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Intelligence and temperament as protective factors for mental health. A cross-sectional and prospective epidemiological study

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Abstract The Sjöbring system of personality dimensions measuring intellectual capacity, activity, impulsivity and sociability was used to study possible “salutogenic” (i.e. causes of health) effects. The study comprised 590 subjects investigated in 1947, 1957, 1972 and 1988–1989 in the Lundby project, an epidemiological study in Sweden. Psychiatric diagnoses were made in 1947, 1957 and 1972. Mental health was estimated in 1988–1989 using the concept “love well, work well, play well and expect well”. The Sjöbring dimensions were clinically assessed in 1972. Both in the concurrent study in 1972 and in the prospective study in 1988–1989 “super capacity” (high intellectual function), “super validity” (high activity level) and “super solidity” (low impulsivity) were statistically associated with lower frequencies of certain psychiatric diagnoses and a higher frequency of positive mental health. These variables are proposed to increase coping capacity, and therefore increase stress resilience.

Key words Lundby study · “Salutogenic” · Temperament · Mental health · Intelligence

Introduction

This paper presents one part of an extensive, prospective, longitudinal and cross-sectional population study on mental health in early and late adult life investigating different possible “salutogenic” (i.e. causes of health) factors (Antonovsky 1987). In research reports on stress resilience in children who have grown up under adverse conditions, the various factors proposed as promoting resilience can

be divided into two categories, individual dispositions and environmental factors. This paper deals with individual factors. Young subjects who were resilient have been described by different authors as co-operative and socially open, with a kind and calm behaviour (Rutter 1979; Garmezy and Rutter 1983; Garmezy 1981). Werner (1989), studying children in Kauai, described those who were resilient in high-risk environments as good-natured with an affectionate disposition, responsive to people and positive in social orientation. Several authors have considered intelligence as a protective factor (Garmezy 1981; Offord 1974; White 1985; Anthony 1974). Good impulse control has also been mentioned (Garmezy 1981; Werner 1989). Werner also noted that a high activity level was a protective factor.

These behaviours, apart from intelligence, could be labelled temperamental dispositions. When reviewing the works of different researchers on temperament, the previously mentioned resilience factors reappear in the description of various temperament dimensions (Table 1). Most research on temperament has been focused on dispositions increasing the risk of behaviour problems. The systematic studies that have been made on temperament variables as protective factors (Rutter 1979; Werner 1989; Wertlieb et al. 1987) have used the “easy child” concept according to Thomas and Chess (Thomas et al. 1968; Thomas and Chess 1977). This concept is characterized by a moderately low activity level, a high level of adaptability and low reactivity to emotional arousal. Buss and Plomin (1984) developed a different system of measuring temperament, which they consider to be highly genetically based. They described an “easy child” as a child with a moderately high activity level, low emotionality (i.e. low arousal to emotional stimuli) and high sociability. Both these groups of researchers have studied mainly children and adolescents. Cloninger (Cloninger et al. 1988, 1991) has developed a model of temperament integrating concepts of the neuroanatomical and neurophysiological underpinnings of behavioural tendencies, styles of learning and adaptation. His concepts consist of harm avoidance, reward dependency and novelty seeking. Recently,

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Table 1 Comparisons of "salutogenic" factors from studies on stress resilience and characteristics of the "easy child" or "optimal character development" from different models of temperament as well as certain concepts of the Sjöbring model of temperaments

"Salutogenic" factors	Socially open, cooperative, affectionate	Persistence, good impulse-control, kind behaviour	High activity level, high energy level	Intelligence
Thomas and Chess (1977)	High level of adaptation (in social interaction)	Low reaction to emotional arousal; low distractability	Moderately low activity level	
Buss and Plomin (1984)	High sociability	Low emotionality (low arousal to emotional stimuli)	Moderately high activity level (energy)	
Cloninger et al. (1988, 1991–1993)	High reward dependency	Moderately low harm avoidance, low impulsivity, high persistence	High exploratory activity	
Sjöbring (1973)	Sub-stability	Super-validity, super-solidity	Super-validity	Super-capacity

Cloninger (Cloninger et al. 1992, 1993) has added a fourth factor: persistence. Cloninger has suggested that "optimal character development" is facilitated by a combination of temperaments characterized by moderately low harm avoidance, high reward dependency and persistence, and, as far as the dimension of novelty-seeking was concerned, high exploratory activity but low impulsivity.

In the present study the subjects were rated according to the Sjöbring system of personality dimensions (Sjöbring 1973; Essen-Möller 1980; Nyman 1956) during investigations in 1957 and 1972. This system, which also measures temperament, was widely used in Sweden at that time. It has many similarities to Cloninger's model, although the latter is more elaborate. The Sjöbring model consists of four dimensions measuring degrees of the described phenomena from low to high. The first dimension, *capacity*, describes a level of general intelligence, where "sub-capacity" means low intellectual capacity and "super-capacity" means high intellectual capacity. The second dimension, *validity*, describes the level of energy where the "sub-valid" person (i.e. low energy level) is characterized as cautious, careful, often tense, uncertain and hesitant. The "super-valid" person (i.e. high energy level), is active, self-assured, energetic, effective, enterprising, full of initiative, persevering and tenacious. The third dimension, *solidity*, measures degrees of flexibility. A "sub-solid" person (i.e. extreme level of flexibility), is characterized as lively and agile, impulsive, superficial, needing novelty and avoiding monotony. The "super-solid" person (i.e. low level of flexibility) is characterized as being reliable, balanced, consistent and persistent with good impulse control. The fourth dimension, *stability*, describes the emotional and social disposition of the individual. The "sub-stable" person is described as being warm as well as sensitive to interpersonal relations, with an interest and capacity for social interaction, and with a good capacity for empathy and sympathy. The "super-stable" person, on the other hand, is more interested in abstract and theoretical subjects than in human relations, with a lower level of empathy and a more cool and detached interaction style. These dimensions were approximately normally distributed (Essen-Möller et al. 1956).

Sub-varieties were assumed to be vulnerable to psychiatric maladaptation and stress reactions. Only the "super-valid" individual was proposed to be particularly stress-

resilient. Previous studies testing the hypothesis of sub-varietis being more prone to psychiatric maladaptation gave some confirmation of the theory. The "sub-solid" and "sub-valid" individuals seemed to have a slightly heightened risk for various psychiatric syndromes (Essen-Möller et al. 1956; Hagnell 1966; Essen-Möller and Hagnell 1975; Essen-Möller 1986). The possibility that some of these temperamental variations could be protective factors was only recently investigated (Hagnell et al. 1986, 1992).

In this study we propose that some of the extreme positions of the temperament variables function as protective factors, rather than those in the middle range: "Those in the middle range are most likely to be influenced by the environment while the extremes will be most likely to seek a different environment or set out to change the social environment." (Buss and Plomin 1984, page 88).

The aim of this sub-study on personal dispositions was to test hypotheses about certain temperamental dispositions and intelligence, measured by the Sjöbring system, as "salutogenic" factors in individuals who had grown up in high- and low-risk environments determined by the number of child psychiatric risk factors during childhood. Our hypotheses were that "super-capacity" (high intelligence), "super-validity" (high activity and energy level), "super-solidity" (good impulse control and persistence) and "sub-stability" (high sociability) are salutogenic factors for individuals who have grown up as children both in high- and low-risk environments for psychiatric malfunctioning.

Materials and methods

The population used in the present study (590 persons; 292 men and 298 women) were born between July 1, 1932 and June 30, 1947, i.e. were between 0 and 15 years of age at the time the original data were obtained (Hagnell 1966; Hagnell et al. 1990; Table 2). They were the children in the Lundby project, a longitudinal, psychiatric epidemiological study, which originated in 1947. The first Lundby study included all of the 2550 inhabitants of a geographically defined area incorporating two adjoining parishes in southern Sweden on July 1, 1947 (Essen-Möller et al. 1956). In 1957 and 1972 all of these individuals were examined again, regardless of domicile. On all three occasions, experienced psychiatrists made home visits and collected the basic information through personal examinations consisting of a semi-structured interview together with a careful description of the probands' behaviour, per-

Table 2 Time-line

1947	Start of the Lundby study with 2550 subjects (590 children, 0–15 years of age). Children were not psychiatrically assessed or rated according to the Sjöbring system.
1957	"Children" above 15 years of age were psychiatrically assessed and rated according to the Sjöbring system
1972	All who were children in 1947 were psychiatrically assessed and rated according to the Sjöbring system
1988–1989	Follow-up of the subjects (0–15 years of age in 1947) who had three or more childhood risk factors (210 subjects)

sonality traits and social environment. All three examinations were carried out in the same way and under comparable circumstances, and the drop-out rate was kept at a minimum (1–2%). Although the interviews were wide-ranging, a core of information was consistently obtained, making the interview protocols a rich source of data on personality, physical illness, mental health and problems of living. The investigators diagnosed the individual's mental state using information from the personal examination and from supplementary sources such as key informants and various registers, e.g. hospital, social insurance and temperance board records and criminal registers. Because on each occasion the examiner was interested in describing Sjöbring's normal mental variants as well as the pathological variants and other mental traits, every proband, healthy or sick, was of equal interest. Every individual was thus assessed according to the Sjöbring system of personality dimensions using the traditional Sjöbring method in which the Lundby investigators had been thoroughly trained for many years.

Only in the 1972 field study were all of the 590 probands of the present study considered old enough (over 15 years of age) for an assessment of personality traits and the Sjöbring variants. Each of the four dimensions was rated on a seven-point scale with verbal descriptions of the extreme manifestations. No undue weight was to be laid on a single word, the descriptions serving only as leads for a "Gestalt" view of the particular variable. A rating was arrived at by the subject's report complemented by behavioural observations during the interviews. The stability (product-moment correlation) of Sjöbring's temperament scales from 1957 to 1972 were for capacity $r = 0.64$, validity $r = 0.35$, solidity $r = 0.29$ and stability $r = 0.42$.

In 1988, the 1947 and 1957 records of these persons were reviewed in a study designed to identify childhood psychiatric risk factors. A review of the literature led to the specification of 40 variables, about which data were available in our records on childhood (Dahlin and Cederblad 1986). These were, among others, psychiatric illness in the father or mother, including criminality and alcoholism, somatic illness or a low intelligence quotient (IQ) in either of the parents, separation due to the death of one of the parents or divorce or separation from home for other reasons, poor socio-economic conditions, five or more children, and family problems such as parental discord, abuse, promiscuity or a poor intra-familial relationship. A cut-off point of three or more childhood psychiatric risk factors was set. Although this was somewhat arbitrary, and the data indicated that there was a significant association between childhood risk factors and mental disturbance in adulthood when a cut-off point of two or more risk factors was used (Cederblad et al. 1988), we chose to take a more conservative position. Although one could argue that these disparate risk factors cannot be treated as if they were equal, Rutter (1979) showed that a simple addition of such factors explained an increased rate of childhood behaviour problems. In his studies two and three factors increased the risk four times, whereas four or more risk factors increased the rate of psychiatric disturbance during childhood ten times (Rutter et al. 1975 a, b). Of the 590 children in the 1947 study, the records showed that 210 (35%) had been subject to three or more risk factors during childhood. These children constituted the total initial population of the present prospective study. In 1988–1989, attempts were made to reach these 210 persons; 15

had died, 10 were too severely ill or handicapped to be interviewed and 4 had emigrated, leaving 181 potential respondents. Successful interviews were completed with 140 of them (77%). Of the others, 18 did not respond to letters and could not be reached by telephone, and 23 refused to participate. Reliable data could be obtained on the psychiatric morbidity, alcohol abuse and criminal convictions from various records on 29 of the drop-outs. The mental health could therefore be rated for 177 subjects (84% of the total risk group). There was also a small internal drop-out on separate variables, due to missing data, which is shown in the tables.

In 1972 the DSM-III system had not been developed. In order to circumvent the diagnostic problems as much as possible, and to be able to compare this study with others, exhaustive care was taken in describing the cases (Hagnell 1966; Hagnell et al. 1990). We tried to make the descriptions so carefully that it would be possible to re-evaluate the cases decades later (which has been possible). The aggregated similar cases were given a "head-word diagnosis". These were used as syndrome diagnoses. For psychiatric impairment, we have adapted the system used in the Stirling County Study (Leighton et al. 1963, 1971). In this study the 26 diagnoses given after the psychiatric examination in 1972 were broken down into six broader categories: psychoses, psychopathy, neuroses, depression, psychosomatic disorders and alcoholism.

Whereas the previous phases of the Lundby study were epidemiological prevalence and incidence studies of mental illness, the study in 1988–1989 was intended to assess "salutogenic" factors in those subjects who were children in 1947, and who could be considered at risk for mental illness. We believed that it would be more profitable to study protective and stress-resiliency factors in a risk sub-group, rather than in the whole population of the study. This required an entirely new approach using different ways of measuring positive mental health. This was assessed by a new group of researchers who were unaware of the results of the 1972 study.

A total of 146 subjects filled in the Symptom Check List (SCL-90; Derogatis et al. 1977), a widely used measure that contains a series of 90 items referring to expressions of psychosomatic and emotional distress. A low score on this questionnaire was considered to be an indication of "good mental health". Cronbach's alpha was 0.79. The product-moment correlation coefficients with Luborsky's Health-Sickness Rating Scale (HSRS) was 0.52.

A total of 148 subjects also filled in a Quality of Life (QOL) scale (Kajandi et al. 1983), which measured satisfaction in different areas of life: material conditions (e.g. work, housing), interpersonal relations (e.g. spouse and children, friends and parents) and inner feelings (e.g. energy, self-image, mood). Cronbach's alpha was 0.89. The product-moment correlation coefficient with HSRS was 0.50, and with SCL-90 it was 0.64.

Based on the in-depth interview, two raters made a consensus assessment of the level of mental and somatic health using a definition by Werner and Smith (1982), who defined health as "worked well, played well, loved well and expected well". The score was made without any knowledge of how the respondent had answered on the self-reporting questionnaires (Dahlin et al. 1990). A five-point "rated health" global scale was constructed. A person rated to have "excellent health" should have reported only trifling psychiatric, psychosomatic or somatic disease symptoms. The person should have also been holding a permanent job judged appropriate to his/her intellectual capacity and training. He/she should have been living in a satisfying marriage. If he/she had children, they should have been developing well. He/she should also have had some hobby or spare-time activity that he/she considered satisfying and stimulating, and he/she should have had an optimistic outlook on his/her future life. To be rated as "good health", a subject might have one negative deviation from the requirements for "excellent health". Our concept "rated health" was validated by calculating the product-moment correlation coefficients with the other health measurements. The correlation with HSRS was 0.68, with SCL-90, 0.55, and with QOL, 0.35, which we considered acceptable. The concepts covered partly the same and partly different aspects of health and mental health, and a moderately high correlation was therefore expected. One of us (KH) rated 10% of the in-

interviews independently. The inter-rater reliability was 0.82 (product-moment correlation).

All material collected at the time of the interview was also evaluated by another blind rater according to the HSRS (Luborsky 1975; Armelius et al. 1985; Armelius 1985). This scale measures mental health and social competence, but not somatic health. Of the interviews, 10% were rated independently by the Swedish researcher who introduced HSRS in Sweden. The inter-rater reliability was 0.88 (product-moment correlation).

Statistical methods

The Sjöbring dimensions have been divided by a cutting point as close as possible to one standard deviation above the mean for the dimension capacity, validity and solidity, and one standard deviation below the mean for stability (according to the hypotheses of "salutogenic" influence). For the different concepts of health (i.e. rated health, HSRS, SCL-90 and QOL) we used a cutting point as close as possible to "30% best health" depending on the distribution. Univariate statistical analyses were made using the χ^2 -test. Where the expected frequencies were small, Fisher's exact test was used. Multivariate analyses were made using logistical-regression analysis (Wilkinson et al. 1992).

Results

The cumulative frequencies of psychiatric diagnoses in the population from 1947 to 1972 showed that 31% had psychosomatic disorders. The most frequent other disorders were depression and neurosis (24% each) and alcoholism (10%). In the high-risk group compared with the low-risk group, the frequencies of alcoholism, psychopathy and psychosis were higher among men, whereas psychosomatic disorders and neurosis were more frequent among women. The diagnoses in 1947–1972 showed statistical associations with different childhood risk factors. Psychoses were diagnosed in subjects whose parents had been somatically ill. Subjects with the diagnosis of psychopathy were found to have experienced socio-economic disadvantage, separation from parents and psychiatric disturbances or alcoholism in the parents. The neurotic subjects, and those diagnosed as depressed, had experienced socio-economic hardships as children. Alcoholics had experienced alcoholism in parents and separation, but they had also suffered socio-economic hardships (Cederblad et al. 1988). The Sjöbring variables in the total group in 1972 were approximately normally distributed. The raters seldom used the extreme values on the seven-point scale.

The distribution of the different health variables in the high-risk group in 1988–1989 showed that 58% had "average" health or better according to "rated health" whereas 66% had 80 or more on the HSRS scale, which corresponds to being free from symptoms, well functioning in all aspects and interested and engaged in a number of different activities. The SCL-90 had a mean of 25, which is substantially lower than the reported mean for several patient samples (Derogatis et al. 1973). No comparisons of the QOL index with data from other studies are available. However, the mean of 54, when 65 would show total, universal satisfaction, pointed to a contented population. (Cederblad et al. 1994).

Psychiatric diagnoses, intelligence and various temperaments in 1972

In Table 3 each potentially "salutogenic" factor and the frequencies of different psychiatric diagnoses are presented. The figures for the total group, the high-risk group (three or more childhood psychiatric risk factors) and the low-risk group are shown. All differences reported in the table were statistically significant. In the table we show, for example, that when "super-capacity" (i.e. high intelligence) was "present", 2 subjects (1%) in the total group were diagnosed as psychotic, and when "super-capacity" was "not present", 20 subjects (6%) had been given the diagnosis. The difference between those frequencies was statistically significant at $P < 0.001$. The same difference was found in the low-risk group. In the same way the frequency of psychopathy was lower in subjects rated "super-capable". The "super-valid" individuals (high activity level) in the total group and the low-risk group had a lower frequency of depression than the rest of the subjects. The "super-solid" individuals (i.e. low impulsivity, good self-control) in the whole group as well as in the low-risk group had a lower frequency of neuroses than the rest. Those who were "sub-stable" (i.e. high level of sociability) in the high-risk group had less alcohol problems. Individuals who were rated both "super-capable" and "super-valid" showed a lower frequency of depression in the low-risk group.

Individuals rated as "super-capable" and "super-solid" in the low-risk group were never diagnosed as alcoholics. Subjects rated "super-valid" and "super-solid" in the whole group and in the low-risk group had lower rates of depression. All groups showed lower rates of neuroses than those without these temperaments. Other combinations of temperaments, such as "sub-stability" with "super-capacity", "super-validity" or "super-solidity", did not show any statistical associations with the psychiatric diagnoses. Only two variables could be combined in each analysis, because there were too few subjects who had been rated as having three or four extreme temperaments.

The magnitude of the differences in the groups having a certain protective variable compared with the rest of the investigation group was considerable. The frequency of psychopathy, for example, was one-third in the group rated "super-capable". The same was true for those rated as both "super-valid" and "super-solid". The rate of neurosis was half in groups characterized by "super-solidity" alone and when this trait was combined with "super-validity". The rate of alcoholism was one-third in subjects rated "sub-stable" in the risk group. "Super-validity" alone and combined with "super-capacity" or "super-solidity" almost halved the rate of depression. The "salutogenic" effect of temperament was thus most pronounced in the low-risk group. The same tendencies were found in the high-risk group, but did not reach statistically significant levels.

Besides the univariate statistical analyses, we have performed multivariate analyses using multiple logistical regression in the total group. We made one analysis for each

Table 3 Concurrent associations with different psychiatric diagnoses in 1972 in groups with and without respective "salutogenic" temperament factors in the total group, the high (three or more childhood psychiatric risk factors) and the low-risk group. n_d number with diagnosis; n_w number without diagnosis

"Salutogenic" factor	Total group			High-risk group			Low-risk group		
	n_d	n_w		n_d	n_w		n_d	n_w	
<i>Super-capacity</i>	Psychosis:						Psychosis:		
Present	2	228	1%				1	176	1%
Not present	20	307	6%***				10	172	6%**
	Psychopathy:						Psychopathy:		
Present	8	222	3%				5	172	3%
Not present	36	292	11%***				14	169	8%*
<i>Super-validity</i>	Depression:						Depression:		
Present	12	68	15%				6	43	12%
Not present	123	354	26%*				79	231	25%*
							Psychosomatic:		
Present							9	40	18%
Not present							99	211	32%*
<i>Super-solidity</i>	Neurosis:						Neurosis:		
Present	21	124	15%				13	89	13%
Not present	109	300	27%**				65	192	25%**
<i>Sub-stability</i>				Alcoholism:					
Present				2	41	5%			
Not present				27	128	17%*			
<i>Super-capacity + Super-validity:</i>							Depression:		
Present							7	46	13%
Not present							78	229	25%*
<i>Super-capacity + Super-solidity:</i>							Alcoholism:		
Present							0	84	0%
Not present							19	256	7%*
<i>Super-validity + Super-solidity:</i>	Depression:						Depression:		
Present	15	80	15%				9	57	14%
Not present	121	341	26%*				76	217	26%*
							Psychopathy:		
Present							0	66	0%
Not present							19	274	6%*
	Neurosis:			Neurosis:			Neurosis:		
Present	9	85	10%	3	85	11%	6	60	9%
Not present	121	339	26%***	49	118	29%*	72	221	25%**

* $P < 0.05$

** $P < 0.01$

*** $P < 0.001$

NOTE: % = Percent with diagnosis when a "salutogenic" factor is present or not present

diagnosis. In the regression equation depression was associated significantly ($P < 0.02$) mainly with validity ($P < 0.01$). Psychosis was associated ($P < 0.05$) with capacity ($P < 0.01$) and solidity ($P < 0.02$). Alcoholism was associated significantly ($P < 0.05$) in the regression equation with capacity ($P < 0.02$). Neurosis was highly associated ($P < 0.001$) with validity ($P < 0.001$), solidity ($P < 0.001$) and capacity ($P < 0.001$). Psychopathy was associated significantly ($P < 0.001$) with capacity ($P < 0.001$) and solidity ($P < 0.05$). Psychosomatics ($P < 0.01$) were associated in the equation with capacity and validity (both $P < 0.02$). This means that even in the multidimensional analysis we found significant associations between intelligence, the temperament variables and the different diagnoses (Table 4).

Prospective analysis of mental health, intelligence and various temperaments

Only the high-risk group was assessed in a way that allowed a prospective analysis. Because the study in 1988–1989 was focused on health, the outcome variables were different aspects of health, rather than psychiatric diagnoses. Table 5 shows that the group of individuals rated as "super-capable" in 1972 had a higher frequency of good mental health in 1988–1989 according to "rated health", HSRS and QOL. In the group rated as "super-valid" a higher frequency of good mental health was registered according to "rated health", HSRS and SCL-90 (i.e. low frequency of self-rated psychiatric symptoms). The group rated as both "super-capable" and "super-valid" had a

Table 4 Results from logistical-regression analysis with intelligence and temperament as independent variables and psychiatric diagnoses as dependent variables

Dependent variables	Logistical likelihood ratio (χ^2)	<i>P</i>	Independent variables in model		
			Variable	<i>t</i> -statistic	<i>P</i>
Depression	11.03	< 0.02	Capacity	1.57	–
			Validity	3.21	< 0.01
			Solidity	1.08	–
Psychosis	9.31	< 0.05	Capacity	2.65	< 0.01
			Validity	0.23	–
			Solidity	2.46	< 0.02
Alcoholism	8.58	< 0.05	Capacity	2.32	< 0.02
			Validity	1.79	–
			Solidity	1.27	–
Neurosis	76.60	< 0.001	Capacity	4.73	< 0.001
			Validity	6.34	< 0.001
			Solidity	5.84	< 0.001
Psychopathy	24.41	< 0.001	Capacity	3.95	< 0.001
			Validity	0.66	–
			Solidity	2.30	< 0.05
Psychosomatics	13.19	< 0.01	Capacity	2.39	< 0.02
			Validity	2.50	< 0.02
			Solidity	1.08	–

higher frequency of good mental health according to “rated health”, HSRS and QOL. The group of individuals rated as both “super-valid” and “super-solid” had a higher frequency of good mental health according to “rated

health” and SCL-90. The percentage of healthy individuals was nearly doubled when the “salutogenic” factor was present.

The presence of “sub-stability” did not show any statistical association with the frequency of mental health. When separate analyses were made for men and women, no consistent differences were found. Because of our hypothesis that certain aspects of intelligence and the temperament variables would be “salutogenic”, we used categorical data for our logistical-regression analysis of their association to different health measures.

For all health concepts we found linear associations (Table 6). For rated health, HSRS and QOL “super-capacity” contributed to the linear model. For SCL-90 and rated health “super-validity” contributed to the association. The main contributor to the variance for all health concepts was “super-capacity”. In this analysis we did not find any association with “solidity”. In the previously mentioned analysis we excluded stability, because it was not associated in the expected direction.

Conclusions

Our hypotheses were thus partly confirmed. Intelligence and the temperamental traits proposed to be “salutogenic”, i.e. furthering a healthy mental condition, were statistically associated with lower frequencies of some psychiatric diagnoses. Different traits seemed to interact with different diagnoses. The statistical association between the presence of a trait and a low frequency of a certain diagnosis, was most striking in the low-risk group in the

Table 5 The prospective associations of temperament factors and mental health according to different measurements in 1988–1989 in the high-risk group. The individuals were grouped according to

good/poor mental health, and present/not present “salutogenic” temperament factors. HSRS Health–Sickness Rating Scale; SCL-90 Symptom Check List; QOL Quality of Life scale

“Salutogenic” factor	Rated health		HSRS		SCL-90		QOL	
	High	Low	High	Low	Low	High	High	Low
Super-capacity								
Present	22	28	44%	28	20	58%	26	21
Not present	28	87	24%**	34	78	41%**	32	61
Super-validity								
Present	14	11	56%	14	11	56%	12	8
Not present	36	104	26%**	48	87	36%*	31	88
Super-capacity + super-validity								
Present	10	10	50%	13	7	65%	11	6
Not present	40	105	28%*	49	91	35%*	47	76
Super-validity + super solidity								
Present	11	10	52%		10	8	56%	
Not present	39	109	27%*		33	88	27%*	

**P* < 0.05

***P* < 0.01

NOTE: % = Percent with good health when “salutogenic” factor is present or not present

Table 6 Results from logistical-regression analysis with intelligence and temperament variables as independent variables, and health variables as dependent variables

Dependent variables	Logistical likelihood ratio (χ^2)	<i>P</i>	Independent variables in model		
			Variable	<i>t</i> -statistic	<i>P</i>
Rated health	12.68	< 0.01	Capacity	2.04	< 0.05
			Validity	2.46	< 0.02
			Solidity	0.27	–
HSRS	13.28	< 0.01	Capacity	3.09	< 0.01
			Validity	1.20	–
			Solidity	0.25	–
SCL-90	9.47	< 0.05	Capacity	0.94	–
			Validity	2.99	< 0.01
			Solidity	0.04	–
QOL	8.08	< 0.05	Capacity	2.10	< 0.05
			Validity	1.25	–
			Solidity	0.85	–

concurrent study. In the prospective study, however, certain traits were statistically associated with positive mental health, although this was measured only in the high-risk group. All of this together confirmed our hypotheses that “super-capacity”, “super-validity” and “super-solidity” were “salutogenic” factors both in high- and low-risk groups. “Sub-stability” seemed to be a “salutogenic” factor regarding alcoholism in the high-risk group in the concurrent study, but was not associated with any of the health variables in the prospective study.

Discussion

In this study we were confined to using the Sjöbring system of personality dimensions, because it had been used in the previous investigations in 1957 and 1972. Its weaknesses were the rather global descriptions of the variables and a clinical assessment method that required extensive training. Although this system is somewhat outdated, Table 1 shows that its basic concepts largely correspond to some of the modern systems of temperament used in more recent research studies. Because of this, we considered that an analysis of the data collected in 1972 was worth including as part of our investigations on “salutogenic” factors in the 1988–1989 study on mental health.

Because the raters of the temperament variables and intelligence in 1972 also made the psychiatric diagnoses, the results of the concurrent study may be subject to a certain bias. The 1972 phase of the Lundby study was, however, focused on psychiatric epidemiology and not on mental health and “salutogenesis”, which probably diminished this bias. In the prospective study there was no such bias, because the researchers had no knowledge of the psychiatric diagnoses or the Sjöbring assessments.

The mental health was unexpectedly good in the high-risk group in 1988–1989. The difference between those who had grown up as children under adverse conditions

and the rest of the population was small. Evidently, there have been compensatory factors in the environment or in the personal dispositions during childhood or later in life. This has been explored by us in previous papers (Dahlin et al. 1990; Cederblad et al. 1994). The focus of this study was both to investigate the statistical association between temperament and intelligence and the presence or absence of different psychiatric morbidity in 1972, and to study the co-variation of temperament and intelligence and positive mental health in 1988–1989. The “salutogenic” character of our independent variables was clearly demonstrated in both analyses. In 1972 our subjects were 25–40 years old, and in 1988–1989 they were 42–57 years old. Thus, the “protective effects” of “super-validity” (i.e. high activity level), “super-solidity” (i.e. low impulsivity) and high intelligence could be demonstrated both in early and later adult life.

Luthar (1993) suggested that the protective effect of a “salutogenic” variable should be differentiated depending on how it affects the behaviour of an individual, taking the level of risk/stress into consideration. A particular attribute that helped maintain stability of performance, mental health, etc. across risk levels could be labelled “protective-stabilizing”. A particular attribute that helped individuals to “engage” with stress/risk and thus augmented their performance/mental health in high-risk situations could be labelled “protective-enhancing”. An attribute that was generally an advantage, but more so when stress/risk levels were low, could be labelled “protective-reactive”. Our findings in the concurrent study showed that intelligence seemed to be “protective-stabilizing”. The temperament variables seemed to be “protective-reactive”, because their interaction with the frequencies of different psychiatric diagnostic groups was most pronounced in the low-risk group. That intelligence is a powerful “salutogenic” factor was also shown in the studies of Vaillant and Vaillant (1990), and by Werner (1985), who both pointed out that this was particularly true in under-privileged groups where it increased chances for upward social mobility.

Rutter (1979) found that the “Easy child” temperamental characteristics defined by Thomas and Chess (1977) seemed to protect a child from negative interchange with its parents, and thereby prevent it from developing behaviour disorders. Wertlieb et al. (1987), in another child study, also found an association between certain temperamental characteristics and the frequency of behaviour symptoms using the same temperamental model. Werner (1985), in her study of risk children from 0 to 32 years of age, pointed out that although different stress factors seemed to be important during different periods of the subjects’ development, at each stage of their life cycle, those who could elicit predominantly positive responses from their environment were more stress-resistant. Thus, in childhood, in adolescence and even in young adulthood, certain temperaments seemed to shape the family and social environment and modify social interaction in a way that could be “salutogenic”. In our study on older adults, “sub-stability”, which measures sociability, did not seem

to be a very strong "salutogenic" variable. This is in accordance with Vaillant and Vaillant (1990) who, in their study of male psychological health from 18 to 65 years of age, did not find that sociability was associated with good mental health in later life. "Super-validity" (i.e. high activity level) seemed to be a "salutogenic" factor in our prospective study. Vaillant and Vaillant (1990), on the other hand, found in their study that "vital affect" correlated with good adjustment in college and young adulthood, but was not associated with later-life outcome. Werner and Smith (1992), whose subjects were only 32 years old in their last study, found that high activity level measured with the EAS scale (Emotionality, Activity, Sociability; Buss and Plomin 1984) was associated with a good psychological and social adjustment.

Why should "super-capacity", "super-validity", "super-solidity", and to some extent "sub-stability", be "salutogenic" factors? Probably because they increase the coping capacity of an individual. To be intelligent and to have a high activity level and a low impulsivity enables an individual to appraise problems more accurately and to apply an active coping style. If a person is high on sociability (sub-stability), he/she can also "get a little help from his friends". Holahan and Moos (1990) proposed that the concept stress resistance is essentially a coping model, where adaptive personality characteristics function as coping resources. In adult life the "salutogenic" importance of different temperament traits thus seems to be different than in childhood. Intellectual capacity, on the other hand, seems to be equally important in studies on stress resilience in children and in our study on adults.

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