Key points

What is already known on this subject

- The European Union Directive on cross-border health care places an obligation on MSs to establish one or more NCPs.
- Although the Directive does not explicitly require MSs to provide NCP websites, 18 MSs have done so, and a further three websites are in the process of development.

What this study adds

- We asked whether MSs were meeting the legal obligations; two researchers evaluated the information that 18 MSs provide on their NCP websites.
- The websites that do exist provide much of the information required by the Directive.
- The Commission and the MSs could work together, seeking to harmonize the information that should be provided and how it would best be presented.

References

1 European Union. Directive 2011/24/EU of the European Parliament and of the Council of 9 March 2011 on the application of patients' rights in cross-border healthcare. *Official Journal of the European Union* 2011. L88:45–65.

2 Kanavos P, McKee M. Cross-border issues in the provision of health services: are we moving towards a European health care policy? *J Health Serv Res Policy* 2000;5: 231–6.

3 Legido-Quigley H, Glinos IA, Baeten R, et al. Analysing arrangements for cross-border mobility of patients in the European Union: a proposal for a framework. *Health Policy* 2012;108:27–36.

4 Legido-Quigley H, Passarani I, Knai C, et al. Cross-border healthcare in the European Union: clarifying patients' rights. *BMJ* 2011;342:d296.

5 European Commission. National Contact Points, 2014. Available at: http://eceuropaeu/health/cross_border_care/docs/cbhc_ncp_enpdf.

6 San Miguel L, Baeten R, Remmen R, et al. Obstacles to the recognition of medical prescriptions issued in one EU country and presented in another. *Eur J Public Health* 2013;23:972–4.

7 Legido-Quigley H, Panteli D, Brusamento S, et al. Clinical guidelines in the European Union: mapping the regulatory basis, development, quality control, implementation and evaluation across member states. *Health Policy* 2012;107: 146–56.

8 Risso-Gill I, Legido-Quigley H, Panteli D, McKee M. Assessing the role of regulatory bodies in managing health professional issues and errors in Europe. *Int J Qual Health Care* 2014;2014. doi: 10.1093/intqhc/mzu036.

European Journal of Public Health, Vol. 25, No. 1, 31–37

doi:10.1093/eurpub/cku051 Advance Access published on 14 May 2014

Cultural, social and intrapersonal factors associated with clusters of co-occurring health-related behaviours among adolescents

Mariska Klein Velderman[1], Elise Dusseldorp[1], Maroesjka van Nieuwenhuijzen[2], Marianne Junger[3], Theo G. W. M. Paulussen[1], Sijmen A. Reijneveld[1,4]

1 TNO (Netherlands Organization for Applied Scientific Research), Behavioural and Societal Sciences, Leiden, The Netherlands
2 Department of Clinical Child and Family Studies, and the EMGO Institute for Health and Care Research and LEARN! Research institute for learning and education, VU University of Amsterdam, Amsterdam, The Netherlands
3 School of Management and Governance, University of Twente, The Netherlands
4 Department of Health Sciences, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands

Correspondence: Mariska Klein Velderman, TNO Child Health, P.O. Box 2215, 2301 CE Leiden, The Netherlands, Tel: +31 888 666 023, e-mail: mariska.kleinvelderman@tno.nl

Background: Adverse health-related behaviours (HRBs) have been shown to co-occur in adolescents. Evidence lacks on factors associated with these co-occurring HRBs. The Theory of Triadic Influence (TTI) offers a route to categorize these determinants according to type (social, cultural and intrapersonal) and distance in the causal pathway (ultimate or distal). Our aims were to identify cultural, social and intrapersonal factors associated with co-occurring HRBs and to assess the relative importance of ultimate and distal factors for each cluster of co-occurring HRBs. **Methods:** Respondents concerned a random sample of 898 adolescents aged 12–18 years, stratified by age, sex and educational level of head of household. Data were collected via face-to-face computer-assisted interviewing and internet questionnaires. Analyses were performed for young (12–15 years) and late (16–18 years) adolescents regarding two and three clusters of HRB, respectively. **Results:** For each cluster of HRBs (e.g. smoking, delinquency), associated factors were found. These accounted for 27 to 57% of the total variance per cluster. Factors came in particular from the intrapersonal stream of the TTI at the ultimate level and the social stream at the distal level. Associations were strongest for parenting practices, risk behaviours of friends and parents and self-control. **Conclusion:** Results of this study confirm that it is possible to identify a selection of cultural, social and intrapersonal factors associated with co-occurring HRBs among adolescents.

Introduction

Many adverse health-related behaviours (HRBs) emerge or augment during adolescence. These behaviours, such as smoking, poor diet, physical inactivity, excessive alcohol consumption, risky sexual behaviours and illicit drug use, are relatively persistent during life. They highly contribute to morbidity and mortality among adults. Because of this, many health-promoting interventions have been developed that target behaviours in this age group. Recent studies have shown adverse HRBs to co-occur in adolescents[1–4] and also in adults.[5–7] This co-occurrence seems to be stronger for some behaviours, i.e. clusters of HRBs were identified,[5,8,9] which seem to vary by age.[4]

The clustering of HRBs leaves to be answered whether factors associated with these behaviours co-occur equally. Several researchers have looked for associated factors across behaviours within a specific cluster. Durlak,[10] for instance, concluded that risk factors for various behaviours, such as behaviour problems, drug use, HIV/AIDS, poor physical health and smoking, are to a large extent similar. These risk factors concerned impoverished neighbourhoods, poor school quality, low family socio-economic status, parental problems and childrearing practices.[10] Jessor and colleagues also hypothesized common factors associated with adverse HRBs in adolescents, based on a theory-based protection and risk approach,[11,12] derived from problem-behaviour theory.[13] They found social regulation (parental control and friends' disapproval and control), personal regulation (i.e. 'psychosocial protection') and problem behaviour among friends (i.e. 'psychosocial risk') to be so.[14] Finally, Wiefferink et al.[15] conducted a systematic review on the degree of co-occurrence of smoking, alcohol abuse, safe sex in adolescence and healthy nutrition, and on shared determinants. They found self-esteem, perceived personal health risk and peer- and family-related factors (e.g. supportive parents, behaviour of peers and parents and perceived acceptability of behaviour by peers and parents) to be related to adverse HRBs.

A useful framework for the assessment of risk factors of co-occurring adverse HRBs may be offered by the Theory of Triadic Influence (TTI) of Flay and Petraitis,[16] which provides a model for the hierarchy of associated factors, i.e. 'determinants'. The TTI identifies three types of determinants of HRBs: cultural determinants in the cultural environment stream, interpersonal determinants in the social stream and intrapersonal in the biology/personality stream (figure 1). Moreover, the TTI includes determinants at different levels, that is, a proximal, distal and ultimate level. Proximal determinants are conceptualized as rather behaviour-specific, being highly predictive for one behaviour. These include attitudes, social normative beliefs and self-efficacy. Distal determinants of behaviour are causes of behaviour in between proximal and ultimate. These are supposed to be predictive of multiple behaviours (as proposed in this study on determinants of co-occurring HRBs) and include knowledge and values, social relationships and sense of self and social competence. Ultimate determinants of behaviour are believed to also affect multiple behaviours but to be almost unchangeable, i.e. more deeply rooted. These include the culture and society one lives in, the more immediate social environment and a person's inherited traits and/or personality dispositions.

The present study focuses on the identification of common 'ultimate' and 'distal' factors associated with co-occurring HRBs and on the TTI streams to which they belong. Clustering of HRBs may lead to multiple-behaviour interventions as opposed to single-behaviour interventions.[5,8,9] This is consonant with the increasing calls for integrative and coordinated approaches to school health promotion.[3,17–19] Therefore, the aims of this study were, first, to identify common risk factors associated with co-occurring HRBs based on the TTI and, second, to assess the relative importance of ultimate and distal cultural, social and intrapersonal factors for each cluster of co-occurring HRBs.

Methods

Sample

We obtained data on a Dutch national sample of 898 adolescents: 504 young adolescents (12–15 years) and 394 late adolescents (16–18 years). Respondents were derived from the 2005–06 Risk Behaviour Survey. This concerned a national random survey of households aiming at residents aged 12–40 years, stratified by age, sex and educational level of head of household. The total sample was 4468 (response 67%); because of the design, separate response rates for adolescents cannot be computed. Details have been reported elsewhere.[4,20] For this study, we used a subsample of adolescents ($n = 898$).

Procedure and measures

Data were collected via face-to-face computer-assisted interviewing and internet questionnaires. Adolescent respondents received a

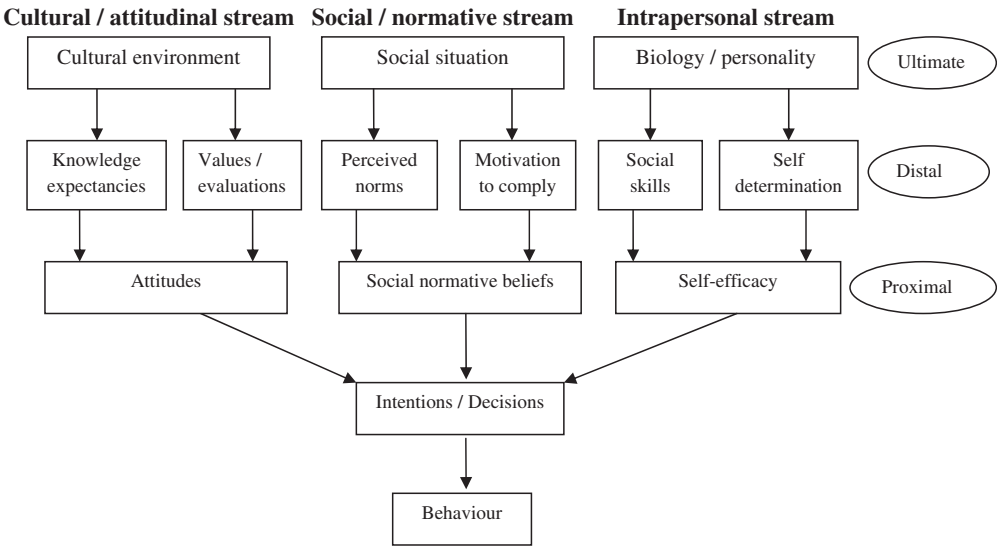

Figure 1 The TTI (adapted from Flay & Petraitis[16])

reward of 10 Euros for filling out the questionnaire. Questions concerned risk factors based on the TTI and HRB. All questions were derived from nationally and internationally standardized questionnaires as used in routine monitoring of HRBs in the Netherlands. Ethical approval was obtained from the Ethical Committee of the Faculty of Social Sciences, Utrecht University, the Netherlands.

Factors measured concerned age, gender, socio-economic and cultural background and cognitive-behavioural factors. Way of measurement, reliability and source of each factor are listed in Appendix 1 (Supplementary Material), categorized according to the attitudinal, social and intrapersonal streams of the TTI, at the ultimate and distal levels, respectively.

For conceptually adjacent risk factors, we also assessed mutual correlations. We did this for educational level and socio-economic index, the five Big5 measures, the four value orientation measures, parental monitoring and parental control, relation with mother and with father, support from and negative interaction with best friend, descriptive norms of parents and of friends and the three coping strategies. Correlations between them were generally absent (<.10) or weak (<.30). Therefore, these factors were all included as separate factors in the further analyses.

Clusters of co-occurring HRBs were identified in a previous study using exploratory and confirmatory factor analyses.[4] These analyses were performed separately for young and late adolescents. For young adolescents, two factors of interrelated behaviours (from hereof referred to as 'clusters') were identified. First, the 'Alcohol' cluster involved the number of glasses of alcohol consumption per day, number of days of alcohol consumption, smoking, drug abuse and hours of sleep (negative coefficient). Second, 'Delinquency' involved physical and verbal aggression, delinquent behaviour during last year and in the past, ignoring red lights while walking, smoking, having breakfast and fruit consumption (negative coefficients) and moderate and vigorous physical activity. In the present study, the scores on these two clusters were used as outcome variables. Correlation between the two clusters of co-occurring HRBs of young adolescents was .43 (see figure 3 and table 3 in[4]).

For late adolescents, Van Nieuwenhuijzen et al. estimated three clusters of co-occurring HRBs (see figure 2 in[4]). First, the 'Alcohol' cluster involved the number of glasses of alcohol consumption per day, number of days of alcohol consumption, unsafe sexual behaviour, ignoring red lights while walking or driving a car and vigorous physical activity. Second, the 'Delinquency' cluster involved physical and verbal aggression, delinquent behaviour during last year and in the past, drug abuse, smoking, having breakfast and hours of sleep (negative coefficients for the latter two). Finally, the 'Health' cluster involved having breakfast, fruit consumption, vegetable consumption and light and moderate physical activity. The correlations between the clusters for late adolescents were .58 for Alcohol and Delinquency, and .21 for Health and Alcohol. The late adolescents Health and Delinquency clusters were not correlated.

Table 1 presents an overview of observed sample characteristics, including the cultural, social and intrapersonal factors measured in this study, categorized by the three streams and two levels of the TTI.

Statistical analyses

We imputed 5 data sets, in line with Rubin[21] who stated that 5–10 imputed data sets are enough to achieve high efficiency. Of the young and late adolescents, respectively, 7 and 36% had a missing value on one or more ultimate factors and 25 and 20% on one or more distal factors. In clusters, no missing values occurred.

First, we performed regression analyses per cluster of co-occurring HRBs to identify cultural, social and intrapersonal factors associated with each cluster. We assessed both the univariate and multivariate association of each factor.

Second, we estimated the variance accounted for of multivariate regression models, with each of the behaviour clusters as outcome and the group of factors (either ultimate or distal) as predictors. In this way, we could assess the relative importance of ultimate and distal factors regarding their association with the behaviour clusters. Analyses were performed for both age groups separately. The social factor: 'negative interaction with best friends' was log-transformed to reduce skewness. The social factors 'descriptive norm parents' and 'descriptive norm friends' were measured behaviour-specifically (e.g. having breakfast). For these, we selected per HRB cluster the descriptive norm that correlated most strongly with the cluster. This resulted in the use of norm towards smoking for the Delinquency cluster in young adolescents and also for the Alcohol cluster. In late adolescents, this concerned having breakfast as descriptive norm for the Health cluster, smoking for the Delinquency cluster and alcohol consumption for the Alcohol cluster.

The statistical significance of the regression coefficients was determined using a false discovery rate correction for multiple testing[22] and an overall two-sided alpha of .05. Analyses were performed using R version 2.15,[23] using the R-package 'MICE'.[24] The mean regression coefficient of the imputed data sets was used as final point estimate for all groups.

Results

Cultural, social and intrapersonal factors associated with co-occurring HRBs in young adolescents

Associations of cultural, social and intrapersonal factors with co-occurring HRBs are shown in table 2 for young adolescents, i.e. for the Alcohol and Delinquency clusters. Univariately, 11 of the included 27 factors were associated with both the Alcohol and Delinquency clusters with statistical significance. An additional 11 factors were significantly associated with the Delinquency cluster only.

For the young adolescents' Alcohol cluster, age, descriptive norms of friends and parental monitoring and control univariately held the strongest associations. For the Delinquency cluster, strongest univariate associations concerned self-control, parental monitoring, descriptive norms of friends, relation with father and with mother, Big5 agreeableness and Big5 conscientiousness.

The multivariate models for the young adolescents, with all ultimate and distal cultural, social and intrapersonal factors, accounted for 45 and 53% of the total variance in the Alcohol and Delinquency cluster, respectively. In the multivariate regression model, the adolescent's age remained the most strongly associated factor with the Alcohol cluster and self-control with the Delinquency cluster (table 2).

Regarding streams of influence according to the TTI, multivariately four ultimate factors came from the intrapersonal stream and one from the social stream. Regarding distal factors, all six multivariately significant factors came from the social stream. Thus, multivariately none of the important associated factors belonged neither to the cultural stream nor to the intrapersonal stream at the distal level, with the most important associated factors belonging to the intrapersonal stream at the ultimate level and the social stream at the distal level.

Cultural, social and intrapersonal factors associated with co-occurring HRBs in late adolescents

Associations of cultural, social and intrapersonal factors with co-occurring HRBs in late adolescents are shown in table 3. Univariately, 5 of the 28 included factors were associated with all clusters of co-occurring HRBs (i.e. sex, self-determined value orientation, parental monitoring and descriptive norms of parents and friends) with statistical significance. An additional 8 significantly associated factors were found for the Alcohol cluster, 6 for the Health cluster and 12 for the Delinquency cluster only.

Table 1 Descriptives for young ($N = 504$) and late adolescents ($N = 394$)

Cultural, social and intrapersonal factors	Young adolescents			Late adolescents		
	Observed range	% or Mean ± SD	*n*	Observed range	% or Mean ± SD	*n*
Ultimate factors						
Religion (C):			497			390
unreligious		57.7			61.0	
Not practicing		13.1			14.9	
Practicing		29.2			24.1	
Living status (S):			504			394
Nuclear family or with partner		77.0			76.1	
Step or blended (reconstituted) family		10.1			7.9	
Single-parent family		11.5			13.5	
Other, without parent or partner		1.4			2.5	
Educational level (S):			504			393
Low		55.2			24.9	
Middle[a]		43.7			65.0	
High[a]		1.3			9.9	
International socio-economic index (S)	–	–	–	16–70	34.7 ± 11.6	257
Age (I)	12–15	13.6 ± 1.1	504	16–18	17.0 ± 0.8	394
Sex (% female; I)		49.4	504		48.2	394
Big5 extraversion (I)	1–7	4.0 ± 1.1	488	1–7	4.0 ± 1.1	390
Big5 agreeableness (I)	2–7	5.4 ± 1.0	494	3–7	5.2 ± 0.9	392
Big5 conscientiousness (I)	1–7	4.7 ± 1.1	491	1–7	4.7 ± 1.1	391
Big5 emotional Stability (I)	1–7	5.0 ± 1.2	491	1–7	5.1 ± 1.1	392
Big5 open to experiences (I)	1–7	5.0 ± 1.1	489	1–7	5.1 ± 1.0	390
Self-control (I)	1–4	2.8 ± 0.4	494	1–4	2.8 ± 0.4	390
Distal factors						
VO self-determination (C)	1–5	3.2 ± 0.7	494	1–5	3.2 ± 0.7	394
VO traditional family (C)	1–5	2.9 ± 0.8	469	1–5	3.0 ± 0.8	377
VO society-critical (C)	1–5	2.7 ± 0.7	449	1–5	2.7 ± 0.7	383
VO hedonic (C)	2–5	3.9 ± 0.6	500	2–5	3.9 ± 0.6	394
Parental monitoring (S)	1–5	4.3 ± 0.6	497	1–5	4.0 ± 0.7	388
Parental control (S)	1–5	3.9 ± 0.8	466	1–5	2.9 ± 1.0	389
Relation with mother (S)	1–5	3.9 ± 0.5	498	1–5	3.8 ± 0.5	391
Relation with father (S)	1–5	3.7 ± 0.6	485	1–5	3.6 ± 0.5	378
Support from best friend (S)	1–5	3.0 ± 0.7	467	1–5	3.1 ± 0.7	367
Negative interaction with best friend (S)	1–4	1.3 ± 0.4	474	1–4	1.3 ± 0.5	370
D-norm parents: alcohol (S)	–	–	–	1–5	3.1 ± 1.1	392
D-norm friends: alcohol (S)	–	–	–	1–5	2.1 ± 1.3	380
D-norm parents: breakfast (S)	–	–	–	1–5	4.5 ± 1.0	390
D-norm friends: breakfast (S)	–	–	–	1–5	3.8 ± 1.1	378
D-norm parents: smoking (S)	1–5	2.1 ± 1.5	504	1–5	2.1 ± 1.5	393
D-norm friends: smoking (S)	1–5	1.6 ± 1.0	489	1–5	2.4 ± 1.4	391
Self-esteem (I)	1–5	3.1 ± 1.2	493	1–5	3.2 ± 1.2	389
CS active (I)	1–4	2.2 ± 0.5	484	1–4	2.3 ± 0.5	387
CS avoiding (I)	1–4	2.1 ± 0.5	485	1–4	2.0 ± 0.5	383
CS seeking social support (I)	1–4	2.4 ± 0.6	493	1–4	2.3 ± 0.6	389

Notes: C, cultural stream; S, social stream; I, intrapersonal stream; VO, value orientation; D-norm, descriptive norm; CS, coping strategy.
a: In the regression analyses the middle and high level of education were merged for the young adolescents.

For the late adolescents' Alcohol cluster, a hedonic value orientation, parental monitoring, Big5 agreeableness and descriptive norms of friends univariately had the strongest associations with outcome. For the Health cluster, strongest associations were univariately found with descriptive norms of friends and parents, and of educational level. For the late adolescents' Delinquency cluster, strongest associations were univariately found with descriptive norms of friends, parental monitoring, self-control and Big5 agreeableness (table 3).

The multivariate models for the late adolescents, with all ultimate and distal cultural, social and intrapersonal factors, accounted for 37, 27 and 57% of the total variance in the Alcohol, Health and Delinquency clusters, respectively. In the multivariate regression model, Big5 extraversion, a hedonic value orientation and descriptive norms of parents and friends were statistically significantly related to higher average scores on the Alcohol cluster. Big5 Agreeableness and parental control remained significantly related to lower scores in the Alcohol cluster (table 3). Multivariately tested, three significantly associated factors remained for the late adolescents' Health cluster: educational level, descriptive norms of friends and a self-determined value orientation. Descriptive norms of friends remained to be the strongest associated factor for the Delinquency cluster.

Regarding streams of influence of the TTI, for late adolescents, three of the significant ultimate factors concerned the intrapersonal stream and one the social stream. For the distal level, four statistically significantly associated factors concerned the social stream and three the cultural environment stream. Multivariately tested, none of the statistically significant risk factors belonged to the cultural stream at the ultimate level or to the intrapersonal stream at the distal level. The most important associated factors belonged to the intrapersonal stream at the ultimate level and the social stream at the distal level.

Relative influences of the group of ultimate and the group of distal factors

For young adolescents, the relative influences of ultimate and distal factors associated with behaviours in the Alcohol cluster were almost equal ($R^2 = 34$ and 33%, respectively). For the Delinquency cluster,

Table 2 Associations of ultimate and distal cultural, social and intrapersonal factors with two clusters of co-occurring HRBs for young adolescents: Alcohol and Delinquency ($N = 504$)

Cultural, social and intrapersonal factors	Alcohol		Delinquency	
	β_{crude}	β_{adj}	β_{crude}	β_{adj}
Ultimate factors				
Religion (ref. = unreligious; C)				
Not practicing	0.02	0.00	−0.02	−0.01
Practicing	−0.05	0.02	−0.13**	−0.04
Living status (ref. nuclear family or with partner; S):				
Step or blended (reconstituted) family	0.06	0.04	0.12*	0.06
Single-parent family	0.10	0.04	0.12*	0.09*
Other, without parent or partner	0.08	0.07	0.05	0.00
Educational level (ref. = low; S)	0.07	0.04	−0.16**	−0.05
Age (I)	0.50**	0.36**	0.16**	0.06
Sex (ref. = male; I)	−0.07	−0.10*	−0.19**	−0.17**
Big5 extraversion (I)	0.10	0.06	0.16**	0.08
Big5 agreeableness (I)	−0.10	0.02	−0.33**	−0.13**
Big5 conscientiousness (I)	−0.13*	−0.03	−0.30**	−0.07
Big5 emotional stability (I)	0.00	0.06	−0.17**	0.02
Big5 open to experiences (I)	0.00	0.05	−0.03	0.08
Self-control (I)	−0.21**	−0.08	−0.54**	−0.32**
Distal factors				
VO self-determination (C)	0.12*	0.08	0.21**	0.04
VO traditional family (C)	0.02	0.04	0.02	0.08
VO society-critical (C)	0.00	−0.11	0.06	−0.02
VO hedonic (C)	0.05	0.00	0.10*	−0.04
Parental monitoring (S)	−0.38**	−0.10	−0.41**	−0.16**
Parental control (S)	−0.29**	−0.13**	−0.15**	−0.07
Relation with mother (S)	−0.23**	0.01	−0.33**	−0.04
Relation with father (S)	−0.26**	−0.09	−0.35**	−0.06
Support from best friend (S)	0.10	0.12*	−0.01	0.11*
Negative interaction with best friend (S)	0.11*	0.06	0.21**	0.10*
Descriptive norm parents (S)	0.12*	0.07	0.25**	0.12**
Descriptive norm friends (S)	0.43**	0.20**	0.38**	0.11*
Self-esteem (I)	0.01	−0.04	−0.03	−0.01
CS active (I)	−0.09	−0.06	−0.21**	−0.09
CS avoiding (I)	−0.01	−0.03	0.05	−0.04
CS seeking social support (I)	−0.10	0.03	−0.15**	0.05

Notes: Pooled results are presented of five imputed data sets.
β_{crude} = standardized regression coefficient in simple regression (Pearson correlation for continuous risk factors); β_{adj} = standardized regression coefficient in multiple regression model, adjusted for the effects of the other ultimate and distal factors.
Ref., reference category; C, cultural stream; S, social stream; I, intrapersonal stream; VO, value orientation; CS, coping strategy.
*Two-tailed overall $P < .05$.
**Two-tailed overall $P < .01$, using a discovery-wise correction.

Table 3 Associations of ultimate and distal cultural, social and intrapersonal factors with three clusters of co-occurring HRBs for late adolescents: Alcohol, Health and Delinquency ($N = 394$)

Cultural, social and intrapersonal factors	Alcohol		Health		Delinquency	
	β_{crude}	β_{adj}	β_{crude}	β_{adj}	β_{crude}	β_{adj}
Ultimate factors						
Religion (ref. = unreligious; C)						
Not practicing	0.01	0.02	0.01	−0.01	0.01	0.00
Practicing	−0.03	0.01	0.08	−0.02	−0.04	0.02
Living status (ref. nuclear family or with partner; S)						
Step or blended (reconstituted) family	−0.02	−0.04	−0.12	−0.04	0.04	−0.02
Single-parent family	0.02	−0.02	−0.05	0.02	0.17**	0.04
Other, without parent or partner	0.05	0.01	−0.03	0.00	0.08	0.05
Educational level (ref. = low; S)						
Middle	0.07	0.07	0.27**	0.19*	−0.20**	−0.10
High	0.01	0.02	0.23**	0.19*	−0.16**	−0.08
ISEI (S)	−0.14	−0.09	−0.10	−0.13	−0.07	−0.04
Age (I)	0.04	0.00	−0.14*	−0.07	0.10	0.01
Sex (ref. = male; I)	−0.22**	−0.06	0.14*	0.10	−0.24**	−0.10
Big5 extraversion (I)	0.16**	0.12*	0.04	0.00	0.11	0.07
Big5 agreeableness (I)	−0.29**	−0.15*	0.04	−0.07	−0.39**	−0.18**
Big5 conscientiousness (I)	−0.19**	−0.08	0.11	0.06	−0.23**	−0.05
Big5 emotional stability (I)	−0.01	0.08	0.05	0.02	−0.12*	0.00
Big5 open to experiences (I)	−0.01	−0.08	0.13*	0.02	−0.01	−0.02
Self-control (I)	−0.21**	−0.10	0.11	0.00	−0.40**	−0.21**
Distal factors						
VO self-determination (C)	0.14*	−0.05	−0.14*	−0.17*	0.23**	0.06
VO traditional family (C)	0.14*	0.12	0.09	−.03	0.11	0.16**
VO society-critical (C)	0.06	−0.04	0.06	0.07	0.07	−0.09
VO hedonic (C)	0.31**	0.21**	0.06	0.10	0.22**	0.03
Parental monitoring (S)	−0.30**	−0.14	0.17**	0.11	−0.42**	−0.17**
Parental control (S)	−0.22**	−0.15*	0.06	−0.04	−0.18**	−0.03
Relation with mother (S)	−0.14*	−0.03	0.05	−0.13	−0.21**	0.03
Relation with father (S)	−0.05	0.01	0.11	0.04	−0.18**	−0.05
Support from best friend (S)	0.02	−0.01	0.21**	0.09	−0.04	0.02
Negative interaction with best friend (S)	0.07	0.01	−0.07	−0.03	0.21**	0.05
Descriptive norm parents (S)	0.21**	0.15*	0.27**	0.11	0.18**	0.09
Descriptive norm friends (S)	0.28**	0.16**	0.29**	0.17*	0.53**	0.37**
Self-esteem (I)	0.07	0.05	0.08	0.04	0.07	0.03
CS active (I)	0.05	0.05	0.18**	0.02	−0.08	0.02
CS avoiding (I)	0.02	0.00	−0.06	−0.01	0.04	−0.08
CS seeking social support (I)	−0.01	0.08	0.21**	0.08	−0.18**	−0.03

Notes: Pooled results are presented of five imputed data sets.
β_{crude} = standardized regression coefficient in simple regression (Pearson correlation for continuous risk factors); β_{adj} = standardized regression coefficient in multiple regression model, adjusted for the effects of the other ultimate and distal factors.
Ref., reference category; VO, value orientation; CS, coping strategy.
*Two-tailed overall $P < .05$.
**Two-tailed overall $P < .01$, using a discovery-wise correction.

the influence of the former was the largest ($R^2 = 42$ and 36%, respectively).

For all late adolescents' HRB clusters, the relative influence was larger for the group of distal cultural, social and intrapersonal factors than that for the group of ultimate factors. The ultimate factors accounted for 18, 15 and 32% of the total variance in the Alcohol, Health and Delinquency clusters, respectively, compared with 28, 21 and 44% of total variance accounted for by the distal factors.

Discussion

Our findings show that associated cultural, social and intrapersonal factors can be identified for co-occurring HRBs in adolescents. These associated factors accounted for 27–57% of the total variance for the clusters of co-occurring HRBs.

None of the important (multivariately significant) factors associated with co-occurring HRBs belonged to the cultural stream at the ultimate level or to the intrapersonal stream at the distal level. This confirms findings of a systematic review by Wiefferink et al.[15] of hardly any reported correlations regarding determinants at these streams and levels. Previous studies predominantly reported associations regarding ultimate determinants in the intrapersonal stream, distal determinants in the social stream and proximal determinants in the cultural stream of the TTI.[4] Our study, being the first to assess associated factors in all streams at both levels simultaneously, confirms these findings.

We found no clear-cut answers regarding the relative importance of distal vs. ultimate factors. An explanation may be that distal factors have stronger associations and affect only a part of a cluster, whereas ultimate factors affect the entire cluster but more weakly because of their more remote position in the model. Although for young adolescents, ultimate and distal factors were either equally important (Alcohol cluster) or the ultimate factors outweighed the distal factors (Delinquency cluster); our results

showed the relative associations of distal factors for late adolescents' HRB clusters to be stronger than those of ultimate factors.

We found self-control to be the most important ultimate factor of co-occurring HRBs in the Delinquency cluster for both age groups. This finding corresponds with that of many studies showing that self-control is a major determinant of behaviour in general[25,26] and, more specifically, for deviant behaviour in childhood,[27–29] adolescence and adulthood[30,31] and for health behaviour.[32,33] Moffitt and colleagues showed that childhood self-control predicts physical health, substance dependence, personal finances and criminal offending outcomes in adults.[33] It has been argued that self-control may be constitutional,[34] the result of adequate parenting[30] or a combination of both.[26] Our findings underscore the importance of self-control as a generic trait that underlies a broad set of behavioural outcomes that can help in explaining the findings that HRBs and deviant behaviour co-occur.

The most important other ultimate factors in this study were educational level, age, sex and personality. Because these were thus associated with multiple co-occurring HRBs, they should generally be considered in health prevention work, and this already seems to be done for the first three ones. Moreover, these associated factors may serve as important starting points to target selective prevention at.

At the distal level, we found some important factors as well, i.e. relation or interaction with parents or best friend, descriptive norms of parents and friends, parental monitoring and control and also specific value orientations (e.g. hedonic or self-determined). The role of friends confirms the general importance of peers in adolescence.[4]

In addition to the descriptive norms of friends and parents, the distal factors parental monitoring and control also had strong associations with co-occurring HRBs, confirming previous findings.[35] Parental monitoring has been shown to be a key protective factor for both limiting access to a deviant peer group and reducing the influence of peers on youth problem behaviour.[36,37] Moreover, improved parenting practices reduce risks for substance use and other problem behaviours.[38,39] This makes parenting support a corner stone for reducing risks regarding multiple HRBs in adolescents.

The present study has several strengths, in particular, the broad range of cultural, social and intrapersonal factors measured, its relatively high response rate and its national representativeness. Some limitations of this study should also be mentioned. First, we had a cross-sectional design, limiting the potential for inferences on causality. Second, self-reported measures were used to obtain information on factors associated with co-occurring HRBs, as well as HRB outcomes, which may have increased associations as found.

Implications

Our findings imply that health gains may be attained by addressing some common ultimate and distal factors associated with multiple HRBs, and provide cues for improving the effectiveness and efficiency of preventive interventions. Moreover, as we were the first to include such a wide range of HRBs and associated factors, our findings deserve confirmation in other, preferably longitudinal or experimental studies. Potential health gains to be made are major.

Supplementary data

Supplementary data are available at *EURPUB* online.

Funding

This research was supported by a grant from the ZonMw Healthy Life Program, which falls under the Dutch Ministry of Health, Welfare and Sport (grant number 40160006).

Conflicts of interest: None declared.

Key points

- Our large study significantly adds to the integral understanding of cultural, social and intrapersonal factors associated with co-occurring HRBs among adolescents.
- Large health gains may be attained by addressing common ultimate and distal cultural, social and intrapersonal factors associated with multiple health behaviours.
- This concerns in particular parenting practices and descriptive norms of friends and parents, as these are associated with several clusters of co-occurring behaviours.
- Self-control could be addressed regarding its association with co-occurring delinquency-related behaviours.
- More integrative intervention approaches could be in particular targeted at distal associated factors, as these are theorized to be underlying constructs and to have a generalizable influence across behaviours.

References

1 Brener ND, Collins JL. Co-occurrence of health-risk behaviors among adolescents in the United States. *J Adolesc Health* 1998;22:209–13.

2 Donovan JE, Jessor R, Costa FM. Adolescent health behavior and conventionality-unconventionality: an extension of problem-behavior theory. *Health Psychol* 1991; 10:52–61.

3 Prochaska JJ, Spring B, Nigg CR. Multiple health behavior change research: an introduction and overview. *Prev Med* 2008;46:181–8.

4 Van Nieuwenhuijzen M, Junger M, Klein Velderman M, et al. Clustering of health-compromising behavior and delinquency in adolescents and adults in the Dutch population. *Prev Med* 2009;48:572–8.

5 Schneider S, Huy C, Schuessler M, et al. Optimising lifestyle interventions: identification of health behaviour patterns by cluster analysis in a German 50+ survey. *Eur J Public Health* 2009;19:271–7.

6 Rosal MC, Ockene JK, Hurley TG, et al. Prevalence and co-occurrence of health risk behaviors among high-risk drinkers in a primary care population. *Prev Med* 2000; 31(2 Pt1):140–7.

7 Schuit AJ, Van Loon AJ, Tijhuis M, et al. Clustering of lifestyle risk factors in a general adult population. *Prev Med* 2002;35:219–24.

8 Conry MC, Morgan K, Curry P, et al. The clustering of health behaviours in Ireland, and their relationship with mental health, self-rated health and quality of life. *BMC Public Health* 2011;11:692.

9 Poortinga W. The prevalence and clustering of four major lifestyle risk factors in an English adult population. *Prev Med* 2007;44:124–8.

10 Durlak JA. *Successful Prevention Programs for Children and Adolescents*. New York, NY: Plenum Press, 1997.

11 Costa FM, Jessor R, Turbin M, et al. Protection and risk in the social contexts of adolescent life: a cross-national study of problem behavior in China and the U.S. *Appl Dev Sci* 2005;9:67–85.

12 Jessor R, Turbin MS, Costa FM, et al. Adolescent problem behavior in China and the United States: a cross-national study of psychosocial predictive factors. *JORA* 2003; 13:329–360.

13 Jessor R, Jessor SL. *Problem Behavior and Psychosocial Development: A Longitudinal Study of Youth*. New York, NY: Academic Press, 1977.

14 Costa FC, Jessor R, Turbin MS. College student involvement in cigarette smoking: the role of psychosocial and behavioral protection and risk. *Nicotine Tobacco Res* 2007;9:213–24.

15 Wiefferink CH, Peters L, Hoekstra F, et al. Clustering of health-related behaviors and their determinants: possible consequences for school health interventions. *Prev Sci* 2006;7:127–49.

16 Flay BR, Petraitis J. The theory of triadic influence: a new theory of health behavior with implications for preventive interventions. *Adv Med Sociol* 1994;4:19–44.

17 Catalano RF, Hawkins JD, Berglund ML, et al. Prevention science and positive youth development: competitive or cooperative frameworks. *J Adolesc Health* 2002;31: 230–9.

18 Flay BR. Positive youth development requires comprehensive health promotion programs. *Am J Health Behav* 2002;26:407–24.

19 Greenberg MT, Weissberg RP, O'Brien MU, et al. Enhancing school-based prevention and youth development through coordinated social, emotional, and academic learning. *Am Psychol* 2003;58:466–74.

20 Reijneveld SA, Van Nieuwenhuijzen M, Klein Velderman M, et al. Clustering of health and risk behaviour in immigrant and indigenous Dutch residents aged 19-40 years. *Int J Public Health* 2012;57:351–61.

21 Rubin DB. *Multiple Imputation for Nonresponse in Surveys*. New York, NY: John Wiley & Sons, 1987.

22 Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J R Stat Soc Series B* 1995;57:289–300.

23 R Development Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing, 2012.

24 Van Buuren S, Groothuis-Oudshoorn K. MICE: multivariate imputation by chained equations. *R J Stat Softw* 2011;45:1–67.

25 Logue AW. Self control: an alternative self-regulation framework applicable to human and nonhuman behavior. *Psychol Inq* 1996;7:68–72.

26 Shonkoff JP, Philips DA. *From Neurons to Neighborhoods: The Science of Early Development*. Washington, DC: National Academy Press, Institute of Medicine, 2000.

27 Eisenberg N, Cumberland A, Spinrad TL, et al. The relations of regulation and emotionality to children's externalizing and internalizing problem behavior. *Child Dev* 2001;72:1112–34.

28 Kopp CB. Antecedents of self-regulation: a developmental perspective. *Dev Psychol* 1982;18:199–214.

29 Mischel W. Delay of gratification as process and person variable in development. In: Magnusson D, Allen VL, editors. *Human Development: An Interactional Perspective*. New York, NY: Academic Press, 1983: 149–85.

30 Gottfredson MR, Hirschi T. *A General Theory of Crime*. Stanford, CA: Stanford University Press, 1990.

31 Pratt TC, Cullen FT. The empirical status of Gottfredson and Hirschi's general theory of crime: a meta-analysis. *Criminology* 2000;38:931–64.

32 Baumeister RF, Heatherton TF, Tice DM. *Losing Control: How and Why People Fail at Self-Regulation*. San Diego, CA: Academic Press, 1994.

33 Moffitt TE, Arseneault L, Belsky D, et al. A gradient of childhood self-control predicts health, wealth, and public safety. *Proc Natl Acad Sci USA* 2011;108:2693–8.

34 Rothbart MK, Ahadi SA, Evans DE. Temperament and personality: origins and outcomes. *J Pers Soc Psychol* 2000;78:122–35.

35 Spoth RL, Kavanagh KA, Dishion TJ. Family-centered preventive intervention science: toward benefits to larger populations of children, youth, and families. *Prev Sci* 2002;3:145–52.

36 Dishion TJ, McMahon RJ. Parental monitoring and the prevention of child and adolescent problem behavior: a conceptual and empirical formulation. *Clin Child Fam Psychol Rev* 1998;1:61–75.

37 Kerr M, Stattin H. What parents know, how they know it, and several forms of adolescent adjustment: further support for a reinterpretation of monitoring. *Dev Psychol* 2000;36:366–80.

38 Dishion TJ, Nelson SE, Kavanagh K. The Family Check-Up for high-risk adolescents: motivating parenting monitoring and reducing problem behavior. In: Lochman JE, Salekin R, editors. Behavior-oriented interventions for children with aggressive behavior and/or conduct problems [Special Issue]. *Behav Ther* 2003;34:553–71.

39 Schmidt SE, Liddle HA, Dakof GA. Changes in parenting practices and adolescent drug abuse during multidimensional family therapy. *J Fam Psychol* 1996;10:12–27.