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Brodbeck, Jeannette, Bachmann, Monica S., Croudace, Tim J and Brown, Anna (2013) *Comparing Growth Trajectories of Risk Behaviors From Late Adolescence Through Young Adulthood: An Accelerated Design.* Developmental Psychology, 49 (9). pp. 1732-1738. ISSN 0012-1649.

Brief report for Developmental Psychology

Comparing growth trajectories of risk behaviours from late adolescence through young adulthood: an accelerated design

Words in the text: 3412

Date of the initial submission: 21. June 2011

Date of the submission of the second revision: 23. August 2012

Running head: Growth trajectories of risk behaviours

Abstract (230 words)

Risk behaviours such as substance use or deviance are often limited to the early stages of the life course. Whereas the onset of risk behaviour is well studied, less is currently known about the decline and timing of cessation of risk behaviours of different domains during young adulthood.

Prevalence and longitudinal developmental patterning of alcohol use, drinking to the point of drunkenness, smoking, cannabis use, deviance and HIV-related sexual risk behaviour were compared in a Swiss community sample (N=2843). Using a longitudinal cohort-sequential approach to link multiple assessments with 3 waves of data for each individual, the studied period spanned between ages 16 to 29 years.

Although smoking had a higher prevalence, both smoking and drinking up to the point of drunkenness followed an inverted u-shaped curve. Alcohol consumption was also best described by a quadratic model, though largely stable at a high level through the late twenties. Sexual risk behaviour increased slowly from age 16 to age 22 and then remained largely stable. In contrast, cannabis use and deviance linearly declined from age 16 to age 29. Young men were at higher risk for all behaviours than young women, but apart from deviance, patterning over time was similar for both sexes. Results about the timing of increase and decline as well as differences between risk behaviours may inform tailored prevention programs during the transition from late adolescence to adulthood.

Keywords: trajectory, risk behaviours, emerging adults, substance use

INTRODUCTION

Risk behaviour such as binge-drinking, cannabis use or deviance is common in adolescence but does often not last beyond young adulthood. Adolescence and emerging adulthood are characterised by neurobiological and physical changes, increasing impulse control, emotional and cognitive maturation, and environmental changes in the social networks and social roles that accompany transitions from youth to early adult life. These processes can result in a considerable level of distress (Allen & Sheeber, 2009; Arnett, 2004). The psychosocial stress model (Jessor & Jessor, 1997; Hurrelmann & Richter, 2006) conceptualises adolescent risk behaviour as the result of an interaction of psychosocial stressors and inadequate coping strategies. Apart from being an attempt to cope with distress, risk behaviours may be functional for the mastery of developmental tasks such as integration into a peer group, demonstrating opposition to parental or conventional norms, or may be a part of identity explorations and the desire to obtain a wide range of experiences (Arnett, 2004).

With the acquisition of adult roles and responsibilities at work, a stable partnership or parenthood, risk behaviour is thought to lose its functionality and become redundant and less socially accepted. However, for substance-related risk behaviours not only the functionality but also the addictive properties of the substance can affect the patterns of use and could lead to a more persistent course than for sexual risk behaviour or deviance. Substances typically differ in the frequency of use. In the general population, smoking is mostly characterised by a dependent pattern of daily use, alcohol is used weekly and cannabis and drinking up to the point of drunkenness are often used recreationally with a low frequency.

While onset and increase of risk behaviour in adolescence is well studied, less is known about young adulthood and the age where different risk behaviours start to decline. Previous research is often cross-sectional, commonly focuses on trajectories of one single type of risk

behaviour or risk behaviours from the same domain, and includes mostly college students. A recent study analysed developmental trajectories of drinking, smoking and cannabis use in a large nationally representative longitudinal sample of US-Americans aged 12 to 34 (Chen & Jacobson, 2012). Findings demonstrate that substance use initiates during adolescence, peaks during the early and mid-twenties and then declines (see also Hammond, 2005; Lee, Mun, White, & Simon, 2010; Maggs & Schulenberg, 2004; Terry-McElrath & O'Malley, 2011). Drinking showed higher and cannabis lower levels of change. Other studies suggest that smoking is more persistent than other substance use and even occasional smoking bears a heightened risk of later daily smoking or of nicotine dependence (e.g. Di Franza al., 2002; Piasecki, 2006). Evidence for the course of cannabis use is inconsistent and ranges from stable high trajectories (Perkonigg et al., 2008) to U-shape curve (Chen & Jacobson, 2012; Lee et al., 2010) to a decrease (Jackson, Sher, & Schulenberg, 2008; Terry-McElrath & O'Malley, 2011). Sexual risk behaviour was found to follow an inverted U-shape curve for 15-23-year-olds (Fergus, Zimmermann, & Caldwell, 2007; Kan, Cheng, Landale, & McHale, 2010) or a stable course in 18-29-year-olds (Duangpatra et al, 2009). Deviance seems to decrease from age 14 to age 18 (Mason, Hitch, Kosterman, McCarty, Herrenkohl, & Hawkins, 2010). In a developmental taxonomy of antisocial behavior, Moffitt (2006) distinguished between a more frequent adolescence-limited and a less frequent life-course-persistent delinquent behavior.

   To our knowledge no previous longitudinal study has compared intraindividual trajectories of distinct risk behaviour including substance use, deviance and HIV-related sexual risk behaviour in a community sample from late adolescence throughout their twenties. The aims of this study were firstly to compare the trajectories of different risk behaviours from age 16 to age 29, using a cohort sequential latent growth model. Assessed risk behaviours cover distinct domains and included smoking, drinking, drunkenness, cannabis use, deviance, and

HIV-related sexual risk behaviour with occasional and/or new partners. Secondly, we were interested in gender effects on the trajectories of all risk behaviours. Although several distress and personality variables were assessed in this project, the current short report is limited to describing patterns of change in risk behaviours from different domains in the whole sample.

In line with existing findings, we expect that risk behaviours generally decline from the early to the late twenties. However we expect distinct trajectories for the assessed risk behaviours. We assume that deviance, which may be more driven by the functionality for coping with developmental tasks, decreases more rapidly than trajectories of substance-related risk behaviours. The latter may also be affected by the development of a physical dependence. We expect sexual risk behaviour to increase at the stage of exploration and changing relationships, and then to decrease in the mid to late twenties when longer-term and more committed relationships have been built. We also hypothesise that socially less accepted risk behaviours like deviance, cannabis use, and drunkenness decrease more rapidly, while habitual moderate alcohol use and smoking decline less or remain stable, as they are easier to integrate into adult life.

METHODS

Participants

The sample comprised 2844 adolescents and young adults from the RIWA study (Risk Behaviour and Well-being in Adolescence and Young Adulthood study), a five-year longitudinal study based on an urban Swiss sample. At baseline (T1), a random sample of 16- to 24- year-old urban Swiss young men and women was selected based on the official registers of the Residents' Administration Offices of the Swiss cities of Basel, Bern, and Zurich.

Data were collected by computer-assisted telephone interview (CATI) initially in 2003 (T1), at the two-year follow-up in 2005 (T2) and at five-year follow-up in 2008 (T3). Before

calling the participants, a letter explaining the study aims and the procedures had been sent out. At T2 and T3 letters were sent to participants who had agreed to take part in the follow-up. If necessary, an extensive search was undertaken to find their new addresses and phone numbers, including checking different telephone directories and contacting the Residents' Administration Offices. If the new telephone number could not be found, or after 40 unsuccessful attempts to reach participants, they were allocated to the dropout group. At the five-year follow-up the option of completing an online questionnaire instead of a telephone interview was offered to those who lived abroad.

Sample characteristics and attrition

After excluding individuals with invalid telephone numbers, persons with insufficient mastery of the German language, and individuals with serious health problems that precluded participation in the interview, 2844 of the eligible 4031 persons were interviewed (response rate 71%). In the second wave after two years (T2), 2031 persons (71% of the baseline sample) were re-interviewed. At the five-year follow-up (T3), 1641 persons were re-interviewed (58% of the baseline sample). Table 1 presents the sample characteristics for each wave and their effect on attrition rate. Most participants were not married. At baseline most of the participants were in comprehensive secondary school or at university (37%), in professional training (26%), or employed (20%). At T3 most participants were employed (57%) or still at university or in further education (34%). Attrition rate was higher for those who were employed or in professional training. Attrition rate at T3 was also higher for married participants and for participants who had a higher frequency of smoking, sexual risk behaviour and deviance.

Insert Table 1 here

Measures

(a) *Substance use*: Respondents were asked how often in the month before the interview they had consumed each of the following substances: tobacco, alcohol, alcohol to the point of drunkenness, and cannabis (0 = *never*, 1 = *1-3 times a month*, 2 = *1-2 times a week*, 3 = *3-6 times a week*, 4 = *daily*). Due to very low response frequencies (see Table 1), daily alcohol use was combined with alcohol use *3-6 times a week*. Also for drunkenness higher categories were collapsed to *1-2 times a week or more often*. Variables were treated as binary or ordinal.

(b) *HIV-related sexual risk behaviour*: HIV-related sexual risk behaviour was defined as 1) sexual intercourse without condom use with a *casual partner*, and/or 2) sexual intercourse with a *new stable partner* without condoms and with no HIV testing for those partners who had ever had intercourse. It was assessed for the 12-month period prior to the interviews (no/yes).

(c) *Deviance:* Respondents were asked whether in the previous 12 months they engaged in theft, violence, blackmail, or substantial damage to property of others (no/yes, respectively). These four items were combined into one measure for deviances which was coded as yes if one type of the above behaviours was reported.

Statistical analysis

We adopted a Cohort-Sequential approach to the analysis of the multiple risk assessments. This provides a way to link adjacent segments of our three-wave longitudinal data, using responses from the different age cohorts to determine the existence of a common developmental trend or growth curve which can be profiled over the full age range. Under this analytic approach, each cohort has a different pattern of intentional attrition or "planned missing data". Simultaneous analysis of each cohort with a related growth model makes it possible to build the complete curve using information from all ages simultaneously (Muthen & Muthen, 1998-2011; Preacher, Wichman, MacCallum, & Briggs, 2008). Thus, our "trajectory" analysis spanned a 14-year-period from age 16 to 29, using only 5 years of

longitudinal data. This approach, providing more measurement points than waves, allows for estimation of non-linear trajectory shapes, for the population profile, even though there are only three observations per individual.

Each accelerated growth model was estimated in Mplus version 6.1.1. (Muthen & Muthen, 1998-2011) using the Diagonally Weighted Least Squares (DWLS) estimator which is appropriate for categorical data. Since this estimator yields robust results under the assumption of missing completely at random (MCAR) only, we performed multiple imputations with the Bayes estimation method (Asparouhov & Muthen, 2010). Variables included in the imputation models were risk behaviours at all three measurement points, age, gender, marital status, and education. We created 10 complete datasets which were analysed in parallel, yielding means and standard deviations for the outcomes and goodness of fit indices, across the 10 datasets.

We estimated models with linear and quadratic slopes. Model fit was assessed using the following indices: the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA). Although no single set of threshold values for these statistics can be relied upon in isolation, we favoured models that exceeded 0.95 for TLI and CFI, although a CFI > 0.90 is sometimes considered acceptable (Bentler, 1990; 1992; Tucker & Lewis, 1973) and models with an RMSEA below 0.05 (Steiger, 1990).

Frequent risk behaviours, i.e. alcohol use, drunkenness, smoking, and cannabis use were treated as ordinal variables. For presenting the trajectories in one figure, we summed the estimated probabilities for all response categories. As post-modelling refinement, the mean of the slope of the cannabis trajectory in the youngest cohort was freely estimated as it showed to be different from the rest of the cohorts. Gender effects were analysed as correlations between sex and intercepts, slopes and quadratic terms.

RESULTS

Table 2 reports the fit statistics for the linear and the quadratic models for all risk behaviours. Trajectories of alcohol use, drunkenness, smoking, and HIV-related sexual risk behaviour were better described by models with quadratic slopes. The course of cannabis use and deviance were sufficiently well characterised by models with linear slopes.

Insert Table 2 here

Table 3 presents the model results for the frequency of risk behaviours (substance use per month, deviance and sexual risk behaviour per year). Inter-individual variance was high in the initial levels and the slopes of all risk behaviours, but not for the slopes of cannabis and deviance.

Insert Table 3 here

Figure 1 summarises the percentages of participants showing risk behaviours from age 16 to age 29, i.e. the prevalence of the risk behaviours. Alcohol was the most commonly used substance. Alcohol use increased rapidly from 66% at age 16 to 79% at age 19, then increased more slowly and finally remained stable around 88% at age 25 to 29. Drinking up to the point of drunkenness was reported by almost 25% of all participants at age 16. Drunkenness peaked from ages 22 to 24 with a 30-day prevalence of 35% and then decreased again to 27% at age 29, a similar level to that at age 16. Although the prevalence rate of smoking is higher, the trajectory is similar to that for drunkenness. At age 16, 37% of the participants smoked during the month prior to the interview. Smoking prevalence increased rapidly during late adolescence, remained relatively stable from age 21 to age 24 with a prevalence rate of almost 50% and then decreased again to 39% at age 29. Cannabis use was also common with about 25% of the 16-year-olds using it at least once in the month prior to the interview. Cannabis use then decreased steadily to 13% at age 29.

Insert Figure 1 here

Deviance and HIV-related sexual risk behaviour were assessed within 12-month timeframes prior to the interviews. At age 16, 40% of all participants reported theft, violence, blackmail, or substantial damage to property of others. Deviance decreased rapidly to a 12-month prevalence of 11% at age 29. In contrast to all other risk behaviours, HIV-related sexual risk behaviour increased between 16 and 29 from 6% to 12%.

Young men reported significantly higher levels of all risk behaviours. Alcohol use, drunkenness, cannabis use and deviance showed moderate association with gender. Small but still significant gender effects were found for smoking and HIV-related sexual risk behaviour. Although gender affected the intercepts, the course (slope) of most risk behaviours was independent of sex. The only exception is deviance where females showed a slower decrease.

DISCUSSION

The present study explored longitudinal patterning of the prevalence of distinct risk behaviours between16 and 29 years. It adds to the existing knowledge about the decline in risk behaviours tracing multiple behavioural domains in a random urban Swiss community sample over a wide age range.

Smoking and drinking up to the point of drunkenness followed an inverted U-shape trajectory, with acceleration during late adolescence, a peak around 22 to 24 and then a decrease. Alcohol consumption also followed a quadratic curve, with an acceleration from age 16 to 21, then a slower increase and then by and large a stagnation until age 29. It is noteworthy that legal drinking age in Switzerland is 16, similar to other European countries, but much lower than in the USA. Age-specific 30-day prevalence rates of drinking, smoking, and cannabis use in this sample of Swiss urban adolescents and young adults are higher than those in national samples of 10th to 12th graders in US Studies in the years 2001-2005 (Johnston, O'Malley, Bachman, & Schulenberg, 2012). Interestingly, the 30-day rates of drunkenness are similar, and the rates for daily use of all substances seem to be lower in

Switzerland than in the USA. In spite of these differences in the level of substance use the growth trajectories for smoking, drinking and drunkenness in both countries are best described by a quadratic model (Chen & Jacobson, 2012). However, while the one-month prevalence of drinking in the US decreases in the late twenties, it stagnates at a high level in our study.

The course of cannabis use seems to be less generalizable than the course of smoking and drinking. Previous research found inconsistent trajectories for cannabis use including high-stable, inverted u-shaped and decreasing trajectories. In our study cannabis declined monotonically from a prevalence rate of 26% at age 16 to 13% at age 29, in line with Lee et al. (2010) and Terry-McElrath and O'Malley (2011). Similar to the course of cannabis use and in line with previous evidence, deviance decreased linearly from a one-year prevalence rate of 40% at age 16 to 11% at age 29.

Findings revealed gender effects for the levels of risk behaviours, but not for the shape of the trends over time. As in other studies (i.e. Chen & Jacobson, 2012) young men reported higher levels of all risk behaviours. However, once risk behaviour is established, both genders follow the same course. The only exception was deviance, with women showing a slower decrease than men.

Our findings are so far in line with the notion that learning how to deal with commonly available substances such as alcohol, tobacco and cannabis, as well as the acquisition of risk-related expertise and competence is a developmental task during emerging adulthood (Franzkoviak, 1987). Especially the decrease of drinking up to the point of drunkenness in conjunction with the stable prevalence may be interpreted as the acquisition of responsible, moderate alcohol consumption.

An exception from the general clear decrease of risk behaviour during young adulthood is HIV-related sexual risk behaviour, defined as unprotected intercourse with an occasional or a

new partner. The late and less pronounced decline might reflect a temporal effect that adolescents and young adults engage in sexual relationships later than they become involved with substances. In a US study, an inverted u-shaped trajectory was found for the number of partners, peaking around the age of 20 and then declining (Kan, Cheng, Landale, & McHale, 2010). Sexual risk behaviour as the result of a dyadic interaction might also have a different functionality compared to other risk behaviours.

A higher frequency and persistence of risk behaviours correlate with negative long-term outcomes such as substance abuse or dependency or low psychosocial adjustment. However, not only persistent, but also transient risk behaviours may cause physical harm such as alcohol poisoning, drug overdose, or a higher risk for accidents or infections with sexually transmitted diseases. Knowledge about developmental trajectories of distinct risk behaviours may help identifying specific periods during which universal population-based prevention programs may be optimally effective.

Limitations and further research

In the present paper we reported only single trajectories from univariate longitudinal analyses, conducted for the different risk behaviours. However, risk behaviours tend to co-occur, which is not accounted for in this paper. One further limitation is that the growth models assume that a single growth trajectory with a common starting or end point can adequately represent growth in the whole sample. Individual variation around the average trajectory, which might be very important in understanding these processes for different individuals or groups, is not of interest in such modelling. Also, our primarily descriptive study does not seek to analyse predictors of the observed population trajectories. A more clinical perspective focuses on the differential vulnerability of individuals for engaging in risk behaviours and tries to identify subgroups with distinct trajectories as well as distinct explanatory variables for each subgroup. Mixture models covering different forms of risk

behaviours may be more appropriate for a clinical or aetiological approach and it is our intention to explore those as a next step. Despite these shortcomings, growth models are useful for epidemiological purposes or population-based prevention, where change of behaviour in a whole population is of interest and a normative development over time is expected. Due to the more parsimonious nature of the trajectories, it is also easier to compare the course of different risk-behaviours (Maggs & Schulenberg, 2004).

A limitation of the sample is that only adolescents and young adults who lived in three major cities at baseline were assessed. We cannot exclude that they differ from participants in rural areas. Attrition rate was influenced by a number of characteristics of the cohort: being married, being employed or in professional training and by a higher prevalence of smoking, deviance, and sexual risk behaviour. Thus, not only individuals who showed more risk behaviour, but also individuals who have "settled down" more than others had a higher risk of dropping out of the study. Additionally, only self-report data were used. Deviance was assessed with a composite score of theft, violence, damaging others property and blackmailing, which would likely have affected the prevalence of deviance. Although we assessed illicit drug use other than cannabis, the prevalence rate of around 2% made it difficult to model the trajectory in an accelerated cohort design. As illicit drugs include substances with highly addictive properties, an increasing trajectory may be possible.

Conclusions

Patterning of risk behaviour from late adolescence to almost thirty years of age differed depending on the type of behaviour. Most risk behaviours decrease from late adolescence to young adulthood, but the age when decline begins differs. While drinking up to the point of drunkenness, smoking, cannabis use and deviance decline during young adulthood, HIV-related sexual risk behaviour still increases. This might indicate a distinct functionality compared to other risk behaviours.

Acknowledgments

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Table 1

Sample Characteristics at Each Wave (Non-Imputed Data) and Effects on Retention Rate

	T1 (N=2844)	T2 (n=2031)	T3 (n=1641)	Effect on dropout T2	Effect on dropout T3
	%	%	%	χ^2 / t	χ^2 / t
Male sex	47.6	50.8	49.0	1.24	.17
Not married	98.1	95.9	92.1	.123	5.86*
Mean age *(SD)*	19.77 (2.62)	21.74 (2.56)	24.79 (2.65)	-.52	-.30
Education/work				75.60***	48.68***
- School/college	21.8	10.7	0.00		
- Professional training	26.9	22.9	3.6		
- University	20.4	29.8	34.5		
- Employed	21.5	29.0	56.3		
Alcohol use last month				.21	4.93
- never	20.16	14.86	14.29		

- 1-3x a month	40.25	40.37	33.58		
- 1-2x a week	32.23	34.82	37.67		
- 3-6x a week	6.54	9.01	13.25		
- daily	0.81	0.04	1.22		
Drunkenness last month				3.59	2.24
- never	69.70	68.43	65.22		
- 1-3x a month	25.40	26.32	29.83		
- 1-2x a week	4.29	4.30	4.40		
- 3-6x a week	0.56	0.94	0.55		
- daily	0.04	0.00	0.00		
Smoking last month				21.78***	30.73***
- never	53.57	52.80	58.15		
- 1-3x a month	5.77	6.43	4.09		
- 1-2x a week	4.54	5.79	4.33		
- 3-6x a week	4.75	5.10	5.06		

- daily	31.38	29.89	28.37		
Cannabis use last month				6.97	8.00
- never	76.75	81.50	85.19		
- 1-3x a month	9.81	8.16	7.07		
- 1-2x a week	5.31	4.15	3.17		
- 3-6x a week	3.80	2.57	2.25		
- daily	4.33	3.61	2.32		
HIV-related sexual risk behaviour:					
ever in the last year	7.70	9.5	13.9	3.24	6.41*
Deviance: ever in the last year	27.77	24.41	11.36	2.07	5.53*

*p < .05, ** p < .01, *** p < .001

Table 2

Goodness-of-Fit Indices for the Linear and the Quadratic Models (Mean Values and Standard Deviations for the 10 Imputed Datasets)

		χ^2		df	CFI		TLI		RMSEA	
		M	SD		M	SD	M	SD	M	SD
Alcohol use	linear	268.45	19.21	126	0.96	0.01	0.98	0.00	0.06	0.00
	quadratic	163.03	10.30	121	0.99	0.00	0.99	0.00	0.03	0.00
Drunkenness	linear	174.43	16.60	100	0.97	0.01	0.99	0.00	0.05	0.00
	quadratic	122.11	11.45	95	0.99	0.00	0.99	0.00	0.03	0.01
Smoking	linear	309.27	10.17	150	0.99	0.00	1.00	0.00	0.06	0.00
	quadratic	211.76	8.47	145	1.00	0.00	1.00	0.00	0.04	0.00
Cannabis	linear	175.38	9.00	150	1.00	0.00	1.00	0.00	0.02	0.00
	quadratic	177.57	9.56	147	1.00	0.00	1.00	0.00	0.02	0.00
Deviance	linear	100.98	9.15	74	0.99	0.01	1.00	0.00	0.03	0.01
	quadratic	95.109	9.33	69	0.99	0.01	1.00	0.00	0.03	0.01
Sexual risk	linear	155. 47	25.04	74	0.81	0.05	0.86	0.04	0.06	0.01

quadratic	122.70	15.90	69	0.88	0.04	0.90	0.03	0.05	0.01

Note: CFI = Comparative Fit Index, TLI = Tucker Lewis Index, RMSEA = Root Mean Square Error of Approximation

Table 3

Unstandardised Parameter Estimates for the Models Measuring the Frequency of the Risk Behaviours

	Mean					Variance				
	intercept	slope	quadratic	I with S	I with Q	intercept	slope	quadratic	I with sex	S with sex
Alcohol use [a] (0-3)	0.07	0.47***	-0.70***	0.08*	-0.58***	0.64 ***	0.75*	0.14	0.24***	0.07
Drunkenness [a] (0-2)	0.07	-0.00	-0.66***	0.10	-0.40*	0.65***	0.78*	-1.21	0.36***	0.06
Smoking [a] (0-4)	0.27***	-0.04	-0.73***	-0.02	-0.38***	0.91***	0.64***	0.60	0.08*	0.06
Cannabis [a] (0-4)	0.23**	-0.51***	--	-0.00	--	0.82 ***	0.01	--	0.30***	-0.01
Deviance [b] (0/1)	-0.09	-0.76***	--	0.02	--	0.61 ***	0.14	--	0.28***	-0.25**
Sexual risk [b] (0/1)	-0.08	0.25**	-0.47*	-0.04	-1.39***	0.62***	3.00***	1.60	0.09*	-0.03

Note: I = intercept, mean of the frequency of use at T1; S = slope, linear growth factor; Q = quadratic term, quadratic growth factor; with = correlated with; quadratic term with sex was not significant; [a] frequency per month (0 = *never*, 1 = *1-3 times a month*, 2 = *1-2 times a week*, 3 = *3-6 times a week*, 4 = *daily*), [b] 0 = no, 1 =yes, per year
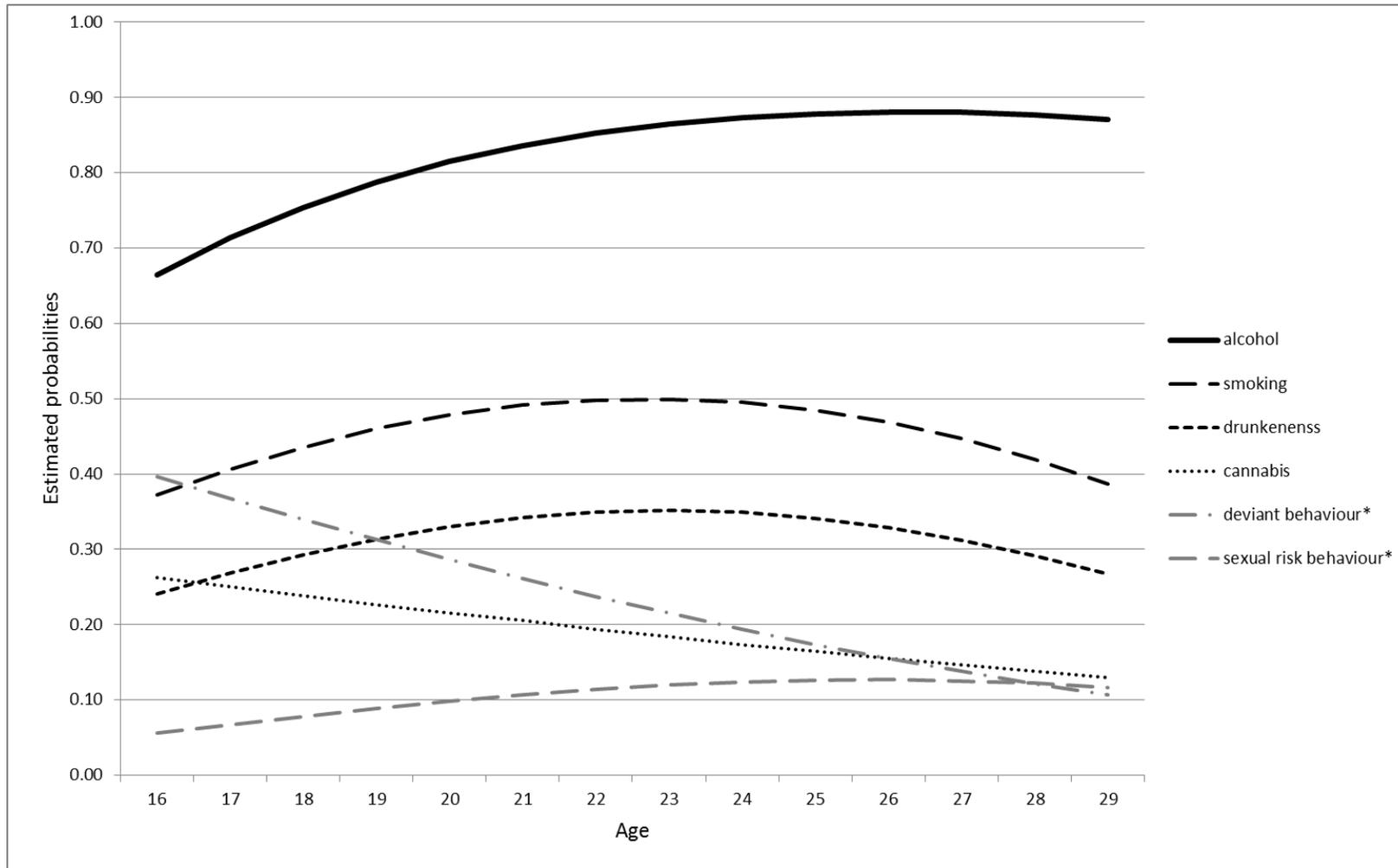
*p < .05, ** p < .01, *** p < .001

Figure 1: Estimated percentage of individuals showing different risk behaviours in a one-month or 12-month (*) period from age 16 to age 29