onset of life-long risky behaviors and the associated negative outcomes.

The psychological and biological issues are of critical importance to the developing young person; however, these biological and psychological processes occur within the framework of a rapidly changing environment. The environmental context of adolescence has undergone major changes. There has been a deterioration in the structure and economic support of many more single females heading households with less income. Associated with these changes in the family, there has been a decrease in effective monitoring of adolescents due to decreased resources within communities and lack of adult time to provide effective supervision. This lack of supervision may have effects on the development of risky behavior. In addition, there has been decreasing access to the health care system, with adolescents and young adults
having the highest rates of no insurance coverage of any age cohort in the United States. School districts in urban centers have deteriorated and there are decreased opportunities for vocational training. Over the past two decades the number of adolescents involved in the juvenile justice system has increased, with increasing numbers being incarcerated or in foster care settings.

**MORBIDITY DURING ADOLESCENCE**

To further elucidate the concept of health-damaging behaviors within the context of the risk paradigm, morbidity during adolescence will be reviewed.

In general, morbidity of a population is generally described by use of physicians, hospital discharge area, disability data, and chronic conditions. Within the adolescent population, these data do not adequately capture the health status of the population. Therefore, for the purposes of this paper, the behaviors that account for the majority of morbidity in the adolescent population will be discussed as well as health-damaging behaviors that are initiated during adolescence, yet do little damage until adulthood. It is important to note that the majority of morbidity and mortality in the adolescent populations is secondary to health-damaging behaviors. Furthermore, these behaviors are also responsible for the majority of morbid conditions in the young adult and adult population.

**Sexual Behavior**

For the past three decades, adolescents have been initiating sexual intercourse at an earlier age. The most recent comprehensive survey (1988) showed that 53% of adolescent females between the ages of 15 and 19 were sexually active and 76% of adolescent males were sexually active. Black adolescents were more likely than white or Hispanic adolescents to have had sexual intercourse. The proportion of sexually active adolescents increased with age and grade levels. Adolescents who are younger at initiation of sexual intercourse are more likely to have multiple partners and are more likely to not utilize contraception consistently. The most recent data from the Youth Risk Behavior Survey indicates that 66 percent of adolescents have had intercourse by their senior year in high school and 50 percent are currently sexually active.

There are no national data on same-sex sexual behavior among adolescents in the United States. A study conducted in a New York City high school found that 10% of females and 9% of males reported same-sex sexual behavior.

**Substance Use**

Until 1992, the use of most illicit substances had declined in the United States since 1970 despite the fairly stable availability of those substances. In 1993, we saw an increase in illicit substance use (lifetime prevalence increased from 6.1 to 6.6%). In 1995, slightly less than half of high school seniors surveyed reported using an il-
licit substance at some time in their lives, more than one-third had used marijuana, and 8% had used cocaine. The declining rate of substance use had been associated with an increasing perception of risks of harm associated with the use of those substances. Over the past two years, there has been a decrease in the perception of risk associated with substance use. At the same time, substance use has increased. One could hypothesize similar processes for the issue in unhealthy eating behavior; if adolescents do not see risks associated with unhealthy eating, they are more likely to eat poorly.

Alcohol and tobacco use have remained relatively constant over the past two decades at consistently high rates. Ninety percent of high school seniors reported having consumed alcohol on at least one occasion, and a third had consumed five drinks or more in a row at least once in the past two weeks (a measure of heavy drinking or drinking to intoxication). Two-thirds of high school seniors reported smoking cigarettes at some time in their lives, and one in five reported smoking cigarettes daily. By the eighth grade, close to half of the students surveyed nationally had experimented with cigarettes, and almost a third had drunk alcohol to intoxication at least once.

Patterns of Substance Use

Experimentation with substances commonly begins in early adolescence, with the greater proportion of substance use initiated in the mid-to late-teens. The major risk for initiation of cigarette, alcohol, and marijuana use is completed for the most part by the age of 20, and for illicit drug use, initiation by 21. Those who have not experimented with any of these substances by age 21 are unlikely to do so thereafter.

Longitudinal studies of adolescent substance use initiation and progression have demonstrated fairly consistent sequences of drug involvement. Specifically, similar but less-serious substance use has been found to predict subsequent use of more serious substances. Adolescent tobacco or alcohol use usually precedes marijuana use. The impact of cigarette smoking on the progression to higher states of substance use is greater for adolescent females than for male youth. Few adolescents will try other illicit substances without prior use of marijuana.

Patterns of substance use may vary by region of the United States, gender, or ethnicity. Males are more likely to consume alcohol, use marijuana, or use cocaine than were female students. Among high school seniors in the United States, Native Americans have been found to have the highest prevalence rates for cigarettes, alcohol, and most illicit substances. Rates for white students were only slightly less than for Native-American youth for most substances. Black youth had consistently lower rates of substance use than whites, and Asian American youth had the lowest rates overall. Hispanic high school seniors reported more substance use than blacks and only slightly less than white youth.

Eating Behaviors

The most current data on unhealthy dietary behaviors comes from the Youth Risk Behavior Surveillance Program. The data reported here come from a nationwide
sample of high school students. The sample size is 10,904. Approximately one-quarter (27.6%) of all students thought they were overweight. Female students (across all racial and ethnic groups) were significantly more likely to think of themselves as overweight. Also, 41.4% of students were trying to lose weight. Across all racial/ethnic and grade subgroups, female students were more likely than male students to have been trying to lose weight.

Only 17.7% of students had eaten five or more servings of fruits and vegetables during the day preceding the survey. Male students more often reported consumption of fruits and vegetables than their female counterparts. In addition, white students reported consuming more fruits and vegetables than their minority peers.

Approximately two-thirds of students (72.3%) nationwide had eaten two or fewer servings of foods typically high in fat content during the day preceding the survey. Females were more likely than males to have eaten foods low in fat. Table 1 highlights these data.

**Delinquent Behavior**

The study of adolescent delinquent behavior has been impeded by the lack of reliable and valid information regarding the extent of adolescent involvement in illegal behavior, and a lack of consensus regarding the definition of delinquency. "Conduct disorder," and "antisocial personality disorder,"—psychiatric diagnoses that may manifest through delinquent behaviors—are sometimes used interchangeably. However for the purposes of this paper, we will treat these psychiatric conditions as potential antecedents to delinquent behavior.

Sources of information on adolescent delinquent behavior include national crime reports and self-report surveys. The former give arrest data, which may underestimate rates of status offenses and minor infractions of the law, and the latter has no independent source of validation. According to the National Youth Survey, a large majority of adolescents have engaged in some, usually minor, illegal activity. A minority have committed a more serious offense at least once in the past, and a small percentage repeatedly engage in both serious and nonserious delinquent behavior. Chronic offenders are more likely than their peers to have initiated delinquent behaviors at an earlier age. In 1988, of the 1.6 million arrests of U.S. adolescents ages 10 to 17,

| Table 1. Percentage of High School Students Engaging in Dietary Behaviors (N = 10,904)* |
|----------------------------------|----------------|--------|
| Total (%) | Female (%) | Male (%) |
| Thought overweight | 27.6 | 33.6 | 22.1 |
| Trying to lose weight | 41.4 | 59.8 | 24.3 |
| Not eating fruits/vegetables | 72.3 | 77.3 | 67.4 |
| Eating high fat foods | 39.5 | 28.4 | 49.7 |

*L. Kann, C. W. Warren, W. Harris, et al., Youth Risk Behavior Surveillance—US, 1995, In Centers for Disease Control and Prevention, CDC Surveillance Summaries, September 27, 1996 (MMWR 1996; 45 (no SS-4).)*
most were for serious property crimes rather than for violence against others. Recently, however, there has been a relative rise in the arrest rates of 13- to 18-year-olds for violent offenses, including murder, nonnegligent manslaughter, and aggravated assault.

Adolescent delinquent behavior generally peaks between 15 and 17 years of age, and declines thereafter. Male adolescents predominate both in self-report and arrest data for delinquent behavior. Sex differences are relatively small for adolescent status offenses (acts committed by minors that would not be considered offenses if committed by an adult, e.g., running away from home, truancy), but are substantial for more serious offenses. The sex differential for arrest rates appears to be narrowing. Between 1965 to 1987, the male-to-female arrest-rate ratios decreased for serious property and violent offenses from 7:1 to 4:1 and from 11:1 to 7.5:1, respectively.

Arrest rates for black adolescents far outnumber those for whites. Disparities in self-reports of serious offenses are much smaller than those typically reported, based on arrest statistics. Black adolescents are overrepresented among those living in urban areas with low family incomes and high crime rates, placing them at increased risk for engaging in delinquent activity. As a result of the disparities in arrest rates, 40% of adolescents in state-operated juvenile detention facilities are black and 15% are Hispanic. Recent increases in rates of juvenile detention have occurred for nonwhites only. Between 1985 and 1987, the number of black and Hispanic adolescent public detainees increased by 15 and 20%, respectively.

Injuries and Injury-related Behavior

Injuries as a whole contribute significantly to overall morbidity within the adolescent population. Injuries constitute a major cause of visits to physician offices and emergency rooms. Within the National Ambulatory Care Survey, 7.2% of all visits to physicians were for injuries. Injuries ranked fifth in terms of frequency of diagnostic categories. Among children younger than 15, injuries ranked as the second leading cause of hospitalization after respiratory conditions and account for 13.5% of discharges. In the 15- through 44-year-old population, injury ranked as the number one cause for hospitalization, if one excludes pregnancy. With the exclusion, injuries account for 15% of the discharges in the 15 through 44 category. Data from emergency room surveys have also documented the vulnerability of the adolescent population: one of every five 15- to 24-year-old received injury-related care in emergency rooms. Males once again contribute disproportionately to the emergency room visits, with one of every four males receiving care versus one in every seven females receiving care.

In 1995, among 10,904 high school students surveyed nationally, 22% had rarely or never used a seat belt. Thirty-nine percent of high school students reported riding during the past month with a driver who had used alcohol or other drugs before getting behind the wheel of a car.

Injury-related, risk-taking behavior may be seen as a continuum that is influenced by a number of external and internal factors. The continuum may begin with exploration within a controlled context, for example, using a bicycle or skateboard with protective gear, or driving a car using a seat belt. Sensation-seeking may increase the
likelihood of taking chances, and thrill-seeking may result in recklessness.25 Some have argued that beyond thrill-seeking, risk taking becomes self-destructive behavior. Slap and others found, however, that there were no similarities between the risk profiles of youth admitted with injuries and those admitted with medical complications of suicide attempts. Suicidal youth were more likely to have dysfunctional families, to have attempted suicide in the past, and to have used alcohol, cigarettes, marijuana, and other drugs in the past. Internal factors influencing injury-risk behavior include lack of experience, as with young drivers, and lack of cognitive ability to take into account potential negative future consequences when making decisions. External factors include substance use, as with the association of alcohol to motor vehicles and drowning fatalities among adolescent males.117

COVARIATION OF RISK BEHAVIORS

Studies have increasingly documented that certain health-damaging behaviors begun during adolescence are associated in predictable ways and that involvement in one type of risk behavior increases the likelihood of becoming involved in other risk behaviors.21,54 Osgood and his colleagues found, for example, that covariation among various types of substance use, and delinquent behaviors among older adolescents and young adults is due in large part to a general tendency toward "deviance" and to a lesser extent to unique antecedents of individual behaviors and that influence of one behavior on another.20 The following section provides examples of the complex ways that risk-taking behaviors cluster and interact. From our review of the literature, we were unable to identify studies that specifically linked eating and risk behaviors.

Vehicle Use and Substance Use

The concurrence of alcohol and motor-vehicle injuries is well established. In approximately half of the motor-vehicle fatalities involving an adolescent driver, the driver had a blood alcohol level above 10%.118,119 Beyond the well-established relationship of alcohol use to motor-vehicle injuries, data are emerging to support the relationship of alcohol use to other injuries including firearm injuries, burns, and drowning.118

Our own data point to the association of substance use and vehicle use. Fourteen percent of our entire sample reported having used a bicycle or skateboard under the influence of alcohol or other drugs. Among adolescents in the middle-school setting (10–14), 7.7% admitted using recreational vehicles under the influence of alcohol and/or drugs. In high school students, the rate was 19.5%.13,120 These data underestimate the percentage of risky users because they reflect the percentage among the sample as a whole and not just among users of the vehicles. With regard to motor-vehicle use, riding with a driver under the influence was reported by 37% of the middle-school students and 58% of the high school students. Driving a car under the influence of alcohol or other drugs was reported by 6.4% of the entire sample. Within the high school sample, 9.4% reported this behavior.

Bierness and Simpson have also reported that risky driving behavior is also asso-
associated with other risky health habits, such as smoking, illicit drug use, or diet, and lack of sleep.\textsuperscript{121,122}

\textit{Substance Use Covariation}

Substance use patterns have been well described in the patterns of substance use section.

\textit{Delinquent and Other Risk Behaviors}

Delinquent youths are also at increased risk for contracting STDs. In a San Francisco study, incarcerated youth were compared to high school students.\textsuperscript{123} The former were more likely to be sexually active, to have initiated sexual activity at earlier ages, to have had more sexual partners, and were less likely to use condoms than similarly aged high school students. Adolescent substance use, in turn, has been found to be associated with involvement in delinquent activities. According to a Bureau of Justice Statistics' survey, illicit substance and alcohol use preceded the commission of 23% of offenses for which detainees under age 18 were arrested. Among male adolescents, delinquency has been found to predict illicit substance use in young adulthood and among females, illicit substance use predicts some delinquent behaviors in early adulthood (e.g., theft).\textsuperscript{124}

\textit{Sexual Behavior, Substance Use, and Other Risk Behaviors}

Associations among sexual activity and other risk behaviors have not been as well documented as in the area of injuries and substance use where outcome data such as motor-vehicle deaths and hospitalization for injuries are more quantifiable outcome measures. With the emergence of acquired immune deficiency syndromes (AIDS), there is a greater focus on this area of covariation.\textsuperscript{125} Research indicates that adolescents who are having sex are also engaging in other risk behaviors. Zabin\textsuperscript{126} looked at the association of cigarette smoking and sexual behavior in a sample of 1200 female teenagers attending 32 contraception clinics. Within this sample that had a 25% prevalence rate of cigarette smoking, there was an association between onset of coitus at an early age and less effective use of contraceptives with cigarette use.\textsuperscript{126} Zabin and colleagues have also shown that at each age, sexually active teens are significantly higher on a substance-use index than virgins.\textsuperscript{127}

Jessor and Jessors\textsuperscript{4} documented the association between early sexual activity and use of marijuana, cigarettes, and alcohol. With drinking status as a marker for at-risk youth, they found that 80% of their subjects were marijuana users and better than 50% had initiated coitus.

Analyses from the National Longitudinal Survey of the Labor Market Experience of Youth show the strong correlation between prior substance use and sexual initiation by age 16.\textsuperscript{128,129} Even when such covariates as race, religion, parental education, family structure, and personality (including delinquency and school characteristics)
are controlled for, there is still a strong association of drug use and sexual behavior. Early sex is 1.4 times more frequent for boys who have used alcohol or cigarettes or both than for boys who did not report any prior drug use. It is 2.7 times more frequent for boys who have used marijuana and 3.4 times more frequent for boys who have used other illicit drugs. For females, the association is even stronger, with 1.8, 3.5, and 4.9 times more frequent use of alcohol or cigarettes, marijuana, and illicit drugs, respectively, for female users than for nonusers. The association is stronger for whites and Hispanics than for blacks.

Additional studies to document the relationship between substance use and sexual activity are highlighted below. Elliott and Morse reanalyzed data from the 1976–1980 waves of the National Youth Survey (a national probability sample of 2360 adolescents aged 11 to 17 at the time of the first interview in 1976). Among males in the survey, the percentage of those who were sexually active increased with increasing involvement in substance use: 10% of boys with no history of substance use, 23% of boys with a history of alcohol use only, 48% for boys with a history of combined alcohol and marijuana use, and 72% with a history of multiple illicit drugs. In these analyses, Elliot and Morse attempted to establish the temporal sequence of sexual activity and substance use. They found that males and females tended to initiate substance use prior to sexual activity: 5 times as many females and 2.25 times as many males initiated substance use prior to sexual activity rather than initiating sexual activity prior to substance use.

Beyond the covariation of substance use and sexual activity, other behaviors covary with sexual activity. Miller and Simon studied the relationship of sexual intercourse with other adolescent behaviors in a random stratified sample of 2064 white adolescents aged 14–17 living in Illinois households. Sexual intercourse was once again associated with drug use in their data. In males more than females, sexual intercourse was also related to delinquent activity. Additionally, they found that adolescents who have had sexual intercourse are less likely to aspire to advanced education and less likely to report being very religious.

In our own data on risk-taking behaviors and intention to become sexually active during the next year, we have found that the number of risk behaviors (e.g., substance use, cigarette use, dangerous vehicle use, etc.) reported by white females correlates positively with their intention to become sexually active. Among the entire sample, sexually active youth engaged in significantly more risk behaviors than confirmed virgins. There was no significant difference between the sexually active teens and those in transition in the number of risks engaged in for any of the subjects. Among white adolescents, males and females in transition had engaged in significantly more risk behaviors than the confirmed virgins. Among females, engaging in risk behaviors is predictive of intentions to become sexually active for whites, but only age is associated with sexual activity intentions for blacks. This relationship does not hold up in black females. A factor analysis of our cross-sectional data on risk behaviors demonstrates an interrelationship of substance use and other physical risk behaviors in males, but not in females.

Other factors associated with intention to initiate sexual behaviors include knowledge of transmission, beliefs and attitudes regarding sexually transmitted diseases/human immunodeficiency virus (STDs/HIV) and the adolescent’s personal vulnerability for STD, and peer influences, including perceptions of peer norms.
Among urban high school students surveyed as a part of a STD/HIV intervention project (mean age 14.6 years), nonsexually active students who anticipated commencing sexual activity over the next 12 months were found to be less anxious about acquiring STD and HIV, perceived that peers do not believe in preventive health behaviors, including condom use with sexual intercourse, and engaged in more risk behaviors as reflected by the increased use of alcohol and drugs. 134

MECHANISMS OF COVARIATION

In the initial section of this paper, we highlighted various theories of risk taking. In this section we utilize theories of risk taking to propose mechanisms for covariation of risky behavior. Even though some of the behaviors covary, few investigators have attempted to develop a theoretical framework for consideration of the mechanisms. Jessor has proposed the problem behavior theory as a mechanism to explain the relationships. 54,135 Udry and his colleagues provided important data on the importance of gonadal steroids in the initiation of coitus in males and heterosocial behavior in females. 67,68 Recently, Udry has proposed an integrated model of the biological and developmental history of adolescents that affects their predisposition toward problem behaviors. 69 Beyond the work by Udry, few investigators have attempted to integrate both biological and psychosocial factors in developing theories to explain the onset of risky behaviors during adolescence.

We maintain that risk taking during adolescence is a part of the developmental process and that a careful understanding of the process of development itself may give clues to the mechanisms that explain the onset and maintenance of risky behaviors. 10 If one examines the data on behaviors for prevalence, age of onset, gender distribution, and covariation and the nature of factors that generate these behaviors, certain issues regarding development emerge.

First, there is a developmental trajectory with certain behaviors preceding other behaviors. For example, alcohol use and unhealthy eating behaviors begins early in adolescence. In fact, the trajectory may be different for certain groups of adolescents, with substance use being a behavior that is generally begun prior to sexual behavior in white adolescents. In black adolescents, sexual behavior may begin the initial transitional behavior without substance use. Unhealthy dietary behaviors also begin early in adolescence with a progression of increasingly unhealthy eating patterns as adolescents traverse the second decade of life. 8

Second, the behaviors do not occur in isolation. Adolescents who engage in one behavior tend to engage in another behavior, especially if the onset of the behavior occurs early chronologically in adolescence. 54 In fact Jessors problem behavior theory suggests that the adolescent propensity for (or proneness to) risk taking or problem behaviors is a manifestation of their "conventionality." 54 The theory suggests that adolescents whose values and behaviors conform to conventional societal norms are less likely to engage in risk-taking behavior, and that problem behavior represents such a syndrome that adolescents who engage in one type of risk behavior are more likely to engage in others. Problem Behavior Theory encompasses three systems of explanatory variables: personality, perceived environment, and behavior. In the personality system, unconventionality is reflected by a lower value on achievement com-
pared to independence, greater attitudinal tolerance for deviance, and lower religiosity. In the perceived environmental system, *unconventionality* involves the relative predominance of peer influence over parental influence, lower parental disapproval of problem behavior, and greater involvement of peers in problem behavior. Unconventionality in the behavior system is determined by a greater involvement in problem behaviors and less involvement in school activities and church attendance. According to the Problem Behavior Theory, the greater the unconventionality across the three systems, the greater the proneness to engage in problem behavior, such as substance use and sexual activity. Recently, the theory has been expanded to include such biological factors as genetic predisposition and protective factors that may mitigate risk proneness in otherwise moderate to high-risk youth.21

Third, there appear to be gender differences among behaviors. For example, injuries are highly correlated with male gender. In addition males are more likely to use substances and engage in delinquent behavior. Females are most likely to engage in certain unhealthy eating behaviors, and yet when it comes to fat intake, females engage in less fat intake than males.

Fourth, peers and family play a key role in the onset of the behaviors.

**Biopsychosocial Model**

Our own investigative work has been based on a biopsychosocial causal model10 that integrates two areas of research that have often been considered separately: (1) the relationship of biological development to psychosocial processes during adolescence,66,87 and (2) the relationship of risk-taking behaviors to psychosocial correlates of these behaviors.54,135,136 Please see Figure 1.

According to our model, biological, psychological, and social or environmental factors influence adolescent risk-taking behaviors. Specifically the timing of biological maturation directly influences four areas of psychosocial functioning: cognition, perceptions of self and the social environment, and personal values. According to the model, biological, psychological, and social or environmental variables, mediated by perceptions of risk and peer-group characteristics, then predict adolescent risk taking. Biological variables influencing adolescent risk-taking behavior include pubertal timing, hormonal effects, and genetic predispositions. Psychological variables associated with risk taking include self-esteem, sensation seeking, and cognitive and affective states. Social influences on adolescent risk taking include peers, parents, and school.137 This model has been well described in previous sections.

**Investigative Work: UCSF Bay Area Teen Health Project**

The data reported here constitute a subsample of data from various facets of our longitudinal research project. For a complete description of our study see Irwin and Millstein.98,133

Our study involves a cohort sequential longitudinal study involving 1306 adolescents from San Francisco County. The sample was racially and ethnically diverse: 29% were white, 18% were black, 17% were Asian/Pacific Islander, and 14% were
Hispanic. An additional 15% of the sample reported being of mixed racial/ethnic background and 7% reported other backgrounds. Five hundred and sixty-three adolescents were selected for longitudinal study entry, with 202 being followed for two consecutive years.

**Frequency of Substance-use Behaviors**

The frequency of adolescents engaging in substance-use behaviors is identified in Table 2. Behaviors reported by greater than 50% of the sample include lifetime prevalence use of tobacco (57% of middle school and 75% of high school); lifetime prevalence of alcohol use (71.8% of the middle school sample and 84% of the high school sample); lifetime prevalence of marijuana (61.4% of the high school sample). Males were more likely to report use of all substances than females.

**Frequency of Sexual Behaviors**

Sexual behavior was measured using three questions: sexual intercourse, causal sex, and unprotected sex. High school students were more likely to have had sexual intercourse. The rates of sexual activity are listed in Table 3. Forty-three and nine tenths percent of the high school sample was sexually active, and 21.4% of the middle school sample was sexually active.
TABLE 2. Percentage of Adolescents Engaging in Substance Use Behaviors

<table>
<thead>
<tr>
<th></th>
<th>% Middle School</th>
<th>% High School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>57.0</td>
<td>75.4</td>
</tr>
<tr>
<td>Alcohol (ever used)</td>
<td>71.8</td>
<td>84.4</td>
</tr>
<tr>
<td>Alcohol (≥ 1 x month)</td>
<td>13.8</td>
<td>42.8</td>
</tr>
<tr>
<td>Marijuana (ever used)</td>
<td>31.9</td>
<td>61.4</td>
</tr>
<tr>
<td>Marijuana (≥ 1 x month)</td>
<td>9.4</td>
<td>33.0</td>
</tr>
</tbody>
</table>

*aAdapted from Millstein and Irwin.

**Frequency of Unhealthy Dieting/Eating Attitudes and Behaviors**

We measured a number of behaviors associated with eating and dieting during adolescence. A number of the questions are similar to those asked by the Centers for Disease Control Youth Risk Behaviors Surveillance Instrument. Those behaviors include: How much salt do you usually add to your food? How many times per day do you usually eat foods that are high in cholesterol or fat? How many times per day do you usually eat foods that are high in fiber? How many times per day do you usually eat foods that are high in sugar?

In addition, we added a number of questions that were used to identify attitudes about food and eating. They included the following: I think about dieting; I am terrified about gaining weight; I am preoccupied with the desire to be thinner; If I gain a pound, I worry that I will keep gaining; I have gone on eating binges where I have felt that I could not stop; I eat moderately in front of others and stuff myself when they are gone; I think about bingeing; I eat or drink in secrecy.

**The Frequencies of Eating/Dieting Attitudes and Behaviors**

The frequencies of eating/dieting attitudes and behaviors are reported in TABLES 4 and 5.

The eating behaviors of adolescents demonstrate a series of unhealthy behaviors except in the area of salt, in which adolescents report adding very little additional salt.

TABLE 3. Percentage of Adolescents Engaging in Sexual Behavior

<table>
<thead>
<tr>
<th></th>
<th>% Middle School</th>
<th>% High School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sexual intercourse</td>
<td>21.4</td>
<td>43.9</td>
</tr>
<tr>
<td>Casual sex</td>
<td>8.0</td>
<td>19.7</td>
</tr>
<tr>
<td>Unprotected sex</td>
<td>11.0</td>
<td>32.6</td>
</tr>
</tbody>
</table>

*aAdapted from Millstein and Irwin.

*bn = 561, ages 11–14.

*cn = 680; ages 14–18.*
Percentage of Adolescents Engaging in Unhealthy Eating Behaviors

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Middle School</th>
<th>High School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add salt</td>
<td>7.1</td>
<td>9.0</td>
</tr>
<tr>
<td>Eat high-fat foods</td>
<td>57.4</td>
<td>62.2</td>
</tr>
<tr>
<td>Eat high-sugar foods</td>
<td>73.8</td>
<td>55.5</td>
</tr>
<tr>
<td>Do not eat food high in fiber</td>
<td>46.4</td>
<td>66.7</td>
</tr>
</tbody>
</table>

*a n = 561; ages 11–14.

*b n = 680; ages 14–18.

to their diets. Only 7% and 9% of middle and high school students, respectively, added salt to their diets. In the other three areas of food behaviors, greater than 45% of adolescents in all age groups and categories of eating behaviors report unhealthy eating behaviors (see Table 4). In the area of eating high-fat and low-fiber servings, there was an increasing progression of unhealthy behaviors going from early to late adolescence. In the area of high sugar, there was a slight decrement in the behavior going from early to late adolescence. With regard to the food behaviors, there were no statistical differences between males and females. In the area of race and Hispanic ethnicity, black and Hispanic adolescents report greater amounts of fat intake and less fiber intake than whites.

As depicted in Table 5, there were surprisingly large numbers of adolescents reporting that they were engaging in or concerned about dieting and their weight. Greater than 20% of adolescents in middle and high school were thinking about dieting and terrified about gaining weight. Nineteen percent of adolescents were preoccupied with being thinner, and 17% were worried about gaining one pound. Greater than 30% of the adolescents were not satisfied with their current weight. A significant minority (7–11%) demonstrated abnormal eating patterns more commonly associated with eating disorders (e.g., cannot stop bingeing, think about bingeing, eat/drink secretly, eat moderately public and stuff privately). As expected, there were

Percentage of Adolescents with Unhealthy Dieting/Eating Attitudes and Behaviors

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Middle School</th>
<th>High School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think about dieting</td>
<td>21.7</td>
<td>26.8</td>
</tr>
<tr>
<td>Terrified about gaining weight</td>
<td>25.3</td>
<td>28.7</td>
</tr>
<tr>
<td>Worry about gaining 1 lb</td>
<td>17.3</td>
<td>17.8</td>
</tr>
<tr>
<td>Not satisfied with weight</td>
<td>33.5</td>
<td>39.5</td>
</tr>
<tr>
<td>Preoccupied with being thinner</td>
<td>19.0</td>
<td>19.3</td>
</tr>
<tr>
<td>Cannot stop bingeing</td>
<td>9.2</td>
<td>10.4</td>
</tr>
<tr>
<td>Think about bingeing</td>
<td>7.2</td>
<td>11.0</td>
</tr>
<tr>
<td>Eat/drink secretly</td>
<td>6.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Eat moderately public and stuff private</td>
<td>8.8</td>
<td>10.8</td>
</tr>
</tbody>
</table>

*a n = 561; ages 11–14.

*b n = 680; ages 14–18.
significant gender differences in the area of attitudes and behaviors about dieting. Females were much more likely than males to be concerned about the behaviors except in the category of eating behaviors. Of interest in these categories of dieting behaviors is the fact that a significant number of males did report the following: 13% reported that they often thought about dieting (as compared to 34% of girls), 17% were terrified about gaining weight (as compared with 36% of girls), 13% were preoccupied with thinness (as compared with 25% of girls), and 8% were worried about gaining one pound (as compared with 26% of girls). The self-reported frequencies of eating behaviors looked remarkably similar by gender, with no significant differences by gender.

**Frequency of Injury-related Behaviors and Covariation**

The frequency of adolescents engaging in injury-related behaviors is identified in Table 6. Behaviors reported by more than 50% of the sample include driving/riding over the speed limit, not using a seat belt in a car, and taking chances on a bike or skateboard. Forty-eight percent of the sample report riding in a car with a driver impaired by drugs or alcohol. A significant minority (14%) report using a bike or skateboard while under the influence of alcohol or drugs. Males were more likely than girls to report behaviors that placed them at risk of injury ($F_c = 77.16, P < 0.001$). Behaviors increasing the risk of injury include greater frequency of use of recreational vehicles, use while under the influence of alcohol or other drugs, and taking chances while using recreational vehicles. Males also reported higher accident rates (41.9%) than girls (17.5%; $2 = 39.20, P < 0.001$).

Within the early adolescent (middle school population) sample, 35% reported riding with a driver who was under the influence of alcohol or some other drug. Among these adolescents ($n = 198$), 68% had ridden with an impaired driver on more than one occasion and 17% had done so on many occasions.

Within this early-adolescence sample, covariation is already well established.

**Table 6. Percentage of Middle- and High-School-age Adolescents Engaging in Injury-related Behaviors**

<table>
<thead>
<tr>
<th>Behavior</th>
<th>% Middle School$^b$</th>
<th>% High School$^c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taking chances on bike/skateboard</td>
<td>67.2</td>
<td>59.5</td>
</tr>
<tr>
<td>Using bike/skateboard under influence of alcohol/drugs</td>
<td>7.7</td>
<td>19.5</td>
</tr>
<tr>
<td>Not using seat belt in car</td>
<td>56.6</td>
<td>71.9</td>
</tr>
<tr>
<td>Driving/riding in car over speed limit</td>
<td>31.8</td>
<td>73.4</td>
</tr>
<tr>
<td>Riding in car with alcohol-or drug-impaired driver</td>
<td>35.4</td>
<td>58.3</td>
</tr>
<tr>
<td>Driving car/motorcycle under influence of alcohol/drugs</td>
<td>2.9</td>
<td>9.4</td>
</tr>
</tbody>
</table>

$^a$Adapted from Millstein and Irwin.

$^b n = 561$; ages 11–14.

$^c n = 680$; ages 14–18.
Those adolescents engaging in any given risk behavior were more likely to engage in other risk behaviors as well. Adolescents who were engaging in dangerous vehicle risks were more likely to also be using tobacco and/or alcohol or illicit substances. In fact, only 3.8% of the early adolescent sample who reported dangerous vehicle use did this as his or her sole behavior.

**Covariation: Multiple-risk Behaviors**

In an effort to understand the covariation among the risk and eating behaviors in the population of adolescents we studied, we conducted a series of analyses. First (Table 7), the relationship among well-established risky behaviors (sexual activity, substance use, and dangerous vehicle use), is reported. Second (Table 8), the relationship among unhealthy eating behaviors is reported. Third (Table 9 and 10), the relationship among eating behaviors and the traditional risky behaviors is reported. In the analyses of risk behaviors and eating behaviors, we first looked at the relationship using the eating behavior as the marker (e.g., of those adolescents who are eating poorly and asked the question about engagement in sexual activity substance use and vehicle use) (Table 9); then we looked at the relationship using the traditional risky behavior as the marker (e.g., of those adolescents who are sexually active, and asked the question about engagement in an unhealthy eating behavior) (Table 10).

**Covariation of Risk Behaviors**

Adolescents engaging in any given risk behavior were more likely to be engaging in other risk behaviors as well (see Table 7). Adolescents who were sexually active were also more likely to be using alcohol or marijuana and to be driving/riding under the influence of alcohol/drugs. Adolescents who used alcohol or tobacco were more likely to use marijuana.

**Covariation of Eating Behaviors Among Adolescents**

The covariation among the eating behaviors is reported in Table 8. There is significant covariation among these eating behaviors.

### Table 7. Covariation of Risk Behaviors Among Adolescents (Percentage of Subjects, \(N = 1241\))

<table>
<thead>
<tr>
<th></th>
<th>Sex Active</th>
<th>Tobacco</th>
<th>Alcohol</th>
<th>Marijuana</th>
<th>Dangerous Vehicle Use&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex active</td>
<td>100.0</td>
<td>83.0</td>
<td>88.0</td>
<td>74.2</td>
<td>16.7</td>
</tr>
<tr>
<td>Tobacco</td>
<td>44.7</td>
<td>100.0</td>
<td>91.7</td>
<td>66.5</td>
<td>12.8</td>
</tr>
<tr>
<td>Alcohol</td>
<td>40.0</td>
<td>77.8</td>
<td>100.0</td>
<td>57.4</td>
<td>12.0</td>
</tr>
<tr>
<td>Marijuana</td>
<td>56.2</td>
<td>93.8</td>
<td>95.3</td>
<td>100.0</td>
<td>15.6</td>
</tr>
<tr>
<td>Dangerous vehicle use&lt;sup&gt;a&lt;/sup&gt;</td>
<td>58.0</td>
<td>82.3</td>
<td>90.8</td>
<td>71.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<sup>a</sup>Dangerous vehicle users include subjects who reported driving or riding in vehicles when the driver is under the influence of alcohol or other substances.
TABLE 8. Covariation of Eating Behaviors Among Adolescents (Percentage of Subjects, N = 1241)

<table>
<thead>
<tr>
<th></th>
<th>Salt</th>
<th>Fat</th>
<th>Sugar</th>
<th>Lack of Fiber</th>
<th>Bingeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt</td>
<td>100.0</td>
<td>73.4</td>
<td>83.1</td>
<td>23.4</td>
<td>15.0</td>
</tr>
<tr>
<td>Fat</td>
<td>11.3</td>
<td>100.0</td>
<td>77.1</td>
<td>18.6</td>
<td>11.1</td>
</tr>
<tr>
<td>Sugar</td>
<td>10.8</td>
<td>64.8</td>
<td>100.0</td>
<td>19.5</td>
<td>9.7</td>
</tr>
<tr>
<td>Lack of fiber</td>
<td>11.6</td>
<td>60.0</td>
<td>75.1</td>
<td>100.0</td>
<td>9.4</td>
</tr>
<tr>
<td>Bingeing</td>
<td>13.2</td>
<td>66.7</td>
<td>69.3</td>
<td>17.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Covariation of Eating/Risk Behaviors

There was a significant association among the eating and risk behaviors. Those adolescents who used high salt, high fat, high sugar, little fiber, and binged were more likely to engage in all the risk behaviors with the exception of dangerous vehicle use. The relationships are remarkably similar independent of which eating behavior is used as the marker. See TABLE 9 for the results.

Covariation of Risk/Eating Behaviors

There was also significant covariation among the risk and eating behaviors. The strongest association was in the area of the dangerous vehicle use, with the majority of these adolescents engaging in high fat, high sugar, lack of fiber, and bingeing behavior. Those adolescents who have sex, drink, and smoke had a similar pattern of high fat and high sugar intake, with approximately 20% of them engaging in low-fiber diets. See TABLE 10 for results.

Covariation of Behaviors by Race, Gender, and Age

Since many of the risk behaviors addressed in our study begin in adolescence, we were particularly interested in how the assessments of health risk covaried with gen-

TABLE 9. Covariation of Eating/Risk Behaviors Among Adolescents (Percentage of Subjects, N = 1241)

<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Tobacco</th>
<th>Alcohol</th>
<th>Marijuana</th>
<th>Dangerous Vehicle Use*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt</td>
<td>46.2</td>
<td>82.9</td>
<td>83.7</td>
<td>56.1</td>
<td>12.9</td>
</tr>
<tr>
<td>Fat</td>
<td>40.2</td>
<td>71.1</td>
<td>82.0</td>
<td>50.2</td>
<td>11.6</td>
</tr>
<tr>
<td>Sugar</td>
<td>39.2</td>
<td>70.4</td>
<td>80.9</td>
<td>50.2</td>
<td>9.5</td>
</tr>
<tr>
<td>Lack of fiber</td>
<td>42.1</td>
<td>71.9</td>
<td>78.4</td>
<td>58.0</td>
<td>9.7</td>
</tr>
<tr>
<td>Bingeing</td>
<td>38.4</td>
<td>69.6</td>
<td>84.3</td>
<td>51.3</td>
<td>10.0</td>
</tr>
</tbody>
</table>

*Dangerous vehicle users include subjects who reported driving or riding in vehicles when the driver is under the influence of alcohol or other substances.
TABLE 10. Covariation of Risk/Eating Behaviors Among Adolescents (Percentage of Subjects, N = 1241)

<table>
<thead>
<tr>
<th></th>
<th>Salt</th>
<th>Fat</th>
<th>Sugar</th>
<th>Lack of Fiber</th>
<th>Bingeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>11.5</td>
<td>66.3</td>
<td>77.4</td>
<td>21.8</td>
<td>10.5</td>
</tr>
<tr>
<td>Tobacco</td>
<td>11.3</td>
<td>63.3</td>
<td>74.6</td>
<td>19.8</td>
<td>10.3</td>
</tr>
<tr>
<td>Alcohol</td>
<td>9.7</td>
<td>62.1</td>
<td>72.8</td>
<td>18.4</td>
<td>10.5</td>
</tr>
<tr>
<td>Marijuana</td>
<td>10.7</td>
<td>63.1</td>
<td>75.1</td>
<td>22.6</td>
<td>10.3</td>
</tr>
<tr>
<td>&quot;Dangerous vehicle use&quot;</td>
<td>11.3</td>
<td>66.7</td>
<td>65.0</td>
<td>76.6</td>
<td>85.4</td>
</tr>
</tbody>
</table>

"Dangerous vehicle users include subjects who reported driving or riding in vehicles when the driver is under the influence of alcohol or other substances.

...under and ethnic or racial background. Accordingly, we subjected the assessments of the following 17 behaviors to factor analysis with varimax rotation:

- Smoking cigarettes
- Drinking beer
- Drinking wine
- Drinking mixed drinks
- Using controlled substances (e.g., marijuana, cocaine, LSD)
- Motorcycle driving or riding
- Using seat belts
- Taking physical risks
- Having broken bones
- Being knocked unconscious
- Engaging in dangerous behaviors (e.g., carry a knife, argue with strangers, seek entertainment in high-crime area)
- Eating high-sugar foods
- Eating cholesterol/high-fat foods
- Going for dental checkups
- Sleeping 8 hours per night
- Exercising
- Getting into a fight

TABLES 11 and 12 highlight the results. For both males and females, five factors emerged that accounted for 53% of the variance among males and 49% of the variance among females. Each factor had a loading of 0.30 or above.

For males (see TABLE 11), the first factor to emerge consisted of three items relating to alcohol use (frequency of the use of mixed drinks, wine, and beer) and an item regarding use of controlled substances (which mostly reflects marijuana use). The second factor represents a broader range of risk behaviors; in addition to beer and substance use, it includes cigarette use, hours riding a motorcycle, and frequency of participating in fights that result in being knocked unconscious. The third factor consists of the amount of fat and sugar consumed each day. The fourth factor includes seat-belt use, consumption of high-fiber foods, and frequency of dental checkups. Finally, the fifth factor reflects potential for interpersonal violence, including fights and the number of dangerous behaviors in which the respondent usually engages.
Table 11. Factor Structure for Males (N = 721)\(^a\)

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed drinks</td>
<td>Beer</td>
<td>Fat servings</td>
<td>Seat belt</td>
<td>Fights</td>
</tr>
<tr>
<td>Wine</td>
<td>Substance use</td>
<td>Sugar servings</td>
<td>Fiber servings</td>
<td>Dangerous behaviors</td>
</tr>
<tr>
<td>Beer</td>
<td>Riding motorcycle</td>
<td></td>
<td>Dental checkups</td>
<td>Broken bones</td>
</tr>
<tr>
<td>Substance use</td>
<td>Knocked unconscious</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)Adapted from Irwin.\(^13\)

For females (see Table 12), a slightly different structure emerged. Alcohol use is more differentiated for females than for males. For females, beer ingestion is associated with cigarette and controlled substance use. Use of wine and mixed drinks falls on separate factors, but is also associated with cigarette use. The third factor reflects interpersonal and physical risk; it includes frequency of fights, number of dangerous behaviors, enjoyment of physical risk, and broken bones. The fourth factor represents the same factor seen with males: daily intake of fat and sugar. The final factor for females is a health factor that includes two of the three items in the comparable factor for males; it includes seat-belt use, exercise, and dental checkups.

We examined ethnic-group differences on these factors separately by sex. For both males and females we found significant differences in the dietary factor scores (fat and sugar intake) across ethnic groups. Blacks scored significantly higher on this factor (showing greater sugar and fat intake) than Asians or whites. In addition, among males, Hispanics scored higher than whites. Among females, ethnic group differences were also evident on the health-behavior factor, with whites showing higher scores than Asians (on seat-belt use, exercise, and dental checkups).

Conclusion

Adolescents are engaging in behaviors in early adolescence with a high probability of negative outcomes throughout adolescence and young adulthood. Behaviors cluster together in specific patterns for females and males. Early in adolescence, teenagers are capable of making differential assessments of risk behaviors. In spite of

Table 12. Factor Structure for Females (N = 691)\(^a\)

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance use</td>
<td>Smoking</td>
<td>Fights</td>
<td>Fat servings</td>
<td>Seat-belt use</td>
</tr>
<tr>
<td>Beer</td>
<td>Wine</td>
<td>Dangerous behaviors</td>
<td>Sugar servings</td>
<td>Exercise</td>
</tr>
<tr>
<td>Smoking</td>
<td>Mixed drinks</td>
<td>Physical risk</td>
<td>Broken bones</td>
<td>Dental checkups</td>
</tr>
</tbody>
</table>

\(^a\)Adapted from Irwin.\(^13\)
this, as adolescents mature both in chronological and physiological age, there appears to be a tendency to reduce the estimate of risk associated with the behavior. This may be associated with experience, advanced cognitive abilities, or with a better understanding of risk. A more likely explanation, consistent with adult literature, is that as adolescents participate in risky behaviors, they tend to underestimate the risks associated with these behaviors, or certain environmental contexts may enhance or decrease the likelihood of engaging in risky behaviors. This change in perception, environment, and context for older adolescents may help explain the increasing frequency-of-risk behaviors in late adolescence with more negative health outcomes.

The various theoretical models presented in this paper are helpful in explaining the process of initiation, the covariation, and the trajectory of risk. What is missing from these models is the fact that decisions about engagement are made in the context of real life experiences and the situational context of the adolescent. Adolescents make decisions about eating, sexual behavior, substance use, and driving vehicles based on biological, social, and psychologic phenomena. Understanding these processes will enable us to develop more effective health-promoting programs for adolescents.

ACKNOWLEDGMENTS

The authors thank Ms. Dulce Mohler and Mr. Jeremy Schiller for their assistance with the preparation of the manuscript for publication.

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