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Health-endangering behaviours among Japanese college students: a test of psychosocial model of risk-taking behaviours

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Abstract

Adolescents' health-endangering behaviours receive attention because they are presumed to threaten the health of individuals in either the short or long term. The present study examined the role of psychosocial determinants on adolescents' health-endangering behaviours using elements of a biopsychosocial model proposed by Irwin and Millstein (1986). It was hypothesized that egocentrism, self-esteem, and perceived social environment affect the onset of risk-taking behaviours, mediating risk perception. Eight hundred and eight Japanese college students completed questionnaires. Results from a structural equation analysis partly supported the hypothesized model. Egocentrism contributes directly to health-endangering behaviours while influences of self-esteem and perceived social norms are mediated by risk perception.

Introduction

The majority of adolescents experience no major physical illnesses. Nonetheless, researchers note that the primary risks of morbidity and mortality among adolescents originate from behaviours characteristic to this period (Irwin & Millstein, 1992). In the United States, most cases of mortality during adolescence result from accidents, homicide, and suicide (Millstein, 1989). In Japan, accidents are the most frequently reported cause of death of adolescents (Ministry of Health, Labour, and Welfare of Japan, 1999). Adolescence is characterized as a time when

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individuals engage in problematic and health-endangering behaviours including delinquent actions, use of tobacco and alcohol, unsafe sexual activities, and poor dietary habits (Sullivan & Terry, 1998). Potential negative outcomes of these actions include more serious crimes following delinquency, drug abuse, unwanted pregnancies, sexually transmitted diseases (STDs), and various health problems caused by eating disorders. As a consequence, there has been increased interest in psychological determinants of health behaviours in adolescents.

While risk-taking behaviours are often recognized as a normal part of adolescents' development, they are of no less concern because they endanger adolescents' health and well-being. Much less is known about the scope and character of psychosocial correlates of health-endangering behaviours among Japanese adolescents. The major purpose of this study was to examine the utility of a theoretical model developed in the United States to Japanese adolescents.

Theories of adolescents' health-endangering behaviours presumed that developmental characteristics determine the involvement in health-endangering behaviours. Such developmental characteristics include attaining adult status, independence from parents, and a failure of probability reasoning. Jessor and Jessor (1977) postulate that unconventionality in personality, perceived environment, and behavioural systems is responsible for the increased engagement in such problem behaviour as precocious sexual activity, substance use, and delinquency. According to Arnett (1992), adolescent reckless behaviours are promoted by sensation seeking, egocentrism, and socialization influences. Particularly, egocentrism is considered to manifest developmental characteristics resulting in a failure of probability reasoning that underlies reckless behaviours. It is presumed that this failure of probability reasoning may distort adolescents' perception of the risk of a particular behaviour and adolescents tend to have feelings of invulnerability.

Irwin and Millstein (1986) integrated risk factors for the development of health-endangering behaviour into a model and proposed a biopsychosocial model. Their causal model integrates biological maturation and psychosocial functioning and demonstrates that biological maturation during adolescence has specific psychosocial consequences. In particular, the timing of biological maturation has immediate influences on four facets of psychological functioning: (a) cognitive scope, (b) self-perceptions, (c) perceptions of the social environment, and (d) personal values. Two mediators exist between these four aspects of psychosocial functioning and risk-taking behaviours: risk perception and characteristics of the peer group. According to Irwin and Millstein (1992), risk perceptions are important in the prediction of actual engagement in health-endangering behaviour.

Parts of the Irwin and Millstein model have been supported by previous studies. Typically, impacts of psychosocial development on health-endangering behaviours have been explored in terms of relationships between health-endangering behaviours and such variables as cognitive development, self-esteem, and social influences. For instance, Arnett (1990) investigated links between egocentrism and actual participation in sex without contraception. Egocentrism, particularly the estimated probability of pregnancy as a result of unprotected sex, was related to risk behaviour. Poor self-concepts have been found to be a precipitant of a high level of risk behaviour engagement (Cooper, Shaver, & Collins, 1998; Ingersoll & Orr, 1989; Turner, Irwin, Tschann, & Millstein, 1993). Not only direct relations to the incidence of health-endangering behaviours but also indirect links to behaviours were explored. For instance, Cooper et al. found that self-concept contributes to problem behaviours, mediating attachment style. Similarly,

Silberstein, Petersen, Albrecht, and Kracke (1989) found that negative feelings about oneself was a function of peer rejection, which in turn, enhanced contacts with deviant peers.

Peers and parents are considered to be the groups most influential in adolescents' social development among social influences. Whereas adolescents are not fully independent in certain aspects, they start functioning as adults in the society, widening their social radius through peer groups. With regard to familial influences, Millstein and Irwin (1988) claim that the likelihood of engagement in health-endangering behaviour is enhanced by parents' and siblings' participation in such behaviours and by maladaptive family conditions including chronic conflicts among family members. Effects of health-endangering behaviours of older siblings on younger siblings have been supported by research findings from a study conducted by D'Amico and Fromm (1997).

Perceptions of friends' behaviours or perceived social norms have been found to be a good predictor of health-endangering behaviours (Beck & Treiman, 1996; Chopak, 1993; Gerrard, Gibbons, Benthin, & Hessling, 1996; Gibbons, Helweg-Larsen, & Gerrard, 1995; Graham, Marks, & Hansen, 1991; Unger et al., 2000). In conjunction with the relationship between perceptions of vulnerability and health risk behaviours, the role of the perceived prevalence of health-endangering behaviours among peers or in general for predicting health-endangering behaviours has been explored. Gerrard, Gibbons, Benthin, and Hessling (1996) demonstrated an inverse association between adolescents' perceptions of vulnerability and their participation in health-endangering behaviours. Gerrard et al. interpreted the role of cognitive manipulations to deal with adolescents' knowledge of the danger. First, adolescents who increase risk tend to overestimate the prevalence of health-endangering behaviours among peers and to normalize their actions. Second, adolescents attempt to reduce the influence of health concerns on their behaviours, avoiding thinking about what will happen if they engage in health-endangering behaviours.

The present study was designed to examine the utility of a biopsychosocial model of Irwin and Millstein (1986) to Japanese adolescents, exploring relationships among components included in it: psychosocial development, risk perceptions, and risk-taking behaviours. As aforementioned, contributions of psychosocial elements to health-endangering behaviours were examined in the past. However, the relationships among three factors, i.e. psychosocial development, risk perception, and health-endangering behaviours, have not been tested. Therefore, this study was expected to expand our knowledge on psychosocial mechanisms of health-endangering behaviours among Japanese adolescents by testing the Irwin and Millstein model. A portion of the Irwin and Millstein model was focused for the current study. It was hypothesized that psychosocial development including egocentrism, self-concepts, and social norm, predict health-endangering behaviours by mediating risk perceptions.

Methodology

Participants

Participants for the study were 808 college students (458 males and 338 females, 12 did not respond) from three universities in Japan. Questionnaires were distributed to college students

during classroom periods at three different institutions: one private university in a metropolitan area, one private university and one national university in two different suburban areas. The average age of the participants was 19. 07 years old (18–27 years old, SD = 1.40). Although efforts were made to include college students at different standings, the majority of the participants were freshmen. Approximately 90 percent of the participants were from two-parent families. There were only five individuals from step families.

Instruments

Each participant was provided with a packet of questionnaires containing items on demographics and instruments that were intended to measure variables for the following constructs: egocentrism, self-esteem, social norms, risk-perception, and the incidence of health-endangering behaviours.

Egocentrism

Two aspects of egocentrism, personal fable and imaginary audience, were measured by the New Imaginary Audience Scale (NIAS) and the New Personal Fable Scale (NPFS) devised by Lapsley, Fitzgerald, Rice, and Jackson in 1989 (Holmbeck, Crossman, Wandrei, & Gasiewsky, 1994). Egocentrism is defined as "an embeddedness in one's own point of view" (Looft & Charles, in Dolcini et al., 1989, p. 410). Elkind (1967) identifies personal fable and imaginary audience as two aspects of egocentrism. According to Elkind, adolescents tend to construct an imaginary audience, believing that other people are preoccupied with their behaviours and appearance. This imaginary audience makes adolescents conceive that there is something unique about their lives and that their lives are special. Consequently, an adolescent sees himself or herself as invulnerable to the outcome of reckless behaviour and develops a personal fable, an untrue story that one tells him/herself.

Japanese versions of NIAS and NPFS were developed based on the original NIAS and the invulnerability subscale of NPFS. After the process of back-translation, redundant items and culturally irrelevant items were deleted. The resulting, modified NIAS was composed of 16 items asking the frequency of daydreaming or imagining oneself to be in specific situations—for example, "being a rock star," "being popular with friends," and "being admired for the way you look." Each item was evaluated on a 4-point scale ranging between 1 and 4 (1 = never, 2 = hardly ever, 3 = sometimes, 4 = often). The modified NPFS consisted of 13 items asking participants to rate how well each statement describes him or her. Participants were asked to assess each item with a 5-point scale ranging from 1 to 5 (1 = strongly disagree, 2 = disagree, 3 = not sure/neutral, 4 = agree, 5 = strongly agree). Examples of items are: "Nothing seems to really bother me," "I don't believe in taking chances," and "I am a fragile person." Averages of NIAS and NPFS were computed for the analysis. High scores of imaginary audience and personal fable imply high egocentrism and a low level of cognitive development. The Cronbach alpha coefficients for each subscale were 0.81 for NIAS and 0.61 for NPFS.

Self-esteem

Self-esteem was assessed by measuring three aspects of the self, using an instrument devised to measure domain-specific self-image. This study employed three subscales of the Offer Self-Image

Questionnaire (OSIQ), impulse control, body image, and mastery of the external world. OISQ was developed to assess different domains of self among adolescents between 13 and 19 years of age (Offer, Ostrov, Howard, & Atkinson, 1988). Internal consistencies for each subscale in the form of the Cronbach alpha coefficient were 0.66, 0.60, and 0.64, respectively (Patton & Noller, 1994).

Because the Japanese version of OSIQ was not available, back-translation was conducted for the items of these subscales. As in the original version of OSIQ, a 6-point scale was employed to rate how well statements given to the subjects describe themselves (1 = describes me very well, 2 = describes me well, 3 = describes me fairly well, 4 = does not quite describe me, 5 = does not really describe me, 6 = does not describe me at all). The impulse control subscale involves seven items, the body image scale includes eight, and the mastery of external world consists of five items. The assessment of internal consistencies revealed that Item 9 "The picture I have of myself in the future satisfies me." would improve the value of alpha coefficient. It was speculated that wording of this item could make the meaning of this sentence both negative and positive. Therefore, Item 9 was deleted from the analysis. Consequently, alphas for three subscales of self-esteem were modest ranging from 0.53 to 0.59. Mean scores of three subscales were computed and used for the analysis. Low scores of these three subscales are indicative of a positive self-image.

Social norms

The social environment contributing to adolescents' health-endangering behaviours consists of perceived disapproval by peers and parents and perceived prevalence of particular behaviours. Items used by previous studies (Chopack, 1993; Gibbons, Helweg-Larsen, & Gerrard, 1995; Indiana Prevention Resource Center, 1991) were adapted for this study.

Concerning perceived disapproval from peers and parents, respondents were asked to rate how they think their friends or parents feel about them engaging in each of these four health-endangering behaviours: (1) smoke one or more packets of cigarettes per day; (2) use illicit drugs occasionally; (3) take one or two alcohol drinks (beer, wine, liquor) occasionally; and (4) have sexual intercourse. A 5-point scale (1 = strongly disapprove, 2 = approve, 3 = don't know, 4 = disapprove, 5 = strongly disapprove) was employed.

Participants were also asked to provide estimations of the prevalence of four extreme health-endangering behaviours of adolescents of the same age as well as those of their own friends. Items included (1) the percentage of people at one's age or friends who are sexually active, (2) the percentage of people at one's age or friends who smoke cigarettes, (3) the percentage of people at one's age or friends who use illicit drugs, and (4) the percentage of people at one's age or friends who drink alcohol regularly. Participants were asked to give such estimates in percentages on a scale providing percentages by 10 percent increments.

Risk perceptions

Risk perception was measured by three different risk characteristics—personal risk, risks to peers, and risks versus benefits—which were derived from a psychometric study by Benthin, Slovic, and Severson (1993). Personal risk asked the degree to which each respondent believed that he or she would be personally at risk of getting hurt or sick as a result of certain behaviours. Risk to peers concerns the magnitude that each participant thinks that other people would be at risk of getting hurt or sick by engaging in health-risk behaviours. The benefits versus risks characteristic refers to the extent to which the benefits or pleasures are greater than the risks

associated with a behaviour. Participants were asked to rate each risk characteristic on a 7-point scale for eight behaviours (1 = very much at risk, 7 = not at all at risk) for personal risk and risk to peers; (1 = risks much greater than benefits, 7 = benefits much greater than the risks) for risks relative to benefits. Eight health-related behaviours include drinking beer, drinking wine, drinking whiskey, drinking five (four for women) or more drinks in a row, smoking cigarettes, taking methamphetamines, using inhalant thinner, and having unprotected sex.

Health-endangering behaviours

Health-related behaviours assessed in this study included: (a) smoking cigarettes, (b) drug use (methamphetamines, marijuana, and inhalant thinner), (c) drinking alcohol, (d) sexual behaviours, and (e) personal safety. Although personal safety is rather a health-promoting behaviour, this was added as a reversed item. Items except those for drinking behaviours were constructed based on the instrument used by the Center for Disease Control (Kolbe, 1990). For cigarette smoking and drug use, four items were used: experience of these behaviours, the age of first participation in these behaviours, frequency of participation in the past year and in the past 30 days. Respondents were asked to choose one of five response categories for each question, which ranged between 1 and 5 (for experience of smoking, 1 = never smoked, 2 = once or twice, 3 = occasionally but not regularly, 4 = regularly in the past, 5 = regularly now; for the first age of smoking, 1 = 12 years or less, 2 = 13–15 years, 3 = 16–17 years, 4 = 18 or more years, 5 = never smoked; for smoking in the past year and in the past month, 1 = none, 2 = 1–5 times, 3 = 6–19 times, 4 = 20–40 times, 5 = more than 40 times). Items used for sexual behaviours asked the age of first experience of sexual intercourse and experience of sexual intercourse without contraceptive methods. There were also five response categories, ranging from 1 to 5. Items related to personal safety asked for the number of experiences of riding in vehicles driven by individuals under the influence of alcohol and the frequency of wearing seat belts in a car.

There were two items for drinking behaviours: the first age of drinking without the presence of parents or guardians; and the frequency of binge drinking during the past two weeks. Binge drinking was assessed employing items developed by Wechsler, Davenport, Dowdall, Moeykens, and Castillo (1994): ''In the last 2 weeks how many times did you have five (four for females) or more drinks in a row?'' Participants were to choose one of six response categories: none, twice, three to five times, six to nine times, and 10 or more times.

Procedure

Data were collected through an anonymous survey. Study information sheets as well as questionnaires were distributed to participants in classrooms by the researcher. The questionnaires were completed during class periods. It took approximately 50 minutes for participants to complete a questionnaire packet. The completed questionnaires were put into an envelope which was then sealed and placed into a box by each participant in order to secure a sense of anonymity for themselves.

Results

With the aim of examining the utility of the biopsychosocial model of adolescent risk-taking behaviours proposed by Irwin and Misllstein (1986), this study investigated the relationships among factors of psychosocial development, perceived risk of health-endangering behaviours, and the engagement of health-endangering behaviours.

Factor analyses were performed for the purpose of data reduction for items measuring health-endangering behaviours and risk perceptions, prior to structural equation modelling analyses, which examine the hypothesized relationships. Principal axis factoring method with promax rotation was employed for both sets of factor analyses. Three factors were extracted for risk perception items: Factor I was named as "risk perception of drinking," Factor II as "risk perception of substance use," and Factor III as "risk perception of unprotected sex." For health-endangering behaviours, four factors were extracted: Factor I "Smoking," Factor II "Drug Use," Factor III "Early Initiation," and Factor IV "Unprotected Sex." Details of factor analyses are described elsewhere (Omori, 2001). For both risk perception and health-endangering behaviours, factor scores were computed and transformed into *T*-scores. Consequently, three variables were created for risk perception: risk perception of drinking, risk perception of substance use, and risk perception of unprotected sex. In a similar manner, four variables were generated for health-endangering behaviours: smoking, drug use, early initiation, and unprotected sex.

Structural equation modelling

Structural equation modeling was performed to test the hypothesized relationships among egocentrism, self-esteem, social norms, risk perception, and health-endangering behaviours. Ninety-one cases were found to have missing values for variables to be included in the structural equation modelling. Since there was no systematic pattern with regard to missing data, these cases with missing values were excluded. The resultant number of participants was 717.

Measurement model

A series of confirmatory factor analyses were performed in order to examine how well each variable represents measurement models of the hypothesized model. The LISREL 8.50 for Windows was used for the analysis.

As exogenous latent variables, egocentrism, self-esteem, and social norm were specified. Indicators for egocentrism latent variable were imaginary audience and personal fable. Self-esteem was manifested by three indicators which are subscales of the Offer Self Image Questionnaire OSIQ: impulse control, body- and self-image, and mastery of external world. Social norm had three indicators: perceived prevalence of health-endangering behaviours, and peer/parental disapproval. For endogenous variables, risk perception and health-endangering behaviours were specified as latent variables. The risk perception construct was manifested by three indicators: risk perception of drinking, risk perception of substance use, and risk perception of unprotected sex. Health-endangering behaviour was specified as a latent variable measured by four indicators involving smoking, drug use, early initiation of risky behaviours, and unprotected sex.

Two confirmatory models were specified using two measurement models: one for exogenous latent variables and another for endogenous variables, using covariances among all the indicators included in each measurement model. The maximum-likelihood method (Jöreskog & Sörbom, 1996) was used for the estimation.

First, a measurement model was tested for the exogenous latent variables. The initial set of path was specified based on the hypothetical relationships between latent variables and indicators. Since the initially hypothesized model did not converge, an additional path was drawn between self-esteem and personal fable. Conceptually, the higher personal fable, the likelihood the one has an untrue story that he or she tells him/herself, would facilitate better sense of self. Thus, the hypothesized model was modified and specified with an additional path between self-esteem and personal fable. The hypothesized model (model 1) was tested and fit indexes were obtained, x^2 (16, $N=717$) = 115.97, $p=0.00$, CFI = 0.86. Squared multiple correlations (SMCs) for indicators were analysed. SMCs for peer and parental disapprovals and perceived prevalence variables were found to be very low (0.00, 0.05, and 0.01, respectively), indicating that the hypothesized model accounted for little of the variance of these indicators.

Modification indices indicated that another path from egocentrism to the perceived prevalence and correlations among measurement errors, i.e. covariances in theta-delta matrices, would improve the goodness-of-fit. Given the fact that precedent studies dealt with the perceived prevalence of health-endangering as a part of health cognition (Arnett, 1990; Gerrard, Gibbons, Benthin, & Hessling, 1996), it was thought to be appropriate to relate perceived prevalence to the social cognition latent variable (model 2). Concerning measurement error correlations, covariances between imaginary audience and two subscales of OISQ were found to improve the goodness-of-fit. The final model (model 3) was obtained with fit indexes, x^2 (14, $N=717$) = 37.48, $p=0.00$, CFI = 0.97 (Fig. 1). Table 1 demonstrates fit indexes in the hypothesized and final models.

A measurement model for endogenous latent variables was specified with two latent variables and seven indicators. Risk perception was manifested by three indicators: risk perception of drinking, risk perception of substance use, and risk perception of unsafe sex. Health-endangering behaviour was specified as a latent variable manifested by four indicators of smoking, drug use, early initiation, and unprotected sex.

A confirmatory factor analysis was performed using the maximum-likelihood method as parameter estimation. First, fit indexes were obtained for the hypothesized model, x^2(13, $N=717$) = 83.22, with a CFI of 0.95. While a CFI indicated that the model had good fit to the data with high loadings of indicators on the constructs, modification index implied that allowing some of measurement error correlations would improve the fit. The final model was obtained, allowing three covariations of measurement error terms. The measurement model fit the data well, x^2(9, $N=717$) = 32.85, with a CFI of 0.98. Fit indexes of the initial and final model are presented in Table 2. The measurement model was satisfactory, with high loadings of indicators on the constructs (Fig. 2).

Structural equation model

A structural equation model was specified to examine the utility of the conceptual model based on Irwin and Millstein (1986). The risk perception latent variable was hypothesized to mediate between three exogenous latent variables and the engagement in health-endangering behaviours.

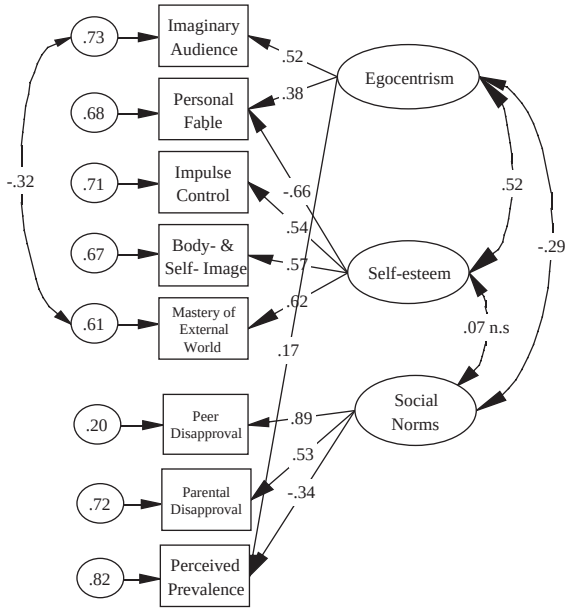

Fig. 1. Measurement model for exogenous latent variables.

Table 1
Goodness-of-fit summary for exogenous latent variables

Model	x^2	df	*p*-Value	RMSEA	P-Close	GFI	AGFI	SRMR
Model 1	115.97	16	0.00	0.093	0.00	0.96	0.91	0.055
Model 2	100.40	15	0.00	0.089	0.00	0.97	0.92	0.053
Model 3 (the final model)	37.48	14	0.00	0.048	0.52	0.99	0.97	0.034

Table 2
Goodness-of-fit summary for endogenous latent variables

Model	x^2	df	*p*-Value	RMSEA	P-Close	GFI	AGFI	SRMR
The initial model	83.22	13	0.00	0.087	0.00	0.97	0.93	0.040
The final model	32.85	9	0.00	0.061	0.19	0.99	0.96	0.024

First, the minimal set of paths was derived from the hypothesized model. Three constructs, egocentrism, self-esteem, and social norm, were specified as exogenous latent variables. Risk perception was specified as the first endogenous latent variable that would be potentially caused by three exogenous latent variables. Specified as a subsequent endogenous variable was health-endangering behaviour, with a regression effect allowed from the prior construct. The modified initial model derived from results of measurement models was estimated using the maximum-likelihood method. All the paths from exogenous latent variables to risk perception construct

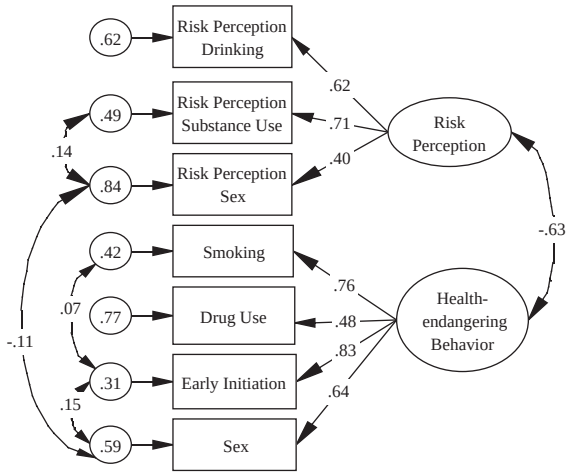

Fig. 2. Measurement model for endogenous latent variables

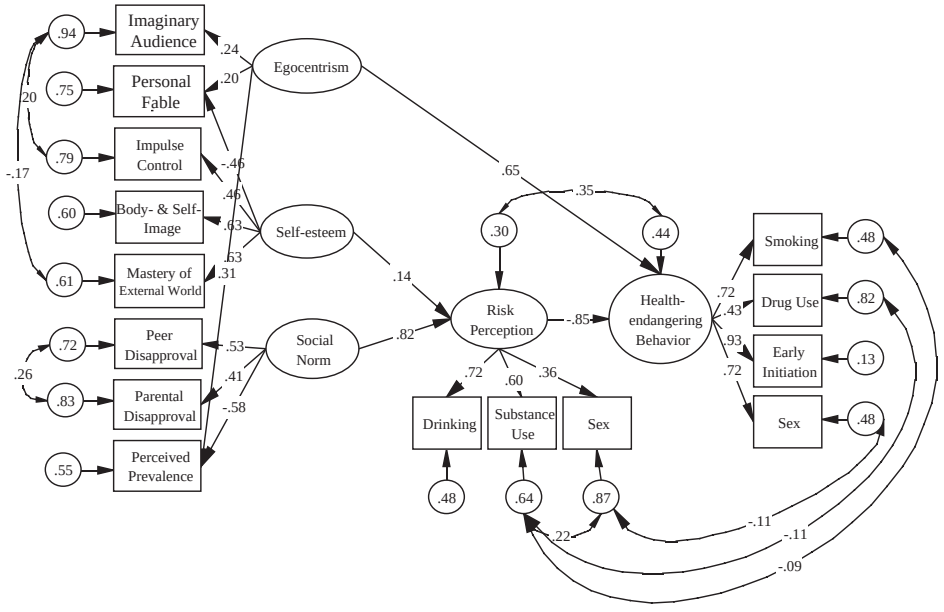

Fig. 3. Final model with standardized regression weights

were non-significant. A standardized regression coefficient indicating a relationship between the first and second endogenous latent variable exceeded 1.00. This implied that the initial model must be modified to achieve a better fit. This model was converged when a path from egocentrism to health-endangering behaviours was added and a path between egocentrism and risk perception was deleted.

The final structural equation model is presented in Fig. 3. The model included a correlated error term between two endogenous latent variables. The summary of goodness-of-fit indexes in Table 3

Table 3
Goodness-of-fit summary for the structural model

Model	x^2	df	p-Value	RMSEA	P-Close	GFI	AGFI	SRMR	AIC	ECVI
The intial model	418.68	83	0.00	0.075	0.00	0.93	0.90	0.066	492.68	0.69
The final model	212.98	76	0.00	0.050	0.47	0.96	0.94	0.051	300.98	0.42

indicates a fairly good fit between the hypothesized model and the observed data. RMSEA was 0.050, which is considered to indicate good fit. The closer to 1.00 values of absolute indexes of GFI and AGFI become, the better the model fits to the data fit (Byrne, 1998). Values of GFI and AGFI in this study were both more than 0.90 and indicated a good fit. Probability of the closeness of fit, P-Close in Table 3, tests whether or not approximation error has an associated probability of less than 0.05 (Byrne, 1998). The probability of the closeness of fit was 0.47. According to Jöreskog and Sörbom (1996), p-value for this test should be greater than 0.50. Akaike Information Criterion (AIC) that provides information of goodness-of-fit that rewards parsimony (Kline, 1998) indicated the best fit with the final model. Thus, it is concluded that the fit of the model to the data was fairly acceptable. Additionally, the expected value of the cross-validation index (ECVI) was examined in order to evaluate the predictive validity of the final model. The use of single sample cross-validation indices was suggested by Browne and Cudeck (1989, 1993). The final model indicated the smallest value of ECVI, implying the fitted covariance matrix is least different from the expected covariance matrix obtained from another sample of the same size.

Table 4 summarizes parameters in the final structural model. The overall model partly supported the study hypotheses. Initially, it was presumed that all the exogenous constructs, egocentrism, self-esteem, and social norm, would cause risk perception, which in turn would influence the engagement. However, the final model indicated that egocentrism would directly predict the engagement of health-endangering behaviours. The variables in the model accounted for 56–70% of the variance in the two criterion constructs, risk perception and health-endangering behaviour, respectively.

Several effects for three psychosocial variables were found. Egocentrism had a direct path to more involvement of health-endangering behaviours ($t=2.69$, $p<0.01$). Self-esteem and social norm constructs were found to have effects on risk perception. Self-esteem had a positive effect to risk perception ($t=2.88$, $p<0.01$). In the present study, lower scores of self-esteem subscales indicate better sense of self whereas higher scores of self-esteem indicate negative sense of self. Therefore, negative sense of self was found to predict higher level of risk perception. In addition, social norm had a path to higher risk perception ($t=7.84$, $p<0.01$), implying that greater degrees of perceived disapprovals predict higher risk perception. A regression effect of risk perception on the involvement of health-endangering behaviours was hypothesized in the present study. A regression coefficient from risk perception to health-endangering behaviour was negative. In other words, lower risk perception predicts higher involvement of health-endangering behaviours ($t=-8.47$, $p<0.01$).

Table 4
Measurement model parameters in the final structural model

Latent variale/indicator	Loadings	S.E.	SMC
Egocentrism			
Imagenary audience	1.00	—	0.06
Personal fable	0.72	0.23	0.25
Perceived prevalence	3.77	1.16	
Self-esteem			
Personal fable	−0.59	0.08	
Impulse control	1.00	—	0.21
Body- & self-image	1.43	0.17	0.40
Mastery of external world	1.40	0.16	0.39
Social norm			
Peer disapproval	1.00	—	0.28
Parental disapproval	0.86	0.09	0.17
Perceived prevalence	−2.23	0.26	0.44
Risk perception			
Drinking	1.00	—	0.52
Substance use	0.78	0.08	0.36
Unprotected sex	0.52	0.07	0.13
Health-endangering behaviour			
Smoking	1.00	—	0.52
Drug use	0.57	0.05	0.18
Early initiation	1.11	0.05	0.87
Unprotected sex	0.87	0.05	0.52

Discussions

The goal of the present study was to test the utility of the biopsychosocial model proposed by Irwin and Millstein (1986) in a sample of Japanese college students. A biopsychosocial model integrates developmental principles characteristic of adolescents with the development of risk-taking behaviours. Of particular interest for this study was the relationship between egocentrism, self-esteem, perceived social norms, risk perceptions, and the involvement in health-endangering behaviours of Japanese college students. A structural equation modelling analysis revealed that egocentrism and risk perception directly contributed to variance in individuals' health-endangering behaviours. The relations of self-esteem and social norm to health-endangering behaviours were found to be mediated by risk perception. Although data from the sample of the present study partly supported the utility of the psychosocial model, it did not support the relationship between egocentrism and risk perception. This result was different from the initial hypothesis, which stated that risk perception would also mediate between egocentrism and health-endangering behaviours.

A confirmatory factor analysis including health-endangering behaviours provided evidence for the co-occurrence of several health-endangering behaviours. The theoretical basis of the present study, a psychosocial model of risky behaviours (Irwin & Millstein, 1986) draws on the problem behaviour theory proposed by Jessor and Jessor (1977) who presumed that there is a common

factor underlying different types of problem behaviours involving cigarette smoking, problem drinking, and drug use. Jessor et al. described this common factor was "unconventionality." A series of studies conducted by Jessor and his associates (Jessor, Donovan, & Costa, 1991) reported that five different problem behaviours—drinking problem, marijuana use, other illicit drug use, general deviant behaviour, and cigarette smoking—were interrelated for a sample of individuals in their transition to adulthood. The present study yielded similar findings to the Jessor et al. study (1991) and implied a common factor underlying different health-endangering behaviours among Japanese college students. Given the evidence of co-occurrence of health-endangering behaviours, it may be appropriate to conceptualize the tendency to engage in problematic behaviours as a syndrome.

Although cognitive development was expected to have an indirect influence on health-endangering behaviours through its influence on risk perception, a direct path from egocentrism to health-endangering behaviours was found without mediating risk perception. In other words, those who scored higher on indicators of egocentrism were more likely to engage in health-endangering behaviours. It is interpreted that adolescents engage in health-endangering behaviours because of egocentrism that is related to exaggerated feelings of personal uniqueness or invulnerability.

Self-esteem was measured by three subscales of OSIQ: impulse control, self- and body- image, and the mastery of external world. The biopsychosocial model presumes that self-esteem predicts risk perception, which in turn influences health-endangering behaviours. An unexpected result was found with respect to the relationship between self-esteem and risk perception. Results of the study showed that higher scores of self-esteem, namely lower sense of self, predicted higher levels of risk perception. This result must be interpreted with caution for the following reasons. First, the standardized coefficient of the path between self-esteem and risk perception was very small. It is speculated that the relationship between self-esteem and risk perception may be unstable. Second, the final model converged with a path from the self-esteem construct to the personal fable indicator. It was assumed that creating an ideal world in oneself would be related to better sense of self. Statistically speaking, the personal fable indicator shared the variance of self-esteem construct with three subscales of OSIQ. It was speculated that the effect of egocentrism was mixed with that of self-esteem. Third, the assumption of the initial model may not apply to the study participant of the present study. Irwin and Millstein (1986) state that lower self-esteem predicts higher degree of health-endangering behaviours, mediating lower risk perception. During early adolescence, one tends to demonstrate higher self-esteem if he or she has good relationships with their peers. In such a situation, the adolescent may engage in risky behaviours including health-endangering behaviours as a tool to associate him- or herself with peers. Therefore, those who are high in self-esteem is likely to estimate risks lower, which in turn predicts higher chance of engaging in health-endangering behaviours. However, it is inferred that this logic may not apply to college population. Fourth, cultural factors may have influenced the relationship between self-esteem and risk perception. Therefore, this portion of biopsychosocial model may not fit to the sample of Japanese college students. Kitayama, Markus, Matsumoto, and Norasakkunkit (1997) proposed a collective constructionist theory of the self and claim that Japanese are more likely to engage in self-criticism while Americans tend to engage in self-enhancement. According to their study, American people showed a tendency to relate success situations to self-esteem while Japanese were more likely to choose failure situations as relevant to self-esteem. Thus, it is

speculated that such a cultural difference in the meaning of self construct may have affected the relation of the self to risk perception.

As hypothesized, social norms were found to be a contributing factor to the formation of risk perception, which ultimately influenced engaging in health-endangering behaviours. The greater the disapproval one perceives from peers and/or parents for engaging in such behaviours, the more likely one is to perceive the risks of such behaviours. In addition to disapproval from peers and parents, perceived prevalence of health-endangering behaviours among peers and friends significantly contributed to the formation of risk perception. If he or she believes that many people at their ages engage in certain types of health-endangering behaviours, he or she tends to estimate risks lower. Ultimately, this individual is likely to engage in health-endangering behaviours.

The present study revealed factors responsible for the involvement in health-endangering behaviours. Particularly, egocentrism and social norms are considered to be more responsible for health-endangering behaviours. These results imply that targeting these factors would preclude adolescents from developing tendencies to engage in risky behaviours. Among examples of prevention programs targeting social cognition, Paisley, Gerler, and Sprinthall (1990) conducted a prevention study dealing with drug-related dilemmas among adolescents. Paisley et al. implemented a short term dilemma discussion approach to 52 ninth graders and found that their short-term approach increased the level of thinking of adolescents. It was demonstrated that fostering levels of thinking corrects one's invulnerability and lowers the degree of involvement in health-endangering behaviours. Thus, it is conceivable that correcting one's perception about particular problem behaviours would result in the reduction of such behaviours.

With respect to intervening mechanism related to the role of social norm on risk perception, Donaldson, Graham, and Hansen (1994) reported that beliefs about prevalence and acceptability of risky behaviours mediated the influences of normative education on adolescents' drug use, using an Adolescent Alcohol Prevention trial targeting 3077 fifth graders. Their programme revealed that fostering appropriate social norms would be a key to successful social-influence-based prevention programmes. Despite differences in demographic characteristics between the Donaldson et al. study and the present study, the present study also suggested that enhancing appropriate social norms would increase adolescents' risk perception, and subsequently lower involvement in health-endangering behaviours. Intervention studies with college students are recommended to examine the effectiveness of such prevention programmes.

Several limitations of the present study should be noted. Although Irwin and Millstein (1986) did not clearly state what stage of adolescence they specifically targeted with their model, the model appears to explain mechanisms of the onset of health-endangering behaviours during middle adolescence. The participants of the present study were college students; their levels of cognitive development may not function to form risk perception as Irwin and Millstein suggested. Presumably, college students are old enough to overcome egocentrism that is thought to facilitate invulnerability and engagement in health-endangering behaviours. The utility of the model itself must be tested with younger population in the future study.

The number of participants included in the final model was 717 while questionnaires were distributed to 808. In the final analysis, 91 participants out of 808 which counts nearly 10 percent of the participants were excluded due to missing values. Although there were no systematic patterns observed in missing values, it is speculated that characteristics of participants who

completed questionnaires and were included in the final model may be positively biased. That is, those who did not complete the questionnaire may have experienced something negative related to health-endangering behaviour and unconsciously refused to answer questions. Therefore, participants remained in the final analysis may have engaged in health-endangering behaviours to a lower degree compared to those excluded.

Although this study aimed at examining the applicability of a biopsychosocial model through a structural equation modeling analysis, not all the elements of the model were included in this present study. Irwin and Millstein (1986) presumed that biological maturation would be associated with psychosocial variables including cognitive scope, self-perceptions, perception of the social environment, and personal values. Consequently, these psychosocial variables were thought to determine risk-taking behaviours, mediating risk perception and characteristics of peer group. In order to fully understand the mechanism of health-endangering behaviours from a developmental perspective, the model should be tested with variables that were not included in this study. Future studies focussing on younger adolescents should explore how pubertal timing determines the development of health-endangering behaviours.

Protective processes of health-endangering behaviours as well as vulnerability processes must be examined. The present study examined the factors that contribute to engaging in health-endangering behaviours. Although models proposed in the past do not focus on protective processes to prevent actual engagement in such behaviours, there should be such processes within individuals which deter or prevent the onset of health-endangering behaviours. From a study on protection and vulnerability processes related to early onset of substance use among African American children, Wills, Gibbons, Gerrard, and Brody (2000) suggest that protective process as well as vulnerability process should be examined. Wills et al. tested a self-regulation model that considers the relationship among temperament dimensions, complex behaviours, and self-control ability. Their study revealed that good self-control had a protective effect against negative life events and that academic orientation had a direct effect on perceived vulnerability. In their structural equation modelling, peer substance use, willingness, and resistance efficacy were dealt with as criterion variables. Peer substance use was determined by life events, poor self-control, and parent–child conflict; willingness was determined by life events, risk taking, and parental support; and resistance efficacy was predicted by perceived vulnerability and poor self-control. It seems that exploring determinants of resistance efficacy will shed light on protective processes. Future studies are recommended to include protective processes in testing the causality related to the onset of health-endangering behaviours.

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