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Risk-Taking Behaviors and Biopsychosocial Development During Adolescence

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INTRODUCTION

Adolescents continue to be portrayed as a homogeneous and healthy group (Irwin, 1990a). They represent a segment of the population having the least contact with the health care system that is often interpreted as absence of need (National Center for Health Statistics [NCHS], 1983, 1984, 1990a). Indeed, most adolescents experience no major health disorders or debilitating conditions as reflected in health status indicators most commonly used for adults and children (Irwin, 1987; Newacheck, 1989). These health status indicators are measures that utilize quantifiable mortality and morbidity outcomes that are best reflected in mortality rates, hospital discharge rates from acute care facilities, conditions cited in visits to office-based physician practices, and prevalence of specific infectious diseases or disabling conditions (Gans, Blyth, Elster, Gaveras, 1990; Irwin, Brindis, Brodt, Bennett, & Rodriguez, 1991; Irwin & Vaughan, 1988). Others (including a popular assumption in the lay press) argue that the health problems experienced by adolescents result from their own risk-taking behaviors that often begin with adolescents' perceptions of invulnerability.

This chapter presents our definition of risk taking; reviews national data on mortality and morbidity using traditional outcome measures, morbidity data on three specific risk behaviors, and covariation of these risk behaviors; provides an overview of the contribution of biopsychosocial development to the onset of risk behaviors; and discusses a model of risk-taking behavior. In the final section, we present some preliminary data on a longitudinal project on risk taking.

RISK-TAKING BEHAVIOR: DEFINITION

Morbidity and mortality patterns of adolescence show some interesting properties: The behaviors responsible for these patterns begin during early adolescence; the behaviors are prevalent in all socioeconomic and racial groups; significant gender differences in prevalence rates emerge; and there is a major increase in mortality from early to late adolescence. Unlike childhood, the morbidity and mortality patterns of adolescence are behaviorally generated and remain that way through the 4th decade of life (U.S. Preventive Services Task Force, 1989).

The behaviors associated with the major mortalities and morbidities of adolescents share a common theme: risk taking. Young people with limited or no experience engage in potentially destructive behaviors with anticipation of benefit and without understanding the immediate or long-term consequences of their actions (Greydanus, 1987; Irwin, 1989, 1990a, 1990b). Even though some risk taking is necessary in the normal developmental process, often the short- and long-term results of risk taking are disastrous (Baumrind, 1987). In the past researchers have included the following behaviors under this generic construct: eating disorders, homicide, mountain climbing, reckless vehicle use, sexual activity, substance use, suicide, and skydiving. These behaviors are associated with a wide range of negative and positive precursors and outcomes. By using our definition of risk taking, issues emerge regarding which behaviors one includes under this broad category. Inherent in the risk-taking terminology is an implication that the behavior has a volitional quality in which the outcome remains uncertain. There is a possibility of a negative health outcome. We include three behaviors in our definition: motor/recreational vehicle use, sexual activity, and substance use. The behaviors included in our definition have an "exploratory" quality to them (Irwin, 1987; Irwin & Vaughan, 1988). These risk behaviors result from an interaction between the biopsychosocial processes of the organism (the adolescent) and the environment. Adolescents may also be utilizing these behaviors as a method to assess their own biopsychosocial functioning.

MORTALITY

Prior to 1980, adolescence (10 to 20 years old) was the only age cohort in the United State to experience a rise in mortality from 1960–1979 (*Healthy people*, 1979). Since 1980, the age specific mortality rate for adolescence has remained high with a less rapid decline than other age cohorts of the population. Mortality rates for the second decade of life in 1987 differ markedly by age, gender, and race. Younger adolescents (10 to 14 years old) have a rate of 26.9 per 100,000 compared to a rate of 84.6 per 100,000 for older adolescents (15 to 19 years old) (NCHS, 1990a). This increase in mortality by over 200% within the second decade is the largest increase in any two consecutive 5-year age cohorts over the

entire life span. Accidents (or unintentional injuries) still account for the majority of adolescent deaths. Fifty-five percent of the deaths are attributed to injuries involving motor vehicles and, to a lesser extent, injuries involving other off-road bicycles, falls, and drownings (NCHS, 1990a). The second leading cause of death for this age group during the 1980s is suicide, with homicide a close third. Injuries from violence, suicide, and homicide account for over 70% of deaths in the second decade of life. The death rates for males are more than twice that for females with 71% of the deaths occurring in males. The difference between males and females becomes more pronounced as they progress through the second decade. For adolescents age 10 to 14 the mortality rate for males is 67% higher than for females whereas for older adolescents age 15 to 19 the rate is over 150% grater (Irwin et al., 1991; NCHS, 1990a). The patterns of mortality in the second decade of life are clearly determined by males. Race is an additional important factor in determining the etiology of death. Black adolescents are more likely to die from homicide than White adolescents. Older Black adolescent males have a rate of mortality from homicide at 50 per 100,000 compared to a rate of 14.8 per 100,000 for White males (NCHS, 1990a).

MORBIDITY

Indicators used to assess morbidity are less well-defined than those used for mortality profiles. Several measures of morbidity have recently been used in combination to build a health profile of populations. These measures include: the prevalence of various diseases and illnesses, the number of acute conditions including unintentional and intentional injuries, and measures of disability (Irwin, 1987; Irwin & Vaughan, 1988). Once again, these measures suggest a relatively healthy adolescent population, although in some domains morbidity is still significant.

Hospital discharge rates for the adolescent population point to some interesting changes during the second decade of life. For males, the rate increases by 53% (from 433 per 10,000 for 13-year-olds to 821 per 10,000 for 18-year-olds), and for females (excluding pregnancy) the rate increases by 43% (from 367 per 10,000 for 13-year-olds to 846 per 10,000 for 18-year-olds) (Graves, 1988; Irwin, 1986). Trauma and poisonings (which includes substance use and abuse) account for the single largest category of hospitalization if one excludes pregnancy (Irwin, 1986).

In the area of infectious diseases (a measure of morbidity for all age groups), sexually transmitted diseases represent a significant negative outcome of sexual activity during adolescence (Bell & Holmes, 1984). Because not all sexually transmitted diseases are reportable and because this number is dependent on a report being made, any number has to represent a minimum of true prevalence rates. The 1988 rates for *Neisseria gonorrhoea* in adolescents are 65 per 100,000 for early adolescents and 1,073 per 100,000 for older adolescents (Centers for Disease

Control [CDC], 1990b; Irwin & Shafer, 1991). Significant gender differences currently exist. During adolescence the reported prevalence of gonorrhea is much greater among females than males. During early adolescence the rate is more than three times higher in females than males whereas during late adolescence, the reported rate is still more than 50% higher. The fact is noteworthy because for all other age groups, the reported prevalence of gonorrhea is substantially higher among males than females. Gender differences may result from access to health care services with teen-age girls having greater access to health services for reproductive or other health problems. Males may represent a huge undetected reservoir of sexually transmittable diseases. Another explanation may be that in order to get similar prevalence rates by gender, we would need to utilize a 2- to 3-year age gradient difference since females tend to have sexual intercourse with males at least 2 years older than themselves in late adolescence. This age difference may be even greater in early adolescence. Beyond the behavioral and access to services explanation for the higher rates in females, there appears to be gender specific risk factors including the site of infection (ectocervix), easier access to the organisms during infectious disease specimen collection in females and efficiency of transmission of organisms (*Chlamydia trachomatis* and *Neisseria gonorrhoeae*) to females. All adolescent population-based prevalence rates should be multiplied by a factor of 2 because a maximum of 50% of the population is sexually active (Aral, Schaffer, Mosher, & Cates, 1988; Cates, 1990; Shafer & Sweet, 1990).

Both morbidity and mortality patterns are reflective of three behaviors that have their onset in early adolescence: sexual activity, motor/recreational vehicle use, and the role of substance use in its contribution to mortality in the area of motor vehicle use and utilization of health services. Another way to assess morbidity within adolescence is to look at behaviors with high prevalence rates and considerable potential for negative outcomes. Utilizing this approach, once again three behaviors emerge which account for greater than 50% of the morbidity in the second decade: motor/recreational vehicle use, sexual activity, and substance use. The prevalence of these three behaviors and their patterns of covariation are reviewed.

RISK-TAKING BEHAVIORS: SINGLE BEHAVIORS

Over the past decade a small group of investigators have suggested that risk behaviors do not occur in isolation but tend to covary within individuals. More is known about specific single behaviors and the factors associated with their onset, maintenance, and negative outcomes. Before we look at the interrelationships of the behaviors, we review what we know about the single specific behaviors under consideration.

Motor and Recreational Vehicle Use

Unintentional injuries (or accidents) continue to head the list of premature mortality in the United States. Unintentional injuries not only cause the largest number of deaths in adolescents, but the resultant nonfatal injuries account for the largest number of hospital days among males and females. Injuries also account for a significant number of ambulatory visits: 16.1% and 12.5% for younger and older adolescents, respectively (NCHS, 1989a, 1989b). Morbidity and mortality data cite speed, time of day, and lack of experience as contributing factors. Jonah has concluded that risky driving habits may be a more significant cause of these accidents than driving experience or exposure (Jonah, 1985). Included in these risky driving habits are speeding, tailgating, nonuse of seat belts, and driving under the influence of alcohol and other drugs.

As early as 10 years of age, Lewis and Lewis (1984) demonstrated that 22% of the fifth graders reported placing themselves at risk for personal injury. Our own work supports this finding with approximately 29.5% in the middle school and 37.5% in the senior high school engaging in physically risky activities such as physical fights, skateboarding, and bicycling dangerous (Millstein et al., in press).

Within all the injury literature, male gender emerges as the most critical factor. Males are particularly vulnerable beginning in the first year of life (NCHS, 1990a).

Sexual Behavior

The most recent data on sexual activity during adolescence comes from the National Survey of Family Growth (NSFG), Cycle IV, and the National Survey of Adolescent Males (Centers for Disease Control [CDC], 1991; Forrest & Singh, 1990; NCHS, 1990b; Sonenstein, Pleck, & Ku, 1989; Pleck, Sonenstein, & Swain, 1988). The incidence of sexual activity has increased dramatically from 1971 to the late 1980s in both younger and older age cohorts of adolescents. In 1988, by age 15, 24% of Black females, 26% of White females and males, and 69% of Black males have experienced coitus at least once. By age 19, 83% of Black females, 76% of White females, 86% of White males, and 98% of Black males have had coitus at least once. White adolescent females report more frequent intercourse with more partners than their age-related Black cohorts (CDC, 1991; Pratt, 1990; Sonenstein et al., 1989). Although specific data on Hispanic adolescents is not reported in the 1988 survey, previous research in 1982 documents that patterns of sexual activity among Hispanic youth fall between that of Black and White youth. For example, among females aged 15–19, 59% of Black females had initiated sexual activity compared to 50% of Hispanics and 44% of Whites (Hayes, 1987).

Since 1970, there have been five national surveys documenting sexual activity (1970, 1975, 1980, 1985, and 1988). The most dramatic increase in the proportion

of sexually active females has occurred in the 3-year period, 1985–1988 (CDC, 1991). One third of the increase in premarital sexual experience among adolescent women for the entire 18-year period spanning 1970–1988 occurred in one 3-year period, 1985–1988.

Age appears to be a significant factor in the adoption of contraceptive use among sexually active adolescents. For adolescents as a whole, the percentage of sexually active adolescents who have ever used contraceptives jumped from 58% to 83% between the ages of 15 to 16 and reached 91% by age 19. By race and ethnicity, sexually active Black adolescents have the highest percentage of sexually active adolescents who have ever used contraception at the youngest ages. At age 15, 71% of Black adolescents have used contraceptives compared to 58% of Whites and only 10% of Hispanics. By age 19, 83% of Black females, 94% of Whites, and 81% of Hispanics have initiated contraceptive use.

Although patterns of contraceptive choice change over the life course of an adolescent, a key factor in their adoption and utilization within the adolescent's sexual relationship appears to be related to their initial utilization at the point of sexual debut. In a recent national survey (Kahn, Rindfuss, & Guilkey, 1990) only about one half of Whites and one third of Blacks use a method of contraception at first intercourse. Only a small proportion of adolescents (19% of Whites and 13% of Blacks) became contraceptive users during the next two months, thus the slow rate of subsequent adoption of a method leaves a large group of adolescents continuing high risk of an unintended pregnancy (Kahn et al., 1990).

The 1988 data provide a further look at the sexual behaviors of young women during their adolescence. Among 15- to 24-year-old women who began coitus before age 18, 75% had 2 or more partners, and 45% reported having had 4 or more partners. Among those women who became sexually active after age 19, only 20% reported having had more than 1 partner and 1% 4 or more partners. When one controls for duration of sexual activity and limits it to less than 24 months, 45% of 15- to 17-year-olds have had 2 or more partners compared with 40% of 18- to 19-year-olds and 26% of those greater than 20 years of age (CDC, 1991). Little is known about sexual behaviors other than coitus in adolescents (Brooks-Gunn & Furstenberg, 1989, 1990).

Substance Use and Abuse

Johnston and his colleagues have documented the trends of substance use over the past decade among high school seniors through cross-sectional epidemiological studies using retrospective measures of substance use during the past year and month. The most recent data continue to point to high rates of use with alcohol and tobacco-related substances.

In 1989 the lifetime prevalence use of alcohol and cigarettes was 91% and 66%, respectively, for high school seniors (Johnston, O'Malley, & Bachman, 1990). Four percent of high school seniors report daily use of alcohol and 33% report having had at least 5 drinks in a row at one sitting in the last 2 weeks.

Nineteen percent report daily use of cigarettes. The National Household Survey data for 1988 indicate that 26% of eighth graders and 38% of tenth graders report having had 5 or more drinks on at least one occasion in the 2 weeks prior to the National Household Survey (National Institute on Drug Abuse [NIDA], 1989).

Marijuana remains the most popular illicit drug for adolescents. Data from the high school survey report lifetime prevalence rates of marijuana use dropping from its peak of 60% in 1979–80 to 44% in 1989. Rates of cocaine use remain at 4.7% for crack and 8.5% for other cocaine. Heroin use is rare among adolescents with approximately 1% of adolescents reporting ever using it (Johnston, O'Malley, & Bachman, 1989a, 1989b, 1990). The problem with the data on substance use is that the highest risk adolescents do not participate in these high school surveys that require attendance in the 12th grade of high schools on the day the surveys are done; therefore, all the current surveys probably underestimate the use of substances in adolescents (Irwin, 1990b).

The 1988 NIDA National Household Survey substantiates the high rates of substance use in adolescence with the following lifetime prevalence rates of 12- to 17-year-olds: alcohol 50.2%, cigarettes 42.3%, cocaine 3.4%, and marijuana 17.4%. These rates are lower than the rates in the 1970s. However, the decreasing rates witnessed in the early 1980s have stopped. This may reflect earlier initiation of use (NIDA, 1989).

The mean age of onset of cigarettes, alcohol, and marijuana are 12.0, 12.5 and 14.0 years, respectively (Irwin & Ryan, 1989; Johnston, O'Malley, & Bachman, 1989a). Kandel and her colleagues further pointed out the importance of early adolescence as a period of vulnerability by providing longitudinal data on sequences and progression of youth and predictors of progression in a sample of 1,300 New York residents. Alcohol use began early with 20% of their cohort having ever used alcohol by age 10, over half by age 14, and 80% by age 18. The onset of cigarette smoking was similar to alcohol until age 15, after which the onset decreased. Marijuana initiation was most likely to occur at age 13 and to peak at age 18, with a 20% prevalence of use (Yamaguchi & Kandel, 1984a, 1984b). Chewing tobacco or smokeless tobacco has recently appeared as the newest substance for adolescents. Current data point to the use of this substance primarily by adolescent males with an onset in Grade 7, and some studies point to a prevalence rate of 23.1% by Grade 10 (Connolly et al., 1986; Hunter, Croft, & Burke, 1986).

Additional support for the early onset of substance use comes from the initial phases of our longitudinal study on risk. This study involves 1,500 adolescents in grades 6 through 10 (ages 10–16). The overall rates of use of alcohol, cigarettes, and marijuana were 48%, 32%, 42%, respectively. In the middle school sample (ages 10–14), the rates for alcohol, cigarettes, and marijuana were 23%, 20%, and 17%, respectively (Millstein et al., in press). Gender and grade level were significant factors in the use of both alcohol and cigarettes. Alcohol use increased by age and was more prevalent in males. Cigarette use increased by age and was more prevalent in females. Marijuana remained the same across gender and grade (Irwin & Millstein, in press).

RISK-TAKING BEHAVIORS: COVARIATION OF RISK BEHAVIORS

A number of investigators have suggested that certain risk-taking behaviors do not occur in isolation but tend to covary within individuals. The most comprehensive work on the covariation of risk behaviors is by Jessor and Jessor who have provided compelling evidence for a syndrome of problem behaviors that includes cigarette smoking, alcohol use, marijuana use, premature sexual activity, and other problem behaviors (Jessor & Jessor, 1977). Before exploring the mechanisms of the interrelations, we review what is currently known about the covariation of substance use, sexual activity, and vehicle use.

Vehicle Use and Substance Use

The co-occurrence of alcohol and motor vehicle injuries is well established. In approximately half of the motor vehicle fatalities involving an adolescent driver, the driver has a blood alcohol level above .10% (CDC, 1983, 1990a; Mayhew, Donelson, & Beirness, 1986). Beyond the well-established relationship of alcohol and motor vehicle injuries, data are emerging to support the relationship of alcohol use to other injuries. The CDC has reported a higher than expected frequency of high blood alcohol levels in individuals coming to emergency rooms for burns, drownings, etc. (CDC, 1983). In another study by Friedman (1985), who looked at adolescent deaths in San Francisco County, data on blood alcohol concentrations were available on 20 adolescents. Four of these adolescents died while using bicycles or skateboards, and all four had blood alcohol levels greater than .10%.

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 (ages 10 to 14), 7.7% admitted using recreational vehicles under the influence: In high school students, the rate was 19.5% (Millstein et al., in press). 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 these vehicles. With regard to motor vehicle use, riding with a driver under the influence was reported by 36.9% of the middle school students and 58% of the high school students. It is probable that many of the impaired drivers are parents of the adolescent, especially among the younger adolescents. Driving a car under the influence of alcohol or other drugs was reported by 6.8% of the entire sample. Within the high school sample, 9.4% reported this behavior. Once again, these percentages underestimate the problem because the sample is primarily composed of adolescents who are not eligible for driving (Millstein et al., in press). Even though conventional wisdom supports the concept that substances other than

alcohol are involved in recreational and motor vehicle injury, there are no definite outcome data to support this assumption.

Substance Use/Abuse Patterns

Within the area of substance use itself, there are certain patterns of covariation that deserve mention. Although many adolescents experiment with certain substances and do not proceed on to other substances, there are some established patterns of initiation and associations. Covington (1981) has shown that adolescents who experiment with cigarette smoking are more likely to experiment with other drugs. In his sample of students in grades 6 through 10, 69%-87% of smokers had tried marijuana compared with only 3%-17% of nonsmokers.

Yamaguchi and Kandel (1984a, 1984b) provided prospective longitudinal data on the interrelations in use of substances and gender differences in these patterns. The critical difference in their sample is that cigarettes or alcohol can precede marijuana use in females whereas with males alcohol generally precedes marijuana use. Marijuana use is also an important precursor of use of other illicit drugs. Kandel and Logan (1984) further examined the role of personal antecedent variables and found that substance use by one's friends in adolescence and early onset of substance use were the best predictors of subsequent substance use. The trajectory of use patterns was validated further by Newcomb and Bentler (1986) in a longitudinal study in Los Angeles with alcohol use in the preceding year being an important predictor of marijuana use and marijuana use in the preceding year being an important predictor of cocaine use in the following year.

Sexual Behavior, Substance Use, and Other Risk Behaviors

Associations among sexual activity and other risk behaviors are not as well documented as 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 syndrome (AIDS), there is a greater focus on this area of covariation (Miller, Turner, & Moses, 1990). Research indicates that adolescents who are having sex are also engaging in other risk behaviors. Zabin (1984) looked at the association of cigarette smoking and sexual behavior in a sample of 1,200 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 (Zabin, 1984). Zabin and colleagues have also shown that at each age sexually active teens are significantly higher on a substance use index than virgins (Zabin, Hardy, Smith, & Hirsch, 1986).

Jessor and Jessor (1977) documented the association between early sexual ac-

tivity and use of marijuana, cigarettes, and alcohol. With drinking status as a marker for at-risk youth, they found 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 (Mott & Haurin, 1987; Rosenbaum & Kandel, 1990). 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 (Rosenbaum & Kandel, 1990). Additional analyses done by Kandel and Davies (in press) on the entire National Longitudinal Survey of the Labor Market Experience of Youth sample from 1984 find that sexual activity is the most important predictor of cocaine involvement. Among the 93% of males and 86% of females who were sexually experienced, the earlier sex was initiated, the greater the incidence of subsequent cocaine use. Additional data from the National Survey of Youth indicate that early alcohol use in females is more predictive of early sexual activity than in males (Mott & Haurin, 1987).

Additional studies to document the relationship between substance use and sexual activity are highlighted below. Elliott and Morse (1989) reanalyzed data from the 1976–80 waves of the National Youth Survey (a national probability sample of 2,360 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% with no history of substance use, 23% with a history of alcohol use only, 48% with a history of combined alcohol and marijuana, 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 (Ensminger, 1987). Miller and Simon (1974) studied the relationship of sexual intercourse with other adolescent behaviors in a random stratified sample of 2,064 White adolescents aged 14 to 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. Studies done in other countries also support the covariation. Epstein and Tamir (1984) found that initiation of sexual intercourse in males was clearly related to cigarette smoking and dropping out of school. Using smoking status as an indicator condition, 64% of those males who began smoking had intercourse compared to 20% of males who did not smoke. In the female cohort, 38.5% of smokers initiated intercourse compared to 13% of nonsmokers.

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 (Irwin & Millstein, in press; Kegeles et al., 1987). Among the entire sample, sexually active youth engaged in significantly more risk behaviors than confirmed virgins. There is 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 (Irwin & Millstein, in press).

Other factors associated with intention to initiate sexual behaviors include knowledge of transmission, beliefs and attitudes regarding sexually transmitted diseases/human immunodeficiency virus (STD/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 (Shafer & Boyer, 1990).

Summary of Covariation Section

With the mean age of onset of cigarette and alcohol use being 12 years, it is not surprising that alcohol and cigarette use often precede or are associated with vehicle use, sexual behavior, and other substances. Substance use and lack of conventional lifestyle including delinquency are clearly related to sexual activity. Prior use of substances, both licit and illicit, significantly increases the risk of early sexual activity among adolescents. Early sexual activity increases the likelihood of involvement with cocaine, a substance for which the age of initiation

is typically much later than that reported for initiation of sexual intercourse. The strong covariation of substance use and dangerous vehicle use and/or sexual intercourse may actually occur secondary to the disinhibitory effect of alcohol and other substances.

Gender differences in the increase and onset of behaviors may be associated with testosterone. Udry and his colleagues (Udry, 1985; Udry & Talbert, 1988) pointed out the critical role of testosterone in males in the onset of risk behaviors and the mediating effect of androgens for females.

Even though the research on covariation establishes some of the mechanisms by which the behaviors are interrelated, there remains little work in the area of motivation for initiation and perception of the actual risk from the perspective of the adolescent. The intervention and prevention programs attempt to educate teens about the risk without a careful understanding of why adolescents actually choose to engage in risk behaviors with the probability of negative outcomes. Recently completed analyses of our longitudinal data regarding expected outcomes of certain risk behaviors show that adolescents are making choices based on positive expectations of outcomes of sexual and fighting behaviors. In the area of substance use, adolescents make choices based on different expected outcomes. They do not expect negative outcomes. These differences of expected outcomes may be critical for developing interventions. Motivations regarding the various behaviors have yet to be explored. Investigators are now focusing on the possible mechanisms responsible for the interrelationships of the behaviors and the positive and negative health outcomes (Baumrind, 1987; Donovan & Jessor, 1985; Irwin & Millstein, 1987, 1991, in press; Udry, 1988).

MECHANISMS OF COVARIATION

Even though some of the behaviors are interrelated, 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 interrelationships (Jessor & Jessor, 1977). Udry and his colleagues (Udry, 1985, 1988; Udry & Billy, 1987; Udry & Talbert, 1988; Udry, Talbert, & Morris, 1986) provided important data on the importance of gonadal steroids (e.g., testosterone) in the initiation of coitus in males and heterosocial behavior in females. Beyond the work by Udry and his colleagues, few investigators have attempted to integrate both biological and psychosocial factors in developing theories to explain onset of risk behaviors during adolescence.

We maintain that risk taking during adolescence is a part of the developmental process of adolescence and that a careful understanding of the process of development itself may give clues to the mechanisms that explain the onset and maintenance of the behaviors. If one examines the data on behaviors for prevalence, age of onset, gender distribution, and covariation of the three behaviors and the

nature of factors that generate these behaviors, certain issues regarding development emerge. First, there appears to be a developmental trajectory with certain behaviors preceding other behaviors. For example, substance use (either alcohol or generally cigarettes) occurs in early adolescence. Other investigators have proposed that there may be a developmental trajectory regarding risk behaviors with one behavior preceding another behavior (Irwin & Vaughan, 1988). As Yamaguchi and Kandel (1984a, 1984b) demonstrated, one substance may precede another substance, and there is a definite progression through different substances with males and females having somewhat different trajectories. Recently, Rosenbaum and Kandel (1990) maintained that one behavior may not be the functional equivalent of another behavior but may actually constitute a risk factor for a subsequent behavior. In our longitudinal analyses of onset of risk behaviors in a middle school population, there appears to be a developmental trajectory with substance use preceding the onset of sexual behavior (Irwin, Millstein, Adler, & Turner, 1988).

A slight variation of this theme is the development of deviant behavior as discussed by Robins and Wish (1977). They argued that the initiation of one behavior is in part a function of past deviant behaviors and also makes more probable the initiation of additional deviant behaviors. They further suggested that differences between subcultures regarding the ages that are considered appropriate for various activities may be a key to value differences between the subcultures as well. In studying St. Louis Black males born in the 1930s, alcohol use was found to be one of the strongest antecedents to precocious sexual activity (Robins & Wish, 1977).

Second, the behaviors do not occur in isolation. Adolescents who engage in one risk behavior are more likely to engage in other risk-taking activities if the onset of the behavior occurs chronologically early in adolescence. Jessor and Jessor (1977) affirmed a group of adolescent problem behaviors that includes precocious sexual activity, cigarette smoking, assertiveness, nonconventionality, marijuana use, and alcohol use. Their problem behavior theory describes a proneness to engage in certain deviant behaviors. Jessor and colleagues utilize three systems to define problem behavior: the personality, the perceived environment, and the behavior. Within the personality constructs, high value on independence and low expectation for academic goals are both conceptualized as favorable to problem behavior. Within the perceived environment system, low support and control from significant others and approval for and models for engaging in problem behavior are the important constructs. Within the behavior system, the degree of involvement in other problem behavior and the degree of involvement in conventional behaviors (e.g., school performance and church attendance) are expected to predict problem behavior. Early transition to sexual intercourse is related to the personality and perceived environment scales (Jessor, Costa, Jessor, & Donovan, 1983; Jessor & Jessor, 1975). In adolescence, early sexual experience, problem drinking, delinquency, and illicit drug use represent a claim on more adult status or a transition in development, and engaging in such behaviors at a time that is

considered too early constitutes a departure from norms. Recently, some investigators have argued that the concept of a single general tendency to explain a variety of risk behaviors accounts for some but not all of the meaningful variance to explain risk behaviors (Osgood, 1989; Osgood, Johnston, O'Malley, & Bachman, 1988).

Third, there appears to be gender specific differences among the three behaviors. For example, White males and females initiate sex at about the same time, however, more males report using substances except cigarettes. Black males and females differ on their initiation of sex and substance use.

Fourth, peers and family play critical roles in the onset and maintenance of the behaviors. Important predictors of substance use are family members (including siblings) and peer participation in substance use. Recent data further supports this finding for sexual activity with regard to peers (Billy & Udry, 1985; Smith, Udry, & Morris, 1985).

BIOPSYCHOSOCIAL DEVELOPMENT

Adolescence is a time of dramatic biological, psychosocial, and environmental change (Hamburg & Hamburg, 1975; Lerner, 1987; Petersen, 1988; Simmons & Blyth, 1987). Before we present our model, we highlight the critical contributing factors of biological and psychosocial change to onset of risk behaviors.

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 lifespan development in which such significant hormonal and biological change takes place. The age of onset and duration of these changes have broad and different ranges both between and within genders.

The range of pubertal onset for females is 8 to 13 years of age, with completion at 13 to 18 years of age (Marshall & Tanner, 1969). For males, the onset is 9.5 to 13.5 years, with completion at 13.5 to 19 years of age (Marshall & Tanner, 1970). The earlier onset of puberty in females may account for some of the gender differences in the onset of certain behaviors.

Psychosocial Significance of Puberty

Psychosocially, the onset of puberty is accompanied by changes in family interactions, parental feelings, peer relationships and expectations, patterns of intimacy, changes in self-esteem, heterosocial interests, and educational achievements

(Clausen, 1975). Recently, data are emerging that show males and females may experience puberty differently with males focusing more on physiological changes and functioning and females focusing on psychosocial changes including affective change (Brooks-Gunn, 1989; Ryan, Millstein, & Irwin, 1988; Shore, 1984).

The effect of the rapid biological, psychological, and environmental changes associated with adolescence may be even greater for adolescents who are out of synchrony with the developmental timing of the majority of their peers. These occurrences are not rare because there is great variation between individuals of the same and opposite gender in the timing of the onset and duration of puberty. The role of these differences in physiological maturation is best described by considering adolescents who lie at the extreme ends of the physical maturation continuum: earlier maturing females and later maturing males.

The earlier maturing female reaches adult biological status before any of her female or male peers and may have an adult physical appearance as early as 11 years of age. At a time when social conformity is the desired state, these girls are set apart from their same chronological age peers and exhibit greater dissatisfaction with physical appearance than do other postpubertal girls, report greater general unhappiness, have lower self-esteem, and lower levels of educational achievement (Brooks-Gunn, Petersen, & Eichorn, 1985; Faust, 1983; Susman et al., 1987; Susman, Nottelmann, Inoff-Germain, Dorn, & Chrousos, 1987). Although their accelerated maturation gives these girls greater social prestige and popularity among older males, it is accompanied by a decrease in recognition from other females (Petersen, Tobin-Richards, & Boxer, 1983). The adult physical appearance of these girls and their popularity with older boys is accompanied by earlier heterosexual interests and behavior; these girls not only spend time with older boys, they also begin their sexual activity earlier than other girls (Hayes & Hofferth, 1987; Shafer et al., 1985). The onset of sexual activity makes them at greater risk for the acquisition of STDs (Irwin, Shafer, & Millstein, 1985). The earlier sexual activity among these girls may reflect not only increased access and issues related to self-esteem but also their more developed needs for independence and decision making.

Clearly, the early maturing girl is more likely to engage in one risk behavior, sexual activity (Shafer et al., 1985). Furthermore, the older and potentially more experienced friends of these girls may also provide them with increased access to other risk behaviors. In the area of motor vehicle accidents, the older male driver may place the early maturing female at risk for accidental injury or death. Our preliminary data point out that although males are more likely to drive a vehicle under the influence of alcohol or other substances, early maturing females are more likely to ride in a car with an impaired driver (Millstein et al., in press).

At the opposite end of the developmental spectrum is the later developing male. Less is known about later maturing males, in part, because retrospective measures of male pubertal timing are not currently validated and also because one

cannot be definitively classified as a late developing male until eighth grade or 14 years of age (Schlossberger, Irwin, Turner, & Millstein, 1990). Later maturing males complete their physical development after all other chronologically similar age peers and are at a social disadvantaged compared with other boys (Blyth et al., 1981; Brooks-Gunn et al., 1985; Eichorn, Clausen, Haan, Honzik, & Mussen, 1981; Irwin & Millstein, 1986). They are more likely to have ectomorphic body types and a negative self-concept, particularly around body image issues (McNeil & Livson, 1963). They are viewed by peers as being less masculine in behaviors, unathletic, and unpopular. Without the somatic physical attributes most highly valued in males, these boys are hypothesized by one group to risk taking as a means of gaining recognition (Irwin & Millstein, 1986). Reckless motor vehicle or skateboard use do not require the kind of physical development that many sports require, yet they fulfill many of the same needs such as testing limits. In addition, due to the lack of sexual development, many of these boys are not capable of engaging in sexual activity, thereby leaving substance use and reckless vehicle use as their only source of risk taking. There is some new evidence that points to the risk of both early development in males and females (Irwin, Millstein, Adler, & Turner, 1989; Westney, Jenkins, Butts, & Williams, 1984) especially in the area of sexual activity.

Psychosocial Development

By looking at psychosocial development as a series of developmental tasks that require mastery, risk-taking behavior is placed within a context of developmental maturation. Some of these developmental tasks include autonomy/independence, mastery, intimacy, individuation/identity formation, and advanced cognitive processing of information.

In early adolescence, increased identification with the peer group facilitates the process of separation from parents. This increased identification has special relevance for risk taking because peer pressure is well established as a principal factor in the onset of risk behaviors including substance abuse and sexual activity. Peer pressure as early as 10 years is operational in encouraging young people to participate in dangerous activities including sexual risk taking that are health damaging (Lewis & Lewis, 1984).

In middle to late adolescence when issues associated with mastery, autonomy, and individuation are operational, many new statistically normative activities are pursued such as sexual activity, substance use, and motor vehicle use. In order to achieve mastery, adolescents may choose to test or verify their physical and psychosocial limits by engaging in risk behaviors.

Cognitive functioning undergoes a major developmental shift during adolescence with the onset of formal operations. Concrete egocentric thinking shifts into abstract sociocentric ways of thinking. Although the adolescent has the

cognitive ability to reason abstractly and consider cause and effect relationships, he or she also has 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 though 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 (Elkind, 1967). 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 adolescents' perceptions of the risk associated with specific behaviors (Millstein, in press).

As one examines the specific cognitive changes and psychosocial changes and biological changes that characterize the adolescent period, the emergence of risk taking is not surprising. With the developmental tasks and biological change providing the push and cognitive abilities being immature accompanied with lack of experience with the behaviors, the adolescent period is a critical developmental period in the life cycle for the onset of life-long risky behaviors and the associated negative outcomes.

ETIOLOGY OF INTEREST IN LINKAGE OF BEHAVIORS WITH MATURATION, BOTH BIOLOGICAL AND PSYCHOLOGICAL

Careful analyses of the mortality and morbidity data of adolescence, the interrelationships of these behaviors responsible for the negative outcomes, age of onset, gender differences, and some important early clinical observations lead to an observation of the behaviors as a group and what might be the common underlying mechanisms driving the behaviors.

Our clinical observations over the past decade are consistent with the literature. Many of our patients with behavioral problems associated with their medical problems developed earlier or later than their age related peers. This asynchrony appears to be a contributing factor to the etiology of their problems. Earlier developing girls were brought to our clinical setting by their mothers because of "acting out problems" within their families. Later developing males were also brought by their parents with concerns about their development and often their sons' dissatisfaction with school. Another group of patients at the Pediatric Endocrinology Clinic were the females with precocious puberty. These females were having difficulty in school, difficulty in functioning within their homes, and, in particular, were seeking out older young people as friends. The problems with adolescent females who have precocious puberty are well documented (Sonis, Comite, & Blue, 1985).

The greatest effects of timing of puberty are in the following areas: self-conceptions (body image and self-esteem), developmental needs (heterosexual

relationships, peer affiliation, and family independence), school performance (academic performance and problem behaviors), and environmental responses (peer, parental, and teacher expectations). These effects vary by gender, the pubertal status of the adolescent and how it relates to that of his or her peers, definitions of maturational timing, and the specific risk behavior under investigation (for extensive discussion, see Brooks-Gunn, 1989; Brooks-Gunn et al., 1985; Irwin & Millstein, 1986; Steinberg, 1987). In general, the most negative effects are reported for early maturing females (Brooks-Gunn, 1989). Some recent work shows that the effects of early maturation may be detrimental for both sexes, with early maturation in males being associated with the early initiation of sexual activity (Irwin et al., 1989; Westney et al., 1984).

For risk-taking behaviors to be both interrelated and developmentally driven, one needs to bring together two areas of research that have until recently been considered separately: (a) the relationship of biological development to psychosocial functioning during adolescence; and (b) the relationship of risk-taking behaviors to psychosocial correlates of these behaviors. The first section of this chapter reviewed the mortality and morbidity data of adolescence emphasizing the negative outcomes. The second section reviewed the covariation literature and introduced the known mechanisms by which the behaviors are interrelated. The third section emphasized the issues of biopsychosocial maturation and the effect of pubertal maturation. The fourth section highlighted how these risk behaviors fulfill many developmental needs which have their onset throughout adolescence.

BIOPSYCHOSOCIAL MODELS OF RISK-TAKING BEHAVIOR

In the past decade, biopsychosocial models (Irwin & Millstein, 1986; Jessor & Jessor, 1977; Udry, 1988) have been proposed that integrate adolescent developmental principles with risk factors for the development of risk-taking behaviors. Jessor and Jessor have proposed a problem behavior framework arising from an interaction of factors within and among each of these systems: the personality system, the perceived environment, and the behavior system (Jessor, 1984; Jessor & Jessor, 1977). This model was discussed earlier in the chapter. More recently, Udry (1988) proposed a model for males that includes the effects of sex hormones. Specifically, considering five behaviors (got drunk, smoked cigarettes, cut school, had sex, and used marijuana), levels of free testosterone add significant variance to a social model. In girls, there are no specific biological effects. Udry has found a link between testosterone and sexual behavior that appears to be mediated through the social environment (Udry & Billy, 1987; Udry, Talbert, & Morris, 1986). Increasing levels of testosterone give rise to increased heterosocial interest and masturbatory activity but not actual coital behavior. Other

models draw heavily from the concept of sensation seeking as a personality trait that correlates with risk behaviors (Daitzman & Zuckerman, 1980; Zuckerman, 1986) and the perception of risk constructs (Slovic, 1987).

The causal model as depicted in Fig. 5.1 integrates biological maturation and psychosocial functioning (Irwin & Millstein, 1986; see Irwin & Millstein, in press-b, and Irwin & Ryan, 1989, for extensive discussion of model). The model draws heavily on the previous work of Jessor and Jessor, the biological effects demonstrated by Udry, and integrates our knowledge about the psychosocial effects of pubertal maturational timing. The model states that biological maturation during adolescence has specific psychosocial sequelae. Specifically, timing of biological maturation directly influences four areas of psychosocial functioning: (a) cognitive scope, (b) self-perceptions, (c) perceptions of the social environment, and (d) personal values. Each broad area of psychosocial functioning has components that play a larger role in initiation and maintenance of risk behaviors. These areas are expanded in Fig. 5.1. In younger adolescents, who are at the height of cognitive egocentrism, these effects are especially strong.

These four factors influence two additional mediating factors, peer group selection and perceptions of risk. The behavior and standards of the peer group are powerful motivators for adolescents. Risk perception, although it has not been studied extensively in adolescents, is expected to be affected by peer norms, cognitive capacity, and self-perceptions, particularly self-esteem. Recently, data from

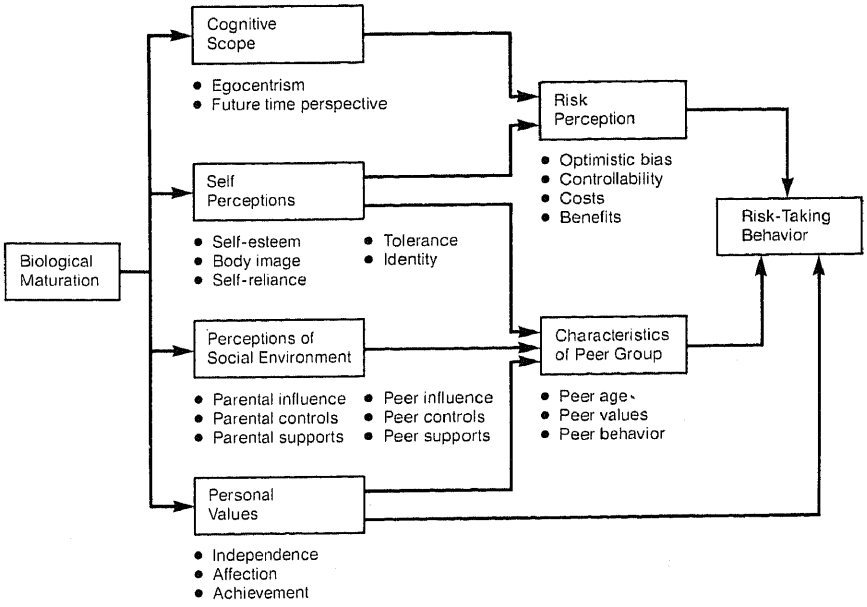

FIG. 5.1. Causal model of adolescent risk-taking behavior. Adapted and modified from Irwin & Millstein (1986).

Johnston and his colleagues in the annual surveys of substance use provide insight into the importance of risk perception. Over the past decade as the high school seniors have viewed marijuana as being more risky to their health, there has been a significant decrease in marijuana use (Johnston, O'Malley, & Bachman, 1989a, 1989b). The adolescent's peer group influences risk-taking behavior both in its effects on risk perceptions and directly in providing opportunities for risk-taking behavior. The influence of personal values on risk taking occurs as a function of its effects on peer group choice with some direct effects as well.

The specific way in which pubertal timing affects the adolescent depends on a number of factors such as gender and age. For example, the effects of early pubertal maturation in males is positive with negative health outcomes in the area of sexual activity. In females, the effects of early pubertal maturation are negative in both the psychological and health outcome arenas. In males, the effect of late development is negative psychosocially with positive health outcomes. In females, the outcomes are both positive in psychosocial functioning and health. The efficacy of this model to explain adolescent risk taking is currently being explored in an extensive longitudinal study of adolescents.

GENERAL OVERVIEW OF CURRENT RESEARCH

A series of longitudinal studies is currently being used to test the model. The initial sample (Phase 1) consists of 1,636 adolescents from one middle school (881) and two high schools (755) in an urban bay area community. Phase 1 identifies the base rates of the risk-taking behaviors in the entire sample and an appropriate cohort of adolescents based on self-report measures of maturation (Irwin, Millstein, Adler, Kegeles, & Cohn, 1986). These data are reported in two publications (Irwin & Millstein, in press; Millstein et al., in press). The final phase (Phase 3) of the longitudinal study consists of a cohort of 200 adolescents who were part of all three phases. In the longitudinal phases (Phase 2 and Phase 3) of the project, two critical qualitative components of the study are (a) the meaning of maturation interview and (b) the concepts of risk interview.

From the self-report data in the schools, it is clear that the self-report measures of maturation in the male population are not accurate reflections of the young people's actual status; however, the bias is in a predicted direction. For males, a much higher percentage reported that they were early developers in middle school than is expected. In high school, a much higher percentage stated they were late developers than expected. For females, there was a bias in the direction of normal to late developers in all classes. The predicted distribution should be Early, 20%; Normal, 60%; and Late, 20% based on an algorithm. Table 5.1 highlights the distribution and the above reported discrepancies.

To understand how timing of pubertal maturation interacts with risk and resultant behavior, it is not enough to know where the young person is in terms of

TABLE 5.1
Percent of Adolescents Classifying Themselves as Early/Normal/Late Developers Based on Self-Staging

	Grade Level in School					
	6	*7*	*8*	*9*	*10*	*Total*
Males (N = 571)						
Early (%)	55	45	36	32	38	38
Normal (%)	28	27	36	17	25	25
Late (%)	(NA)	2	12	51	26	26
Unknown (%)	17	27	15	0	11	11
Females (N = 590)						
Early (%)	6	8	5	13	9	8
Normal (%)	51	64	76	70	56	63
Late (%)	16	3	4	18	35	18
Unknown (%)	27	25	16	0	0	11

NA–Not applicable in Grade 6.

maturation. One needs to also have an understanding of the meaning of maturation to the young person. The meaning of maturation interview queries adolescents about where they currently are in maturation and then probes the following areas: sources of information, social support, affective response from friends, perceived advantages and disadvantages of their own rates of maturation and other rates of maturation.

From our early work on risk taking it is clear that adolescents recognize the negative aspects of risk-taking behaviors, however, they are also able to identify developmental changes in risk as a function of age (Millstein & Irwin, 1985). Of 11 behaviors ranging from taking drugs to not exercising, they ranked them as *at least somewhat risky* to *extremely risky* on a 5-point scale. Older adolescents perceive significantly less risk across the 11 behaviors than do younger adolescents. There are some interesting anticipated changes of risk with age. In the area of sexual activity and smoking cigarettes, adolescents anticipate less risk when older. In the area of not seeing a physician and not exercising, they anticipate more risk when older. In the areas of driving and drinking, driving fast, reckless vehicle use, and drug use, they anticipate no changes with age: the risk will be the same as they get older (Irwin & Millstein, in press). The concepts of risk interview is an in-depth qualitative assessment of the positive and negative expectations assigned to risk, both prospectively and after engagement.

Several of the early analyses focus on the relationship between onset of risk behaviors and the attributions assigned to risk behaviors. Throughout this chapter, data has been provided on morbidity, covariation, and biopsychosocial development. Recent analyses testing the model point out the importance of expectations of outcomes of risk behaviors and the social environment. Positive attributions regarding sexual activity and fighting predict their onset, whereas less negative

attributions predict substance abuse behaviors (Irwin et al., 1988). Preliminary analyses of the social environment point out that adolescents in nontraditional families have a greater tendency to initiate substance use related behaviors earlier, however, the effects of emotional detachment (Ryan & Lynch, 1989; Steinberg & Silverberg, 1986) are powerful predictors of initiation and maintenance of risk behaviors (Turner, Irwin, & Millstein, 1989, 1991). Throughout the studies, intention to initiate a behavior remains a critical factor in determining whether adolescents will engage in a behavior in the following year (Irwin et al., 1988) that further confirms the volitional nature of these behaviors.

CONCLUSION

Risk behaviors are not unique to adolescence. The major health-damaging behaviors initiated during adolescence continue into adulthood. These same behaviors are responsible for the major morbidities and mortalities through the fourth decade of life. The major biopsychosocial changes that are interactive and may be additive are unique to adolescence.

Over the past decade, there has been a significant movement away from studying single behaviors to studying multiple behaviors and their covariation. With this movement, there is a tendency to focus on the sociodemographics of risk behaviors. Irwin (in press), Millstein (1989) and others (e.g., Baumrind, 1987, 1991) suggested that there is little information on the functional role of risk taking for adolescents and the meaning and natural history of risk taking as adolescents enter adulthood.

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