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TNO report

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A first hypothetical estimate of the Dutch burden of disease in relation to negative experiences during childhood

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Contents

1 Introduction

Felitti et al. (1998) examined the effects of Adverse Childhood Experiences (ACEs) for the American population. They showed, among others, that many persons have one or more ACEs and that these experiences attribute eminently to the high costs in health care. Until now, not much is known about ACEs in the Dutch population. In this study, we assess the prevalences (i.e., relative frequencies) of ACEs in the Netherlands. For this purpose, a questionnaire was used based on the ACE questionnaire of Felitti. The ACE questionnaire, results in an ACE total sum score, ranging from 0 to 10. This score reflects how many types of ACEs a person has experienced in childhood.

This study will answer the following questions:

a) Do the ACE items measure one underlying dimension? In other words: can we express the scores on the ACE items on one measurement scale?
b) What is the distribution of the ACE items and the ACE sum score in the Netherlands?
c) Do the ACE scores in the Netherlands differ from those in America?
d) Are there differences in ACE scores related to demographic characteristics?
e) What is the hypothetical burden of disease of the Netherlands?

These questions are answered in the next chapters.

2 Method

2.1 Sample

Veldkamp used the TNS NIPO base, a database of approximately 140,000 persons, willing to participate in questionnaires, of which 115,000 are 18 years or older. In total, N=2,425 of these persons were approached in an internet based survey. Additionally, 977 persons were approached by mail. Overall, of the 3,402 persons approached, 2,208 persons (i.e., 65%) responded.

2.2 Measures

The Dutch ACE questionnaire (see Appendix A.1) was created by Augeo Foundation in corporation with the Dutch Centre for Applied Scientific Research (TNO) and is based on the questionnaire of Felitti (see Appendix A.2). Furthermore, Veldkamp advised on the formulation of the items. The ACE questionnaire consist of 17 items that are answered with a Yes (a score of 1) or a No (= a score of 0). The scores on these items were combined into scores on ten ACE categories in the same way as was done by Felitti et al. (1998). For example, a score of 1 on item "V15_01" *or* a score of 1 on item "V15_02" results in a score of 1 on the first ACE category (ACE1). See Table 1 for the relation between the ACE items and ACE categories.
The 2,208 respondents filled in the 17 ACE items and questions on demographic characteristics, like gender, age, education, size of household, region, and access to internet.

Table 1: Relation between the ten ACE categories and the 17 ACE items (using the labels in the Dutch questionnaire).

ACE category	Label	ACE items
ACE1	Emotional Abuse	V15_01 and V15_02
ACE2	Physical Abuse	V15_03 and V15_04
ACE3	Sexual Abuse	V15_05 and V15_06
ACE4	Emotional Neglect	V15_07 and V15_08
ACE5	Physical Neglect	V15_09 and V15_10
ACE6	Parental Separation or Divorce	V30
ACE7	Mother treated violently	V40_1, V40_2, and V40_3
ACE8	Household Substance Abuse	V40_4
ACE9	Household Mental Illness	V40_5
ACE10	Incarcerated Household Member	V40_6

2.3 Statistical analysis

To some extent, the distributions of the demographic variables of the respondents differed from those in the population (data from the Central Statistics Agency (CBS)). Therefore, we used weighted data, that is, data corrected for these differences, to determine the ACE prevalences. To evaluate the differences between prevalences we used the unweighted data. Relationships with other variables were also tested using the unweighted data. Only 83 respondents out of 2,208 (i.e., 3.8%) had missing values on one or more ACE items and/or demographic characteristics. The missing values seemed not to be related to one of the ACE items and/or demographics and were discarded in the analyses.

As mentioned before, two samples were approached, namely one via internet (“CASI”, acronym for Computer Assisted Self-completion Interviewing) and one via mail. The data from these two groups may only be combined if their answers are comparable. We found some differences on three ACE items (as is discussed in Appendix B). Most of these differences can be explained by differences in demographic features (like gender and region). Hence, the two groups can be seen to come from the same population. Therefore, we can safely combine the two groups in the analyses to be done in this research. The only exception is ACE item V15_05 (or ACE category ACE3). Results including this ACE item must be dealt with carefully. More details can be found in Appendix B.

3 The psychometric properties of the ACE

The ACE sum score is calculated by summing the scores on the ten ACE categories (see Table 1 for the ACE categories). The assumption made by calculating a sum score is that the ACE items can be expressed on a one-dimensional measurement scale and that the items are indicators of a single construct. If that is the case, calculating a sum score is (statistically) meaningful, as a sum score has less measurement error than each single item and a sum score easily summarizes the scores on single items that are related to each other.

To test whether there is indeed one underlying dimension, we carried out two Principal Component Analyses (PCA): in the first analysis we used the seventeen ACE items and in the second analysis we used the ten ACE categories. Essentially, a PCA analysis assesses the degree to which the separate items are interrelated. Mathematically, this is done by an eigenvalue decomposition. An eigenvalue represents the amount of variation explained by a common component (i.e., a dimension).

Kaiser (1960) recommends retaining all components with an eigenvalue greater than one, since in that case the amount of variation explained is substantial. Zhu (2001) recommends another way to determine the number of components, by looking at the scree plot (see Figure C1 in Appendix C.1). This shows the eigenvalue for each component on the y-axis and the component number on the x-axis. The number of components to retain is set equal to the component number where the slope of the line changes. Since the items should all measure ACEs, we would like to find one component.

3.1 Dimensionality: PCA

The assumptions of the PCA are not violated (as can be seen in Appendix D.1). Therefore, the results of the PCA are reliable.
The analyses resulted into 5 components with an eigenvalue greater than 1.00 (see Tabel D1). Tentatively, these five components can be summarized by:
component 1: *physical and emotional individual abuse*
component 2: *family member abuse*
component 3: *household issues*
component 4: *sexual individual abuse*
component 5: *physical neglect*

However, the scree plot in appendix D.1 clearly shows that the first component (of the unrotated solution) has a much higher eigenvalue than the other four. It explains about 30% of the variance. We may, therefore, conclude that the ACE is essentially unidimensional (Zhu, 2001) and that summing the Yes answers is justified.

We did the same analysis for the ten ACE categories. Again, the assumptions of the PCA are not violated. From the PCA on the ACE categories it follows that two components can be distinguished, which can be summarized as *individual abuse* and *family problems*. However, analogously to the first PCA, the ACE categories have a strong first dimension. According to Zhu (2001), we can conclude that the ACE categories do measure one dimension which consists of two subscales.

3.2 Reliability analysis

Preferably the questionnaire reflects the construct it is measuring consistently, that is, the scale should preferably be reliable. Thus, individual items or sets of items should give results consistent with the overall questionnaire. This is also referred to as internal validity of the questionnaire. In order to assess this internal consistency, we calculated Cronbach's alpha. The internal validity of the ACE items is high and that of the ACE categories moderately high (see Appendix D.2). So, using the ACE items renders a higher internal validity than using the ACE categories. However, the higher internal validity is due to the higher number of items (see Appendix D.2). Therefore, one can use the ACE items and ACE categories interchangeably without loosing or gaining information.

3.3 Conclusion

In conclusion, based on the high internal validity for all the items together (section 3.2) and on the strong first dimension found in PCA (section 3.1), we can express the items on a one scale, measuring a meaningful construct, called the ACEs.

4 The prevalence of ACE in the Netherlands

Tabel 2 presents the percentage of respondents reporting a Yes answer to the ACE items and the ACE categories. The table also presents the percentages of respondents reporting a Yes answer to the ACE categories in the USA (acquired from http://www.cdc.gov/ace/prevalence.htm).

Table 2: The prevalences of the ACE items in the Netherlands (NL) and the prevalences of the ACE categories (in bold) in the Netherlands (NL) and the USA.

ACE category and ACE item	NL	USA
1. **Emotional Abuse:** Did a parent or other adult in the household often or very often…		
a. Swear at you, insult you, put you down, or humiliate you?	17.5	
b. Act in a way that made you afraid that you might be physically hurt?	9.1	
Total: a or b is answered with yes	**19.4**	**10.6**
2. **Physical Abuse:** Did a parent or other adult in the household often or very often…		
a. Push, grab, slap, or throw something at you?	14.4	
b. Ever hit you so hard that you had marks or were injured?	9.6	
Total: a or b is answered with yes	**16.9**	**28.3**
3. **Sexual Abuse:** Did an adult or person at least 5 years older than you ever…		
a. Touch or fondle you or have you touch their body in a sexual way?	10.3	
b. Attempt or actually have oral, anal, or vaginal intercourse with you?	4.4	
Total: a or b is answered with yes	**10.3**	**20.7**
4. **Emotional Neglect:** Did you often or very often feel that …		
a. No one in your family loved you or thought you were important or special?	14.2	
b. Your family didn't look out for each other, feel close to each other, or support each other?	16.2	
Total: a or b is answered with yes	**20.5**	**14.8**
5. **Physical Neglect:** Did you often or very often feel that …		
a. You didn't have enough to eat, had to wear dirty clothes, and had no one to protect you?	3.4	
b. Your parents were too drunk or high to take care of you or take you to the doctor if you needed it?	2.3	
Total: a or b is answered with yes	**4.5**	**9.9**
6**. Parental Separation or Divorce**: Were your parents ever separated or divorced?	**14.8**	**23.3**
7. **Mother treated violently:** Was your mother or stepmother:		
a. Often or very often pushed, grabbed, slapped, or had something thrown at her?	7.2	
b. Sometimes, often, or very often kicked, bitten, hit with a fist, or hit with something hard?	4.3	
c. Ever repeatedly hit at least a few minutes or threatened with a gun or knife?	2.5	
Total: a or b is answered with yes	**7.9**	**12.7**
8. **Household Substance Abuse:** Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?	**8.1**	**26.9**
9. **Household Mental Illness:** Was a household member depressed or mentally ill, or did a household member attempt suicide?	**9.7**	**19.4**
10. **Incarcerated Household Member:** Did a household member go to prison?	**2**	**4.7**

Summation of the Yes answers on the ACE categories results into the ACE sum score, with a minimum score of 0 and a maximum score of 10. The values on the ACE sum score (referred to as the ACE scores) represent the number of ACE categories. For example, when respondents have an ACE score of 3, it means that they reported a Yes answer to three ACE categories. Table 3a displays the prevalence of each ACE score for the Netherlands. Note that the prevalence of each ACE score greater than 4 is lower

than 3.5 %. Therefore, as in Felitti's publications, ACE scores of 4 and higher are taken together as one category. Table 3b displays the prevalence of the values of this truncated ACE sum score for the Netherlands (and for America).

Inspection of Table 3b shows that the ACE prevalences in the Netherlands differ from those in the USA. For example, in the Netherlands there are more persons with no adverse childhood experience (i.e., with an ACE score of 0) than in the USA. In Section 5, we will test whether the differences are statistically significant, that is, we assess whether the differences cannot be attributed to random differences.

Table 3a: The Dutch prevalences of ACE scores. An ACE score represents the number of ACE categories.

ACE score	Percentage	Cumulative percentage
0	56.1	56.1
1	17.2	73.3
2	9.3	82.6
3	6.2	88.8
4	4.3	93.1
5	3.3	96.4
6	1.7	98.1
7	1.0	99.1
8	0.7	99.8
9	0.1	99.9
10	0.1	100.0

Table 3b: The prevalences of the truncated ACE sum score in The Netherlands (NL) and America (USA)

ACE score	NL	USA
0	56.1	36.1
1	17.2	26.0
2	9.3	15.9
3	6.2	9.5
4 or higher	11.2	12.5

To obtain more insight into how the ACE items cluster in the Netherlands, we present the prevalences of the ACE items for the Dutch who have an ACE score of one and for those who have an ACE score of two (Table 4). The table shows that three adverse childhood experiences are reported very often in combination with at least one other event: Emotional Abuse, Physical Abuse and Emotional Neglect. The prevalence of an Incarcerated Household Member is low, but when it occurs it is never reported alone.

Table C2 in Appendix C displays the percentage of persons with an ACE score of two who report a certain ACE category combination. For example, within the group of persons with an ACE score of two, 15.7% reports both an emotional abuse and physical abuse and 14.1% reports both an emotional abuse and emotional neglect.

Table 4: The Dutch prevalence of the ACE categories in general, for those with an ACE score of one, and those with an ACE score of two

		ACE score of	
ACE category	General	1	2
1. Emotional Abuse	19.4	9.1	39.2
2. Physical Abuse	16.9	15.3	34.5
3. Sexual Abuse	10.3	15.6	21.5
4. Emotional Neglect	20.5	17.7	37.2
5. Physical Neglect	4.5	0.8	3.1
6. Parental Separation or Divorce	14.8	23.3	23.0
7. Mother treated violently	7.9	1.5	8.7
8. Household Substance Abuse	8.1	5.9	13.3
9. Household Mental Illness	9.7	10.8	15.9
10. Incarcerated Household Member	2.0	0.0	3.6

5 The differences between the Dutch and American prevalences of the ACE scores

There are differences between the prevalences of the ACE scores between the Dutch and American sample. These differences cannot be explained by random differences (p-value < .001). The p-value indicates that the chance that the differences between the actual and expected prevalences would be as we found (or extremer) is less than 1 pro mille, if the two samples would come from the same population. More details are given in Appendix E.

To obtain more insight into the differences in the prevalences of the ACE scores, we also evaluated the differences per ACE score (i.e. 0, 1, 2, 3, or '4 or higher'). The prevalence of each ACE score differs significantly between the Netherlands and America (see Appendix E), except for an ACE score of four or higher. It may be concluded from these tests (see also Tables E1 and E2 in Appendix E), that there are more Dutch respondents with an ACE score of zero than expected based on randomness. For the ACE scores of one, two, and three, there are fewer Dutch respondents than expected. The prevalence of an ACE score of four or higher does not differ significantly in the two countries.

6 Relation between ACE scores and demographic characteristics

The ACE scores might relate to demographic characteristics, like gender, age, region, level of education, size of household, and having access to internet. We examined these relationships using non-parametric methods (see appendix F). Table 5 shows which tests were used for each factor together with the corresponding *p*-value.

Table 5: The name of the test and corresponding p-value of the relation between the ACE scores and a demographic characteristic

Factor	Test	*p*-value
Gender	Mann-Whitney	< .001
Age	Kruskal-Wallis	. 003
Internet yes/no	Mann-Whitney	.006
Region	Kruskal-Wallis	.022
Education	Kruskal-Wallis	.001
Size of household	Kruskal-Wallis	.184

Overall, we can conclude that all demographic characteristics are significantly related to the ACE sum scores, except Size of household. Appendix F describes the differences between the several groups in more detail. We will elaborate on the differences between men and women (Table 6a) and between the three education categories (Table 6b).

From Table 6a it can be concluded that (relatively) more men have an ACE score of 0 or 1 and that (relatively) more women have a higher ACE score (see also Appendix F).
From Table 6b it follows that the ACE score prevalences are more or less the same in the lower and medium level of education group. Respondents with higher education more often have an ACE score of zero (see also Appendix F).

Table 6a: The Dutch prevalences of ACE scores for men and women

ACE score	Men	Women	Total
0	60.3	52.0	56.1
1	17.6	16.9	17.2
2	8.6	10.0	9.3
3	5.0	7.4	6.2
4	4.2	4.3	4.3
5	1.8	4.8	3.3
6	1.5	1.9	1.7
7	0.4	1.5	1.0
8	0.4	1.0	0.7
9	0.2	0.0	0.1
10	0.0	0.1	0.1

Table 6b: The Dutch ACE score prevalences for three levels of education

ACE score	Low ("t/m mavo")	Medium	High	Total
0	53.5	54.2	62.8	56.1
1	18.2	17.6	15.4	17.2
2	10.1	9.5	8.0	9.3
3	6.7	6.3	5.4	6.2
4	3.9	4.5	4.1	4.3
5	2.9	4.6	1.8	3.3
6	2.0	1.9	1.1	1.7
7	1.4	0.5	1.2	1.0
8	1.3	0.5	0.3	0.7
9	0.1	0.2	0.0	0.1
10	0.0	0.2	0.0	0.1

Until now, we have examined the relation between the ACE sum score and every demographic feature separately. Differences between demographic groups may be interrelated. For example, when more people in certain regions have lower educational levels, we could find differences by region and educational level. Therefore, we also investigated the relation between ACE and all the demographic features together. We carried out a logistic regression analysis on a new variable that is based on the ACE sum score. This new variable has two values: 0, when the ACE score is zero, and 1 for ACE scores of 1 or higher. The results are shown in Appendix G. In summary, it can be concluded that all the demographic characteristics except for age and region contribute significantly to the prediction of an ACE score of zero or higher.

Based on this analysis, we can estimate the effect on ACE score (zero or higher) of each demographic characteristic (e.g., gender), called the approximate reduction of the chance for reporting at least one adverse child event for, for example, a man compared to a woman[1]. Table 7 gives the approximate reduction in reporting one or more adverse childhood experiences. For example, according to this table, men have approximately a 27.2% (namely, 100%*[1-0.728]) reduction in reporting one or more adverse childhood experiences compared to women. Note that if we would compare the women to the men, the odds ratio for gender is 1/0.728. Hence, women have approximately a 37.4% increase (namely, a 100%*[1-1/0.728] = -37.4% reduction) in reporting one or more adverse childhood experiences in comparison to men.

[1] This approximate reduction is calculated using the formula: 1 – *odds ratio.*
In case one would like to change the reference group, the new odds ratio is equal to one divided by the original odds ratio; therefore, the adjusted approximate reduction is calculated using the formula 1 – 1/*odds ratio.*

Table 7: Odds ratios and approximates of reductions in reporting one or more ACEs

		Comparison	
	Odds ratio (OR)	Original [1 – OR]	Opposite [1 – 1/OR]
Gender (male vs female)	0.728	27.2%	-37.4%
Age	0.974	2.6%	-2.7%
Internet (yes vs no)	1.530	-53.0%	34.6%
Region			
Region (big cities vs south)	1.138	-13.8%	12.1%
Region (west cities vs south)	1.003	-0.3%	0.3%
Region (north cities vs south)	0.692	30.8%	-44.5%
Region (east cities vs south)	0.978	2.2%	-2.2%
Education			
Education (low vs. high)	1.607	-60.7%	37.8%
Education (medium vs. high)	1.479	-47.9%	32.4%
Size household	0.921	7.9%	-8.6%

Note. A negative reduction means an increase.

7 Hypothetical burden of disease

Felitti (1998) shows that the ACE score is strongly associated with several risk factors and disease conditions (which are referred to as health problems). This is reflected by the odds ratios that are corrected for differences in age, gender, race, and educational attainment. Essentially, odds ratios, in this case, indicate approximately the relative risk on such a health problem compared to no health problem. The odds ratio for a certain ACE score represents the change in odds of having that health problem in comparison to an ACE score of zero. Stated otherwise, when the ACE score changes from zero to a certain number, the chance of having the health problem (rather than not having that problem) is equal to the odds ratio. For example, the odds ratio of alcoholism for an ACE score of one is equal to 2.0 (Felitti et al, 1998). This tells us that, compared to persons with an ACE score of zero, those with an ACE score of one are approximately twice as likely to be alcoholic (than non-alcoholic). This indicates an increase of approximately 100%.

Our own data collection did not include measures on risk factors, nor did it assess the occurrence of the diseases comparable to Felitti's study. However, the RIVM kindly provided us with data concerning several medical conditions more or less comparable to those mentioned in Felliti's studies. More details can be found in Appendices G.1 and G.2.

Based on Felitti's odds ratios, the distribution of the ACE score in our study, and the prevalences of the conditions in the Netherlands, we determined an estimation of the burden of disease associated with adverse childhood events. Nevertheless, this estimation is hypothetical and depends on the degree to which the following assumptions are met:

- The sample of Felitti is comparable to ours – which clearly is not true, aince Felitti's sample is mainly middle class and ours is more representative for the total population in the Netherlands,
- The association between ACE scores and burden of disease in the Netherlands is comparable to that in the USA – which we do not know,
- The definition of the medical condition as assessed in the USA is comparable to the definition in the Netherlands – which is not always the case (as can be seen in Appendices G.1 and G.2).

Yet, to the degree to which these assumptions are met, we can calculate the (relative) prevalence of several medical conditions in association with the ACE distribution in the Dutch population. The formulas used are given in Appendix G.3.

Tables 8a and 8b show the percentages of persons with a certain ACE score and a certain health problem (for health problems with prevalences of 2% and higher). Tables H6 and H7 also display the percentages stroke (which has a prevalence of 1.3%).
In Table 8a, the percentages are calculated with respect to the number of persons within a certain ACE score (see Table G1). In Table 8b, the percentages are calculated with respect to the number of persons who have a certain health problem (see table G3).
For example, from Table 8a, it may be concluded that about 40% of those who have an ACE score of four or higher smoke. We know that 27% of the populations (older than 15) smokes (see Appendix G.2). One might conclude that there are more smokers with an ACE score of 4 or higher than expected based on the population average.
Table 8b shows, among others, that out of the persons who are alcoholic about 27% has an ACE score of zero and about 28% has an ACE score of four or higher. Assuming a causal relationship, this might indicate that, when the adverse childhood experiences are

treated effectively, this could result in a substantial reduction in persons who are alcoholic.

Table 8a: Percentage of people (with a certain ACE score) that have a certain health problem

ACE score	Risk factors						Disease conditions	
	smoking	severe obesity	physical inactivity	depressed mood	alcoholism	cannabis use	COPD	diabetes
0	23.20	10.66	39.59	3.77	5.16	10.57	1.31	3.85
1	24.87	11.50	44.12	5.61	9.63	16.58	2.14	3.74
2	31.19	14.36	44.06	8.42	17.82	25.25	1.98	3.47
3	37.78	14.07	48.15	9.63	20.74	29.63	2.96	4.44
4 or higher	39.75	15.98	45.90	15.57	28.69	35.66	4.92	6.15
Reference	27.00	12.00	42.01	6.20	10.70	17.01	2.00	4.10

Table 8b: Percentage of people (with a certain health problem) that have a certain ACE score

ACE score	Reference	Risk factors						Disease conditions	
		smoking	severe obesity	physical inactivity	depressed mood	alcoholism	cannabis use	COPD	diabetes
0	56.1	48.21	50.00	52.84	34.07	27.04	34.96	36.36	52.81
1	17.2	15.84	16.54	18.05	15.56	15.45	16.80	18.18	15.73
2	9.3	10.73	11.15	9.74	12.59	15.45	13.82	9.09	7.87
3	6.2	8.69	7.31	7.11	9.63	12.02	10.84	9.09	6.74
4 or higher	11.2	16.52	15.00	12.25	28.15	30.04	23.58	27.27	16.85
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

8 Future research

Although the central issue of this study was to obtain the prevalences of the ACE items, the ACE score, and the hypothetical burden of disease for the Netherlands, the comparison between the Dutch and American prevalences could be improved, namely by using the data of Felitti and/or by reducing the sources leading to differences on forehand, which are discussed next.

In this research, there are at least two sources of differences in prevalences and scores:
A) The differences might be due to culture-/country-differences in:
1) the definitions (e.g., when are you considered to be an alcoholic).
2) admitting an adverse childhood event (e.g., in the Netherlands you might easier say to experience physical abuse and in America you might easier admit that you have an alcohol problem).
3) the real prevalence of adverse childhood experiences; hence, there is an actual difference in ACE prevalences and scores.
B) The American data set contains only person who belong to the middle class (Felitti et al., 1998) and the Dutch data set contains persons from the whole population. Limiting the analysis to middle class respondents (based on demographics) could result in a better comparison.
We think that the middle class is mainly determined by income, but will be linked to age and region. Since no data are available on income, we could not filter the middle class from our sample. Therefore, new data should be collected to make a better comparison.

When the data of Felitti et al. are available, the structure of the Dutch and American data could also be compared (with a multi-group confirmatory factor analysis).

The relation between the ACE scores and demographics should also be evaluated with a zero-inflated Poisson regression. We did not do this, because it was too time-consuming.

In a new study, not only data on the ACE items and demographics should be collected, but also on the health problems, that is, risk factors and disease conditions. If possible, the definitions of the health problems should resemble the ones of Felitti. In that case, one can determine the (adjusted) odds ratios (regarding certain health problems for a certain ACE score) for the Netherlands. Then, the conclusions regarding the relation between ACE score and health problems are more accurate.

9 Conclusions

In this section, we will briefly describe the conclusions with respect to the questions mentioned in the introduction.

Is ACE one dimension, that is, do the ACE items form one scale?
The questionnaire measures one strong dimension, which can be defined as adverse childhood experiences (ACEs). This dimension contains five meaningful subscales: physical and emotional individual abuse, family member abuse, household issues, sexual individual abuse, and physical neglect.

Furthermore, there is no loss in information by using the ACE categories, therefore, one could use the seventeen ACE items as well as the ten ACE categories.

What is the distribution of ACE in the Netherlands?
Although there are many persons with an ACE score of zero, there is a considerable amount of persons who have at least one adverse childhood experience.
The prevalences of the ACE scores are presented in Table 3a and 3b.

Do the ACE scores of the Netherlands differ from those of America?
There is a significant difference in the ACE scores of the Netherlands and those of America. Furthermore, the difference between the Dutch and American prevalence for a certain ACE score is significant for each ACE score, except for an ACE score of four or higher.
It may be concluded that there are relatively more Dutch respondents with an ACE score of 0 than expected when there was no difference between the countries, that is, when they would belong to the same population. For the ACE scores of one, two, or three, there are relatively fewer Dutch respondents than American respondents.

Are there differences in ACE scores for demographic characteristics?
The difference in ACE score for each demographic feature is significant, except for size of household.
• Women have on average a higher ACE score than men.
• The persons in age category 65+ have on average a lower ACE score than those in the sequential category 55-64. This might indicate that, comparable to what Felitti et al. (1998) suggests, there are fewer high ACE scores in the 65+ category, because those with a high ACE score die before their 65th birthday.
• Persons who live in the North have on average a lower ACE score than persons who live in the big cities of the Netherlands. All the other pairs of regions do not differ significantly in ACE score.
• Persons with a higher education have a significantly lower ACE score than persons with a lower of medium education.

What is the burden of disease of the Netherlands?
Table 8a and 8b summarize the hypothetical disease burden in the Netherlands.
From Table 8a it can, among others, be concluded that, for almost all diseases, there are more persons with an ACE score of four or higher than expected on the population average.
Table 8b shows, among others, that a large percentage of those who have a depressed mood or who are alcoholic have an ACE score of 4 or higher. This might indicate that, when the adverse childhood experiences were treated, there would be fewer persons with a depressed mood or persons who are alcoholic.

A A.1: The Dutch questionnaire (in Dutch)

Hartelijk dank voor uw bereidheid mee te werken aan dit onderzoek naar ervaringen van mensen in hun jeugd dat wij uitvoeren voor Augeo Foundation en TNO Kwaliteit van Leven. Met deze vragenlijst willen we in kaart brengen hoeveel mensen in hun jeugd deze ervaringen hebben gehad. Dit helpt om te bepalen hoe vaak dit leidt tot latere ziekten en problemen. Uw antwoorden worden anoniem en vertrouwelijk verwerkt.

**TAB 60, 75, 90, 99*

VRAAG 15 **FORMULIER VRAAG**

De volgende vragen hebben telkens betrekking op uw jeugd, dat wil zeggen, de eerste 18 jaren van uw leven.

Is het vaak of heel vaak gebeurd dat een ouder of andere volwassene bij u in huis:

- ❑ u uitschold, beledigde, kleineerde of vernederde?
- ❑ dingen deed waardoor u bang was dat u misschien gewond zou raken?

Heeft een ouder of andere volwassene in het huisgezin:

- ❑ u vaak of heel vaak geduwd, vastgegrepen, een klap gegeven of iets naar u gegooid?
- ❑ u weleens zo hard geslagen dat u blauwe plekken had of gewond raakte?da

Is het ooit gebeurd dat een volwassene of iemand die minstens vijf jaar ouder was dan u:

- ❑ u op een seksuele manier aanraakte of streelde of zich door u liet betasten?
- ❑ orale, anale of vaginale seks met u had of dat probeerde?

Hebt u vaak of heel vaak het gevoel gehad dat:

- ❑ niemand bij u in het gezin van u hield of u belangrijk of speciaal vond?
- ❑ de mensen in het gezin geen oog hadden voor elkaar, zich niet met elkaar verbonden voelden of elkaar niet steunden?

Hebt u vaak of heel vaak het gevoel gehad dat:

- ❑ u niet voldoende te eten had, vuile kleren moest dragen en niemand had om u te beschermen?
- ❑ uw ouders te dronken of high waren om voor u te zorgen of met u naar de dokter te gaan als dat nodig was?

1 ❑ ja, dat kwam voor in mijn jeugd
2 ❑ nee, dat kwam niet voor in mijn jeugd

VRAAG 30

1012L1

Zijn uw ouders tijdens uw jeugd ooit uit elkaar gegaan of gescheiden?

1 ❑ ja, mijn ouders zijn uit elkaar gegaan of gescheiden
2 ❑ nee, dat kwam niet voor in mijn jeugd
9 ❑ geen info

**TAB 65, 80, 95, 99*

VRAAG 40 **FORMULIER VRAAG**

De volgende vragen hebben telkens betrekking op uw jeugd, dat wil zeggen, de eerste 18 jaren van uw leven.
ja, dat kwam voor in mijn jeugd nee, dat kwam niet voor in mijn jeugd

❑ Heeft uw moeder of stiefmoeder meegemaakt dat zij vaak of heel vaak werd geduwd, vastgegrepen, een klap kreeg of iets naar zich toe gegooid kreeg?

❑ Heeft uw moeder of stiefmoeder meegemaakt dat zij soms, vaak of heel vaak werd geschopt, gebeten, met een vuist of met iets hards geslagen?

❑ Heeft uw moeder of stiefmoeder meegemaakt dat zij ooit zeker een paar minuten herhaaldelijk werd geslagen of met een vuurwapen of mes werd bedreigd?

❑ Heeft u in uw jeugd samengewoond met iemand die een probleem-drinker of alcoholist was of drugs gebruikte?

❑ Was er iemand bij u in huis depressief of psychisch ziek of heeft iemand bij u in huis geprobeerd zich van het leven te beroven?

❑ Heeft iemand die bij u in huis woonde in de gevangenis gezeten?

1 ❑ ja, dat kwam voor in mijn jeugd
2 ❑ nee, dat kwam niet voor in mijn jeugd

VRAAG 100

Tot zover deze vragenlijst.
We kunnen ons voorstellen dat het beantwoorden van deze vragen gevoelens bij u heeft opgeroepen. Mocht u daarover willen praten, dan willen wij u
verwijzen naar LCVT (www.lcvt.nl). Via dit centrum kunt u zich ook aanmelden bij een hulpverleningsinstelling in uw regio.

A.2: Original ACE Questionnaire

While you were growing up, during your first 18 years of life:

1. Did a parent or other adult in the household often or very often…
a. Swear at you, insult you, put you down, or humiliate you?
or
b. Act in a way that made you afraid that you might be physically hurt?

Yes or No. If yes enter 1 _____

2. Did a parent or other adult in the household often or very often…
a. Push, grab, slap, or throw something at you?
or
b. Ever hit you so hard that you had marks or were injured?

Yes or No. If yes enter 1 _____

3. Did an adult or person at least 5 years older than you ever…
a. Touch or fondle you or have you touch their body in a sexual way?
or
b. Attempt or actually have oral, anal, or vaginal intercourse with you?

Yes or No. If yes enter 1 _____

4. Did you often or very often feel that …
a. No one in your family loved you or thought you were important or special?
or
b. Your family didn't look out for each other, feel close to each other, or support each other?

Yes or No. If yes enter 1 _____

5. Did you often or very often feel that …
a. You didn't have enough to eat, had to wear dirty clothes, and had no one to protect you?
or
b. Your parents were too drunk or high to take care of you or take you to the doctor if you needed
it?

Yes or No. If yes enter 1 _____

6. Were your parents ever separated or divorced?

Yes or No. If yes enter 1 _____

7. Was your mother or stepmother:
a. Often or very often pushed, grabbed, slapped, or had something thrown at her?
or

b. Sometimes, often, or very often kicked, bitten, hit with a fist, or hit with something hard?
or
c. Ever repeatedly hit at least a few minutes or threatened with a gun or knife?

Yes or No. If yes enter 1 _____

8. Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?

Yes or No. If yes enter 1 _____

9. Was a household member depressed or mentally ill, or did a household member attempt suicide?

Yes or No. If yes enter 1 _____

10. Did a household member go to prison?

Yes or No. If yes enter 1 _____

Now add up your “Yes” answers: _____ This is your ACE Score.

B Combining the two samples

To combine the two samples (i.e., CASI and Mail), both groups should not differ in answering the questionnaire. Therefore, we looked at the answers for both groups for each item and determined whether this was significantly different from what you would expect them to answer if the two groups actually come from one population, that is, whether this differs significantly from random differences. This is done with a Chi-square statistic. Since we do not expect one of the groups to differ from the other group in a certain direction, we use the two-sided test.
Except for three ACE items, the answers for the two groups do not differ. However, for ACE items V15_05, V30, and V40_4 the answers do differ significantly.
The respondents in the CASI Group have more No answers on V15_05 than expected and, logically, the respondents of the Mail Group have more Yes answers than expected ($p = .006$). The opposite holds true for the answers on V30 and V40_4, that is, the CASI Group gave more Yes answers than expected when there is no difference between the two groups ($p = .012$ and $p = .049$, respectively).

When looking at the ACE categories, we found (more or less) the same result. Namely, except for three ACE categories, the answers for the two groups do not differ. The answers of the two groups do differ for ACE3 ($p = .008$), which contains ACE item V15_05 (see Appendix A.2), for ACE6 ($p = .012$), which is equal to V30 (see Appendix A.2), and for ACE8 ($p = .049$), which is based on V40_4 (see Appendix A.2).

The answers of the two groups CASI and Mail can differ due to difference in demographic characteristics in the two groups. Namely, demographics can be a confounding factor, that is, an indirect effect. In that case, the two groups can be combined (for all ACE items). Therefore, we first test whether the two groups differ on demographics with a two-sided Chi-square statistic.
There are significantly more women (than expected) in the Mail Group ($p = .005$); and evidently significantly more men (than expected) in the CASI Group.
There is also a significant difference in age for the two groups ($p < .001$). The respondents in Mail are older than expected. To be more precise, there are more than expected respondents in the categories 55-64 and 65+. In the CASI Group there are more respondent in the categories 18-24, 25-34, 35-44, and 45-54 than expected when the two groups do belong to the same population.
Also a significant difference is found in education ($p < .001$), where education is split up into three categories, namely low (i.e., in Dutch: “t/m mavo”), medium, and high. More than expected respondents of Mail are found in the low education category.
The size of the respondents’ household also differs significantly for the two groups ($p < .001$), which is measured by the number of people in the household. There are more singles than expected, based on randomness, in the Mail Group.
The two groups also came from different regions ($p = .001$). More respondents of the Mail Group live in the south of the Netherlands (and a bit more in the north) and more of the CASI Group live in the big cities and in the west (and a bit more in the east) of the Netherlands.
As can be expected from the way the samples were created, more than expected respondents of the CASI Group have internet.

Because the two groups differ in demographic features, we will investigate whether the difference in answers of the two groups are due to these features. We will test this for each ACE item. Since the answers to the ACE items are dichotomous, we carry out a logistic regression for each ACE item. The demographics and the group are the predictors of the model. We first use the demographics as the predictors. Subsequently, we add the group as a predictor. In case the difference can be explained by the demographic characteristics, adding the group to the model is not significant (in the by SPSS called "omnibus tests of model coefficients", which is a Chi-square test). This was the case for all ACE items, except for ACE item V15_05 ($p = .020$). In that model, the effect of the group was also significant ($p = .015$; tested with the Wald test).

We did the same analysis for the ACE categories and we got the same results. That is, adding the group to the model was not significant (in the omnibus tests of model coefficients) for all ACE categories, except for ACE3 ($p = .023$), which contains ACE item V15_05 (see Tale 1). In that model, the effect of the group was also significant ($p = .017$; tested with the Wald test).

To conclude, the differences in answers between the two groups are due to demographic features (like gender and region). Hence, the two groups can be seen to come from the same population. Therefore, we can safely combine the two groups in the analyses done and comparisons made in this study. The only exception is ACE item V15_05 (or ACE category ACE3). Hence, results including this ACE item must be dealt with carefully.

C Dutch and American prevalences per ACE item and per ACE category

Table C1: Dutch and American prevalences of the ACE items and ACE categories

ACE item	Percentages				
	NL				USA
subquestion:	a	b	c	total	total
1. Emotional Abuse	17.5	9.1		19.4	10.6
2. Physical Abuse	14.4	9.6		16.9	28.3
3. Sexual Abuse	10.3	4.4		10.3	20.7
4. Emotional Neglect	14.2	16.2		20.5	14.8
5. Physical Neglect	3.4	2.3		4.5	9.9
6. Parental Separation or Divorce				14.8	23.3
7. Mother treated violently	7.2	4.3	2.5	7.9	12.7
8. Household Substance Abuse				8.1	26.9
9. Household Mental Illness				9.7	19.4
10. Incarcerated Household Member				2	4.7

As can be seen from Table 1, subquestion 1a and 1b corresponds to ACE items V15_01 and V15_02, respectively. For the other subquestions, the analogue holds true.

Table C2 displays the combinations of ACE categories that are reported together by respondents with an ACE score of 2. There are 202 persons in the data set who have an ACE score of two. Table C2 gives the percentage of persons (out of the 202) that report a certain ACE category combination. Thus, when the ACE score is two, 15.7% of the persons report both an emotional abuse and physical abuse.

Table C2: Combinations of reported ACEs for an ACE score of 2

	1	2	3	4	5	6	7	8	9	10
1. Emotional Abuse	-	15.7	2.8	14.1	0.0	1.0	1.6	1.5	2.4	0.0
2. Physical Abuse		-	4.2	4.6	0.5	2.5	2.8	1.6	2.2	0.4
3. Sexual Abuse			-	5.7	0.6	2.8	0.0	1.3	4.0	0.0
4. Emotional Neglect				-	1.0	7.5	1.0	1.4	1.9	0.0
5. Physical Neglect					-	0.0	0.4	0.6	0.0	0.0
6. Parental Separation or Divorce						-	1.8	3.2	2.9	1.2
7. Mother treated violently							-	0.3	0.7	0.0
8. Household Substance Abuse								-	1.6	1.7
9. Household Mental Illness									-	0.3
10. Incarcerated Household Member										-

D D.1: The underlying structure of the ACE items and ACE categories

Assumption check
The *Kaiser-Meyer-Olkin (KMO) measure* confirmed that the sample was large enough for a reliable PCA. Namely, the overall KMO = .848 (see Table D1), which is labeled with "great". Furthermore, all the KMO values of the individual items are > .421 (these values are not presented in this paper).
The KMO of item V40_1 is .487 and that of item V40_2 is .422. For all the other ACE items, the KMO is greater than 0.5. The KMO values should be greater than 0.5 for all items, but this is mainly needed to identify problematic variables when the overall KMO is not sufficiently high.

Bartlett's test of sphericity (see Table D1; $\chi^2(136) = 11156.71$) is significant ($p < .001$), which implies that the correlations between the items are large enough for PCA.

Table D1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.848
Bartlett's Test of Sphericity	Approx. Chi-Square	11156.712
	df	136
	Sig.	.000

Results of the PCA
An initial analysis was carried out to obtain the eigenvalues of each component in the data (see the first four columns of Table D2). Table D2 shows that there are five components with an eigenvalue greater than one (Kaiser's (1960) criterion) and that in total almost 61% of the variance in the data is explained by these five components.

Interpretation
In a sequential analysis, the components are rotated such that the components can be interpreted in a more meaningful way. The items that load highly on a certain component measure together one construct.
The results of both the "varimax" and "direct oblimin" rotation techniques render the same constructs, which will be given later on. Table D3 displays the rotated component matrix for the varimax rotation. This presents which items load on which component (with absolute loadings greater than .4).

Table D2: Total variance explained

Com-ponent	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.112	30.072	30.072	3.017	17.745	17.745
2	1.584	9.317	39.389	2.405	14.145	31.891
3	1.429	8.404	47.793	1.840	10.821	42.712
4	1.183	6.958	54.751	1.655	9.733	52.444
5	1.045	6.148	60.899	1.437	8.455	60.899
6	.913	5.370	66.269			
7	.812	4.774	71.044			
8	.781	4.595	75.639			
9	.750	4.412	80.051			
10	.548	3.223	83.274			
11	.529	3.114	86.387			
12	.482	2.834	89.222			
13	.447	2.631	91.853			
14	.398	2.338	94.191			
15	.369	2.169	96.360			
16	.334	1.966	98.327			
17	.284	1.673	100.000			

Note. The extraction method is Principal Component Analysis (PCA).

From Table D2, we can conclude that there are five underlying dimensions, that is, five components. According to Table D3, the following can be concluded:

The ACE items belonging to component 1 are
15.01 (Emotional Abuse)
15.02 (Emotional Abuse)
15.03 (Physical Abuse)
15.04 (Physical Abuse)
15.07 (Emotional Neglect)
[15.08 (Emotional Neglect)]
Hence, a possible label for component 1 is *physical and emotional individual abuse*

The ACE items that load strongly on component 2 are
40.1 (Mother treated violently)
40.2 (Mother treated violently)
40.3 (Mother treated violently)
40.6 (Incarcerated Household Member)
Thus, a possible label for component 2 is *family member abuse*

The ACE items that cluster together on component 3 are
[15.07 (Emotional Neglect)]
15.08 (Emotional Neglect)
30 (Parental Separation or Divorce)
40.4 (Household Substance Abuse)
40.5 (Household Mental Illness)
So, a possible label for component 3 is *household issues*

The ACE items that belong to component 4 are
15.05 (Sexual Abuse)
15.06 (Sexual Abuse)
Thus, a possible label for component 4 is *sexual individual abuse*

The ACE items that load strongly on component 5 are
15.09 (Physical Neglect)
15.10 (Physical Neglect)
[40.4 (Household Substance Abuse)]
Hence, a possible label for component 5 is *physical neglect*

Table D3: Rotated component matrix (with absolute loadings greater than .4)

ACE items	Component				
	1	2	3	4	5
V15_03	.773				
V15_04	.728				
V15_01	.715				
V15_02	.669				
V15_07	.612		.417		
V40_2		.854			
V40_3		.798			
V40_1		.722			
V40_6		.447			
V30			.675		
V15_08	.466		.601		
V40_5			.529		
V40_4			.527		.479
V15_05				.877	
V15_06				.862	
V15_10					.850
V15_09					.598

Note. The extraction method is Principal Component Analysis (PCA). The rotation method is Varimax with Kaiser Normalization. Rotation converged in 7 iterations.

Conclusion

The assumptions of the PCA are not violated. So, the results of the PCA are reliable.
From the PCA it follows that the questionnaire contains five underlying dimensions. However, there is strong indication that there is one underlying dimension, since there is a strong first dimension, as can be seen in Table D2 and Figure D1. Namely, the first component (unrotated) explains 30% of the variation in the data. According to Zhu (2001), a component measuring more than 20% is said to be strong. Since the other components explain eminently less and because they explain more or less the same amount of variance, we can say that there is actually one (strong) dimension (Zhu, 2001). This supported by the (moderately) high loadings of the component matrix displayed in Table D4.
Thus, one could say that the questionnaire of Appendix 5.1 (i.e., the ACE items) measures one construct (i.e., one underlying dimension), in which five subscales can be defined.

We did the same analysis for the ACE categories. Also in this case, the assumptions of the PCA are not violated. From the PCA on the ACE categories it follows that the ACE categories consist of two components, which can be summarized as *individual abuse* and *family problems*. As was the case for the ACE items, the ACE categories have a strong first dimension and the loadings of the component matrix are (moderately) high (see Table D4). According to Zhu (2001), we can conclude that the ACE categories do measure one dimension which consists of two subscales.

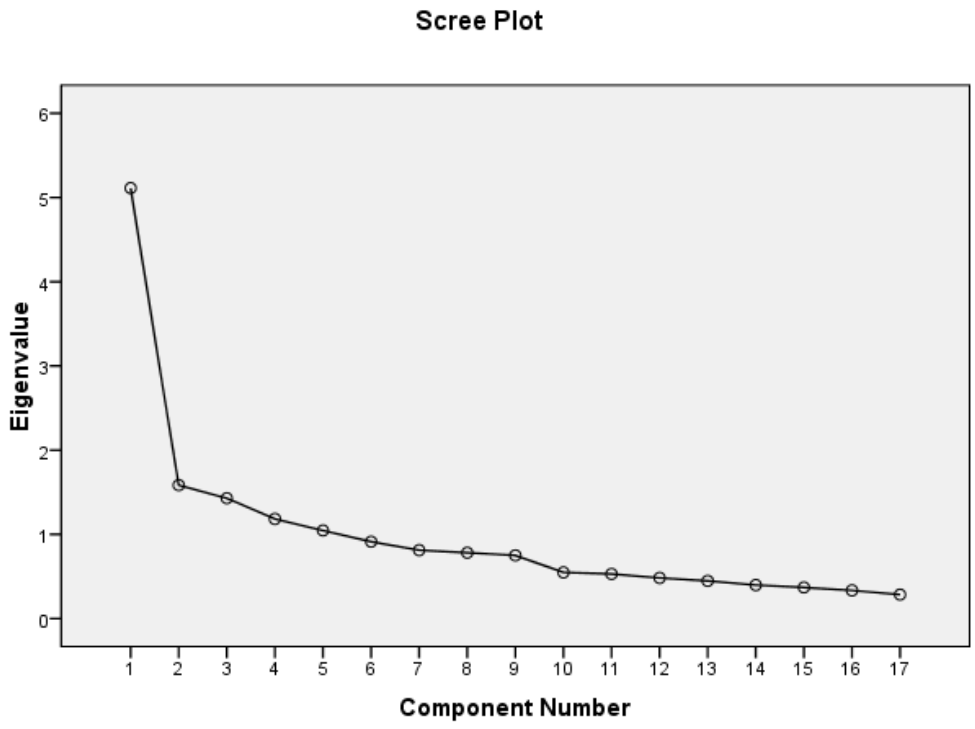

Figure D1: Scree plot

Table D4: Component matrix for one component

ACE category	subquestion:	a	b	c	Overall
1. Emotional Abuse		.701	.687		.749
2. Physical Abuse		.614	.600		.628
3. Sexual Abuse		.386	.416		.384
4. Emotional Neglect		.607	.651		.715
5. Physical Neglect		.497	.430		.555
6. Parental Separation or Divorce		.412			.497
7. Mother treated violently		.669	.617	.555	.633
8. Household Substance Abuse		.462			.542
9. Household Mental Illness		.439			.503
10. Incarcerated Household Member		.391			.408

Note. The extraction method is Principal Component Analysis (PCA). 1 component extracted.

D.2: The internal validity of the subscales

The questionnaire should reflect the construct it is measuring in a constant manner, that is, the scale should be reliable. Thus, individual items or sets of items should give results consistent with the overall questionnaire. This is also referred to as internal validity of the questionnaire, which can be quantified by Cronbach's alpha.

The Cronbach's alpha of the 17 ACE categories is equal to 0.84 and that of the 10 calculated ACE categories is 0.76. Values of 0.80 and higher are considered to be high and values lower than 0.70 low.
Note that using the ACE categories renders a higher internal validity than using the combined ACE categories. However, the higher Cronbach's alpha can also be due to the higher number of items. Namely, every extra item increases the Cronbach's alpha. therefore, we cannot conclude that the Dutch questionnaire has a higher internal validity.
According to the Spearman Brown Prophecy, this increase in Cronbach's alpha is to be expected based on the increase of number of items: multiplying the number of items with 1.7 (i.e., an increase from 10 to 17 items), in a questionnaire with a Cronbach's alpha of 0.76, renders a Cronbach's alpha of 0.84. This implies that there is no loss in information or loss in relationships by using the fewer items. Hence, one could use the ACE items as well as the ACE categories.

We also looked at the internal validity of the subscales.
We first investigated the five subscales based on the ACE categories. The Cronbach's alpha of the first component is high, that of the second component not low (namely around 0.75), and that of the other three low.
Next we inspected the two subscales based on the ACE categories. The Cronbach's alpha of the first component is high and that of the second component not low (namely, around 0.75).

E Differences between the Dutch and American prevalences

Table E1 presents in each cell 3 figures: the actual frequencies in the Dutch and American sample, the expected frequencies when both samples would come from one and the same population, and the actual percentage found. If the two samples would be from the same population, the difference between the actual and expected count would be rather small. Clearly this is not the case. Overall the differences cannot be explained by random differences, as is indicated by a p-value < .001 (tested with the Chi-square statistic). That means, the chance that the differences between the actual and expected counts would be as we found is less than 1 pro mille, if the two samples would come from the same population.

Table E1: Crosstabs of ACE score and country

ACE score		Country		Total
		Netherlands	USA	
0	Count	1220	6260	7480
	Expected Count	833.7	6646.3	7480.0
	% within country	56.1%	36.1%	38.3%
1	Count	374	4508	4882
	Expected Count	544.1	4337.9	4882.0
	% within country	17.2%	26.0%	25.0%
2	Count	202	2757	2959
	Expected Count	329.8	2629.2	2959.0
	% within country	9.3%	15.9%	15.2%
3	Count	135	1647	1782
	Expected Count	198.6	1583.4	1782.0
	% within country	6.2%	9.5%	9.1%
4 or higher	Count	244	2168	2412
	Expected Count	268.8	2143.2	2412.0
	% within country	11.2%	12.5%	12.4%
Total	Count	2175	17340	19515
	Expected Count	2175.0	17340.0	19515.0
	% within country	100.0%	100.0%	100.0%

To obtain more insight into the differences of the ACE scores between the two countries, we also tested the differences per ACE score (i.e. 0, 1, 2, 3, or '4 or higher') with the Chi-square statistic. Because of multiple testing, which inflates the error I type (i.e., incorrectly rejecting the null hypothesis), we will adjust the nominal alpha level

with the Bonferroni correction. Since we carry out five tests, we will use a nominal alpha level of $1 - (1 - .05)^{1/5} \approx .01$ instead of .05.
The prevalences of each ACE score differs significantly between the Netherlands and America except for an ACE score of 4 or higher ($p < .001$ for the ACE scores 0, 1, 2, and 3 and $p = .092$ for the ACE score '4 or higher').
For example, (see Table E2) there are more Dutch respondents with an ACE score of zero than expected when there was no difference between the countries, that is, when they would belong to the same population. For ACE scores of 1, 2, and 3, there are fewer Dutch respondents than expected (not shown here, but can be deduced from Table E1).

Table E2: Crosstab of 'the ACE score is zero or not' and country (i.e.. the Netherlands (NL)or America (USA))

		Country		
		NL	USA	Total
ACE score >= 1	Count	955	11080	12035
	Expected Count	1341.3	10693.7	12035.0
	% within country	43.9%	63.9%	61.7%
ACE score = 0	Count	1220	6260	7480
	Expected Count	833.7	6646.3	7480.0
	% within country	56.1%	36.1%	38.3%
Total	Count	2175	17340	19515
	Expected Count	2175.0	17340.0	19515.0
	% within country	100.0%	100.0%	100.0%

F The relation between the ACE scores and the demographic features

The relation between the ACE scores and the demographic features could be investigated by a t-test, an analysis of variance (ANOVA) model, or a regression model. One assumption that has to be met is the normality assumption. Consequently, we tested whether ACE is (conditionally on the demographic features) normally distributed. Since this was not the case, we also investigated transformations of ACE (namely, ACE^2, log(ACE+1), exp(ACE), 1/ACE). However, these are also not normally distributed (conditionally on the demographic features). This can be due to the high number of zero scores, but also to the fact that the variable ACE consists of discrete values. Therefore, we will examine the relation between the ACE score and the demographic characteristics via non-parametric methods.
When we compare two independent samples (like for gender), we use the Mann-Whitney test and, when we compare more than two independent samples (like in the case of age), we use the Kruskal-Wallis test (see also Table 5).

The difference in ACE score for gender (see Table F1) is significant ($p < .001$).
It may be concluded that women have a higher ACE score than men.

Table F1: Descriptive statistics of the ACE score for gender

Statistic	Gender	
	male	female
Mean	.9280	1.3226
Median	.0000	.0000
Minimum	0	0
Maximum	9	10

The difference in ACE score between the various age categories (see Table F2) is significant ($p = .003$).

Table F2 Descriptive statistics of the ACE score for age

Statistic	Age					
	18-24	25-34	35-44	45-54	55-64	65+
Mean	.8044	1.1983	1.3385	1.1121	1.2485	.9112
Median	.0000	.0000	.0000	.0000	.0000	.0000
Minimum	0	0	0	0	0	0
Maximum	8	9	9	10	8	9

To examine which age categories differ from each other, we conducted a post-hoc test. Since the categories of age are ordinal (i.e., the persons in the first category are younger than in the second, et cetera), we only tested whether the difference in ACE score between two sequential categories are significant. Since each time we examine two independent samples, we use the Mann-Whitney test. Multiple testing inflates the Type I error (i.e., the error of incorrectly rejecting the null hypothesis ‘there is no

difference'), therefore, we will use a Bonferroni correction. Since we conduct five tests, we will use a nominal alpha level of $1 - (1 - .05)^{1/5} \approx .01$ instead of .05.
The differences in ACE score between the categories 55-64 and 65+ are significant (p = .004) and the differences between the other sequential categories are not (p = .015 , p = .700, p = .301, and p = .398, respectively).

The difference in ACE for having access to internet or not (see Table F3) is significant (p = .006).
It may be concluded that persons with internet have a higher ACE score than persons without internet.

Table F3: Descriptive statistics of the ACE score for having internet or not

Statistic	Internet	
	Yes	No
Mean	1.1381	1.0319
Median	.0000	.0000
Minimum	0	0
Maximum	10	8

The difference in ACE for region (see Table F4) is significant (p = .022).

Table F4: Descriptive statistics of the ACE score for region

Statistic	Region				
	Big cities	West	North	East	South
Mean	1.2904	1.0891	.9253	1.0815	1.2040
Median	0.0000	.0000	.0000	.0000	.0000
Minimum	0	0	0	0	0
Maximum	9	10	8	8	10

To examine which regions differences from each other, we carried out a post-hoc test. Since the categories of region are nominal (i.e., the categories are just labels), we tested the difference in the ACE score for all possible pairs of categories with the Mann-Whitney test (with the nominal alpha level equal to $1 - (1 - .05)^{1/10} \approx .005$). The p-values of the ten pairwise tests are given in Table F5.

Table F5: p-values

	Region				
	Big cities	West	North	East	South
Big cities	-	.179	.001	.164	.334
West		-	.010	.905	.725
North			-	.019	.007
East				-	.642
South					-

From Table F5 it follows that the difference in ACE score between the North and the big cities of the Netherlands is significant (p = .001) and the differences for all the other combinations are not (p > .005).

The difference in ACE for education (see Table F6) is significant (p = .001).

*Table F6: Descriptive statistics of the ACE score for ed*ucation

Statistic	Education		
	low	medium	high
Mean	1.2241	1.2018	.8838
Median	.0000	.0000	.0000
Minimum	0	0	0
Maximum	9	10	8

To investigate in which education categories the differences are, we did a post-hoc test. Since the categories of education are ordinal, we only tested whether the difference in ACE score between two sequential categories are significant. This is done with the Mann-Withney test at a alpha level of $1 - (1 - .05)^{1/2} \approx .025$.
The difference in ACE between lower and medium education is not significant (p = .986) and between medium and high education is (p = .001).

The difference in ACE for size of household (see Table F7) is not significant (p = .184). Note that there are only a few people for which the household consists of 8 or more persons.

Table F7: Descriptive statistics of the ACE score for size of household

Statistic	Size of household							
	1	2	3	4	5	6	7	8
Mean	1.2484	1.0976	1.1250	0.9813	1.1377	1.6795	2.3072	.3137
Median	.0000	.0000	.0000	.0000	.0000	.0000	1.0000	.0000
Minimum	0	0	0	0	0	0	0	0
Maximum	10	8	8	8	8	9	8	1

G Logistic regression of demographic characteristics on 'ACE score is zero or greater than zero'

The results of the logistic regression of the demographic features on the variable indicating whether the ACE score is greater than zero or zero (labeled as ACE_0) are shown in Table G1.
The B values in Table G1 represent the change in the logit of ACE_0 resulting from a unit change in the predictor, that is, demographic variable, where the logit of Y is the natural logarithm of the odds of Y occurring (i.e., ln{(P(Y)/[1-P(Y)]}). Since this is not insightful, we will look at the odds ratio later on.
The variables with a B coefficient marked with an * are the coefficients that are significantly different from zero (at a nominal alpha level of .05). This implies that that predictor is making a significant contribution to the prediction of ACE_0. For example, gender contributes significantly to explaining ACE_0.
The odds ratio, that is, exp(B), represents the change in odds (i.e., P(Y)/[1-P(Y)]). An odds ratio greater than one [smaller than one, respectively] indicates that as the predictor increases the odds of ACE_0 increases [decreases, respectively]. For example, the odds of having an ACE score higher than zero are 0.728 higher for men than those for women. Stated otherwise, the odds of having an ACE score higher than zero are 1/0.728≈1.374 higher for women than those for men.

The odds ratio is approximately equal to relative risk. For example, according to Table G1, men have approximately a 27.2% (=100%*[1-0.728]) reduction in reporting one or more adverse childhood experiences than women. Stated otherwise, woman have about a 37.4% increase (namely, a 100%*[1-1/0.728] reduction) in reporting one or more adverse childhood experiences than men.

Table G2 displays the classification table, a 2 x 2 table that contains the observed and predicted model results. The classification table is used for model quality evaluation. The estimated model (in Table G1) is used to classify each data point using the computed probability given by the model (see also Figure G1) and the so-called cut value. The cutvalue is the minimal value of probability that should be classified as 1. The default "cut value" value of 0.5 is used here. This implies that a data point that has a value larger than 0.5 should be classified as 1.
Here, the model in Table G1 predicts 58% of the cases correctly.

The predicted probabilities of all data points are given in Figure G1. Ideally, the probabilities are near zero and near one, which does not seem to be the case here. This implies that relevant variables for exploring ACE_0 are missing. However, we are interested (at this moment) in the difference in ACE_0 for the various demographics and not in explaining ACE_0.

Table G1: logistic regression of the demographic features on ACE_0 (i.e., the ACE score is zero (0) or higher than zero (1))

	B	S.E.	Wald	df	Sig. (p-value)	Exp(B)	95.0% C.I.[1] for EXP(B) Lower	Upper
Constant	-.443	.296	2.246	1	.134	.642		
Gender (male vs female)	-.317*	.089	12.757	1	.000	.728	.612	.867
Age	-.026	.032	.688	1	.407	.974	.915	1.037
Internet (yes vs no)	.425*	.178	5.711	1	.017	1.530	1.079	2.167
Region			7.991	4	.092			
Region (big cities vs south)	.130	.144	.807	1	.369	1.138	.858	1.510
Region (west cities vs south)	.003	.122	.001	1	.978	1.003	.790	1.275
Region (north cities vs south)	-.368*	.168	4.791	1	.029	.692	.498	.962
Region (east cities vs south)	-.023	.132	.029	1	.864	.978	.755	1.267
Education			16.967	2	.000			
Education (low vs high)	.475*	.123	14.966	1	.000	1.607	1.264	2.044
Education (medium vs high)	.391*	.113	11.897	1	.001	1.479	1.184	1.847
Size household	-.083*	.036	5.340	1	.021	.921	.858	.988

[1] *C.I. is a acronym for confidence interval.*

Note: R^2 = .022 (Cox & Snell), .030 (Nagelkerke). Model $\chi^2(8) = 10.815$, $p = .212$

** $p < .05$*

Table G2: Classification table

Observed	Predicted (0) ACE score = 0	(1) ACE score >= 1	Percentage Correct
ACE score = 0	964	230	80.7
ACE score >= 1	664	272	29.0
Overall Percentage			58.0

Note. The cut value is .500

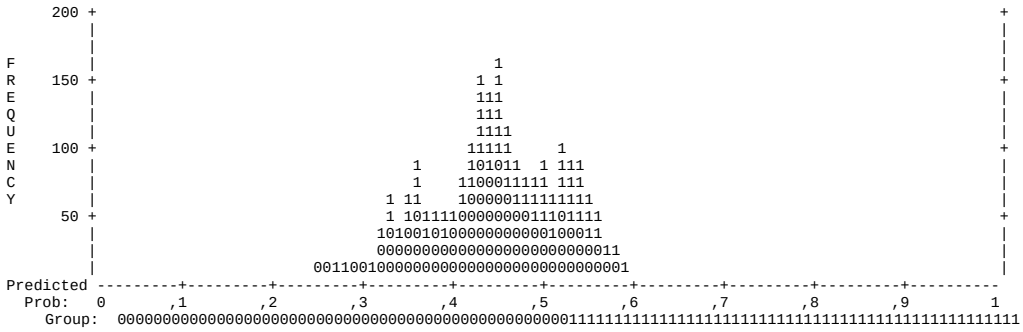

Figure G1: Observed Groups and Predicted Probabilities

H H.1: Definitions of Felitti

Table H1: The definitions of the health problems (risk factors and disease conditions) used by Felitti et al (1998)

Health problem	Definition
risk factors:	
smoking	Current smoker
severe obesity	BMI >= 35
physical inactivity	No participation in recreational physical activity in the past month
depressed mood	Two or more weeks of depressed mood in the last year
alcoholism	A “yes” response to the question “Have you ever considered yourself to be an alcoholic”
any drug abuse	ever used illicit drugs
disease conditions:	
any cancer	Had any cancer
stroke	Had any stroke
chronic bronchitis or emphysema (COPD)	Had chronic bronchitis or emphysema
diabetes	Had diabetes
hepatitis or jaundice	Had hepatitis or jaundice

H.2: Definitions used in this study

The RIVM directed us to the "nationaal kompas volksgezondheid" (www.nationaalkompas.nl), where we found the following prevalences and definitions.

Table H1: The definitions of the health problems (risk factors and disease conditions)used in this study and their prevalences

Health problem	Definition	Preva-lence
risk factors:		
smoking	Persons, older than 15, who smoked daily in 2008	27.0
severe obesity	Persons, older than 20, who had a BMI >= 30 in 2009	12.0
physical inactivity	Persons, older than 18 and younger than 55, who did not fit the 'combinorm' in 2007	42.0
depressed mood	Persons, older than 18 and younger than 65, who had "mood swings" in 2007	6.2
alcoholism	Persons, older than 12, who drunk more than five glasses containing alcohol at least once a week in 2007	10.7
any drug abuse	ever used cannabis	17.0
disease conditions:		
any cancer	not analyzed; see below	
stroke	Had stroke in 2003	1.3
chronic bronchitis or emphysema (COPD)	Had chronic bronchitis or emphysema	2.0
diabetes	Had diabetes mellitus	4.1
hepatitis or jaundice	Had hepatitis B (in 2006)	-

Remarks

Ad. Severe obesity.

In 2009, 11.2% of the men and 12.4% of the women (older than 20) had a BMI greater than or equal to 30. As a consequence, we used an overall percentage of 12%.

Note that these data come from self-reported data about length and weight. Hence, there is a reasonable change that the BMIs are underestimated.

Ad. Physical inactivity.

The 'combinorm' implies that a person either satisfies the 'Norm Gezond Bewegen (NNGB)' or the 'fitnorm'. The 'fitnorm' indicates that a person exercised intensively at least 3 times a week during 20 minutes.

Ad. Any drug abuse / cannabis use.
We did not use prevalences of hard drugs, since these are often underestimated and since these are not easily obtained.

Ad. Any cancer.
Prevalences of various types of cancer are reported by CBS. Since these are reported for different populations in different years, we could not combine them to the prevalence of 'any cancer'. Therefore we could not use these numbers in the analysis.

Ad. Stroke.
The number of people who had a stroke in 2003 was 216,500: 106,900 (=1.3%) men and 109,600 (=1.3%) women. Consequently, we used 1.3%.

Ad. Chronic bronchitis or emphysema (COPD).
It is reported that in 2003 the prevalence of COPD for women is 2.2% and that for men 1.7%, therefore, we used 2.0%.

Ad. Diabetes mellitus.
In 2007, the prevalences for diabetes mellitus are 4.0% for men and 4.2% for women. Hence, we used 4.1%.
About 90% of the persons with diabetis has type 2, all the other have type 1.

Ad. Hepatitis B.
In 2006, 1,772 persons with hepatitis B are reported. Therefore, we did not examine hepatitis B.

H.3: Formulas

Based on the definition of the odds ratio (referred to as OR), the number of people with ACE score i and health problem r (referred to as N_ri) can be calculated by

$$N\_ri = N\_i / \{(N\_0 - N\_r0)/(OR\_ri*N\_r0) + 1\},$$

where N_i is the number of people who have an ACE score of i and OR_ri is the odds ratio for people with ACE score i and health problem r. Note that N_0 is the number of people who did not report any ACE and N_r0 the number of people who did not report any ACE and have health problem r.

Notably, to determine N_ri we must know N_r0 which is actually unknown. Consequently, we will first use a starting value for N_r0 and then determine N_r0 (based on trial and error) via another formula, as is discussed next.
First, we calculate N_ri, for i = 1, 2, 3, 4+, with N_r0 = 1.
Since the sum of all N_ri's is equal to the number of times health problem r occurs (referred to as N_r; see Table H3), we can determine N_r0 (with trial and error) next. Finally, all the N_ri's can be determined based on the real N_r0 value.

The figures in Table H1 are the prevalences in counts instead of percentages. Thus, the figures are equal to the prevalences in percentages times the sample size of 2,175.
Table H3 summarizes the Dutch prevalences as discussed in Appendix H.2, also here the counts are obtained by multiplying the percentages by 2,175.
Table H4 displays the number of persons (of the 2,175 of the Dutch sample) who have a certain ACE score and a certain health problem (according to the Dutch health problem prevalences and the American odds ratios).
To make these figures more insightful, we transformed them into percentages. We did this three times: once in Table H5 with respect to the sample size of 2,175, once in Table H6 with respect to the number of persons with a certain ACE score (see Table H1), and once in Table H7 with respect to the number of persons who have a certain health problem (see table H3).

Table H1: Number of persons with a certain ACE score

ACE score (i)	N_i
0	1220
1	374
2	202
3	135
4 or higher ('>=4')	244
Total	2175

Table H2: Adjusted odds ratio of Felitti et al (1998) for a certain ACE score and a certain health problem

ACE score	Risk factors						Disease conditions		
	smoking	severe obesity	physical inactivity	depressed mood	Alcohol-lism	cannabis use	stroke	COPD	diabetes
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1	1.1	1.1	1.2	1.5	2.0	1.7	0.9	1.6	1.0
2	1.5	1.4	1.2	2.4	4.0	2.9	0.7	1.6	0.9
3	2.0	1.4	1.4	2.6	4.9	3.6	1.3	2.2	1.2
>= 4	2.2	1.6	1.3	4.6	7.4	4.7	2.4	3.9	1.6

Table H3: Dutch prevalence of health problems (risk factors and disease conditions)

Risk factors						Disease conditions		
smoking	severe obesity	physical inactivity	depressed mood	Alcohol-lism	cannabis use	stroke	COPD	diabetes
Percentage								
27	12	42	6.2	10.7	17	1.3	2	4.1
Count (= N_r)								
587	261	914	135	233	370	28	44	89

Table H4: Number of people with a certain ACE score and a certain health problem (= N_ri)

ACE score	Risk factors						Disease conditions		
	smoking	severe obesity	physical inactivity	depressed mood	Alcohol-lism	cannabis use	stroke	COPD	diabetes
0	283	130	483	46	63	129	14	16	47
1	93	43	165	21	36	62	4	8	14
2	63	29	89	17	36	51	2	4	7
3	51	19	65	13	28	40	2	4	6
>= 4	97	39	112	38	70	87	7	12	15
Total	587	260	914	135	233	369	29	44	89

Table H5: Percentage of people with a certain ACE score and a certain health problem with respect to the sample size of 2,175

ACE score	Risk factors						Disease conditions		
	smoking	severe obesity	physical inactivity	depressed mood	Alcohol-lism	cannabis use	stroke	COPD	diabetes
0	13.01	5.98	22.21	2.11	2.90	5.93	0.64	0.74	2.16
1	4.28	1.98	7.59	0.97	1.66	2.85	0.18	0.37	0.64
2	2.90	1.33	4.09	0.78	1.66	2.34	0.09	0.18	0.32
3	2.34	0.87	2.99	0.60	1.29	1.84	0.09	0.18	0.28
>= 4	4.46	1.79	5.15	1.75	3.22	4.00	0.32	0.55	0.69
Total	26.99	11.95	42.02	6.21	10.71	16.97	1.30	2.00	4.10

Table H6: Percentage of people with a certain ACE score and a certain health problem with respect to N_i (see Table H1)

ACE score	Risk factors						Disease conditions		
	smoking	severe obesity	physical inactivity	depressed mood	Alcohol-lism	cannabis use	stroke	COPD	diabetes
0	23.20	10.66	39.59	3.77	5.16	10.57	1.15	1.31	3.85
1	24.87	11.50	44.12	5.61	9.63	16.58	1.07	2.14	3.74
2	31.19	14.36	44.06	8.42	17.82	25.25	0.99	1.98	3.47
3	37.78	14.07	48.15	9.63	20.74	29.63	1.48	2.96	4.44
>= 4	39.75	15.98	45.90	15.57	28.69	35.66	2.87	4.92	6.15
Reference	27.00	12.00	42.01	6.20	10.70	17.01	1.30	2.00	4.10

Table H7: Percentage of people with a certain ACE score and a certain health problem with respect to N_r (see Table H3)

ACE score	Risk factors						Disease conditions		
	smoking	severe obesity	physical inactivity	depressed mood	Alcohol -lism	cannabis use	stroke	COPD	diabetes
0	48.21	50.00	52.84	34.07	27.04	34.96	48.28	36.36	52.81
1	15.84	16.54	18.05	15.56	15.45	16.80	13.79	18.18	15.73
2	10.73	11.15	9.74	12.59	15.45	13.82	6.90	9.09	7.87
3	8.69	7.31	7.11	9.63	12.02	10.84	6.90	9.09	6.74
>= 4	16.52	15.00	12.25	28.15	30.04	23.58	24.14	27.27	16.85

Table H6 summarizes the disease burden in the Netherlands relative to the number of persons with a certain ACE score.
If our assumptions are valid, it would mean that 39.75% of the persons with an ACE score of 4 or higher smoke, while the overall prevalence is 27%. Similarly, 15.57% of the people with an ACE score of 4 or higher have a depressed mood, whereas the overall prevalence is 6.2%. The analogue holds true for the other health problems.

Table H7 summarizes the disease burden in the Netherlands relative to the number of persons with a certain health problem. On other words, it presents the proportion of persons with a certain health problem that belong to the ACE score categories of 0 to '4 or higher'.
The effect of ACE is the biggest for depressed mood and alcoholism. For example, 28.15% of the persons who have a depressed mood have an ACE score of 4 or higher.
This might indicate, assuming a causal relation, that when the adverse childhood experiences were treated there would be far less persons with a depressed mood or persons who are alcoholic.

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