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Stress and the Onset of Sudden Hearing Loss and Tinnitus

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Abstract: Forty hospitalized patients with sudden hearing loss and tinnitus were compared to a control group (N = 28) of inpatients of an ear-nose-throat ward. They were similar in various background variables except for the kind of disorder itself. The main objective of our study was to test the hypothesis of stress as a predisposing risk factor in the development of sudden hearing loss and tinnitus. Thus, differences in life events and daily "hassles" were expected between groups, as were differences in coping styles, habitual worrying, and social support. The hypothesis of more frequent and more stressful life events and daily hassles was supported empirically. The dominant role of daily hassles, especially their stressfulness as a risk factor, was shown clearly. Those in the experimental group also reported more coping endeavors and more worrying. Social support had no discriminating function. The prospective part of the study aimed at the prediction of chronicity of sudden hearing loss and tinnitus (3 months after onset) by sociodemographic, psychological, and disease-associated variables. The strongest predictor of chronicity was the degree of well-being at the time of first assessment (soon after disease onset). Coping and a fatalistic locus of control also had some predictive power. Methodological limitations of the study are discussed.

Sudden hearing loss (SHL) and tinnitus (TIN) are closely related. They occur together in 60–90% of cases [1–4]. Their pathophysiological features, the assumptions concerning their pathogenesis, and their medical treatment are rather similar [5–8]. Quite a number of experts and laymen believe that the onset of SHL and TIN is mediated by stress. Popular as this notion is, it has not been subjected to very much empirical investigation.

Certain single-case studies have reported the association between stress and SHL [9], as have some group studies that used qualitative interviews as assessment instruments [10,11]. Data from Hoffmeister's 1988 study [1] also lend support to the stress hypothesis. Patients suffering from SHL (N = 98) reported more stress than did 13 patients with morbus Ménière who were used as control subjects. However, no standardized measures were applied, and no quantitative statistical analysis of the data was conducted. Two other studies, though limited by method and design, rendered similar results [12]. In a well-designed but unpublished study by Münzel and Sander (oral presentation), however, no differences in stress were found between a group of patients with SHL and those in a clinical control group.

Concerning TIN, even fewer data are available. Most studies dealing with chronic TIN focus on its symptomatology, consequences, and treatment [13–21]. They frequently neglect the issue of predisposing and precipitating factors.

From a physiological point of view, the assumption of the contribution of stress to the onset of SHL and TIN has some plausibility. One presently prominent theory postulates that both disorders result from a diminished supply of blood to the inner ear, which impairs the inner and outer hair cells by lack of oxygen [1,5,10,22]. Vascular processes, mainly responsible for blood flow, are regulated by the sympathetic nervous system and the hypothalamic pituitary adrenal axis, the main systems activating cardiovascular stress responses. What must be borne in mind, however, is the existence of various theories of pathogenesis and etiol-

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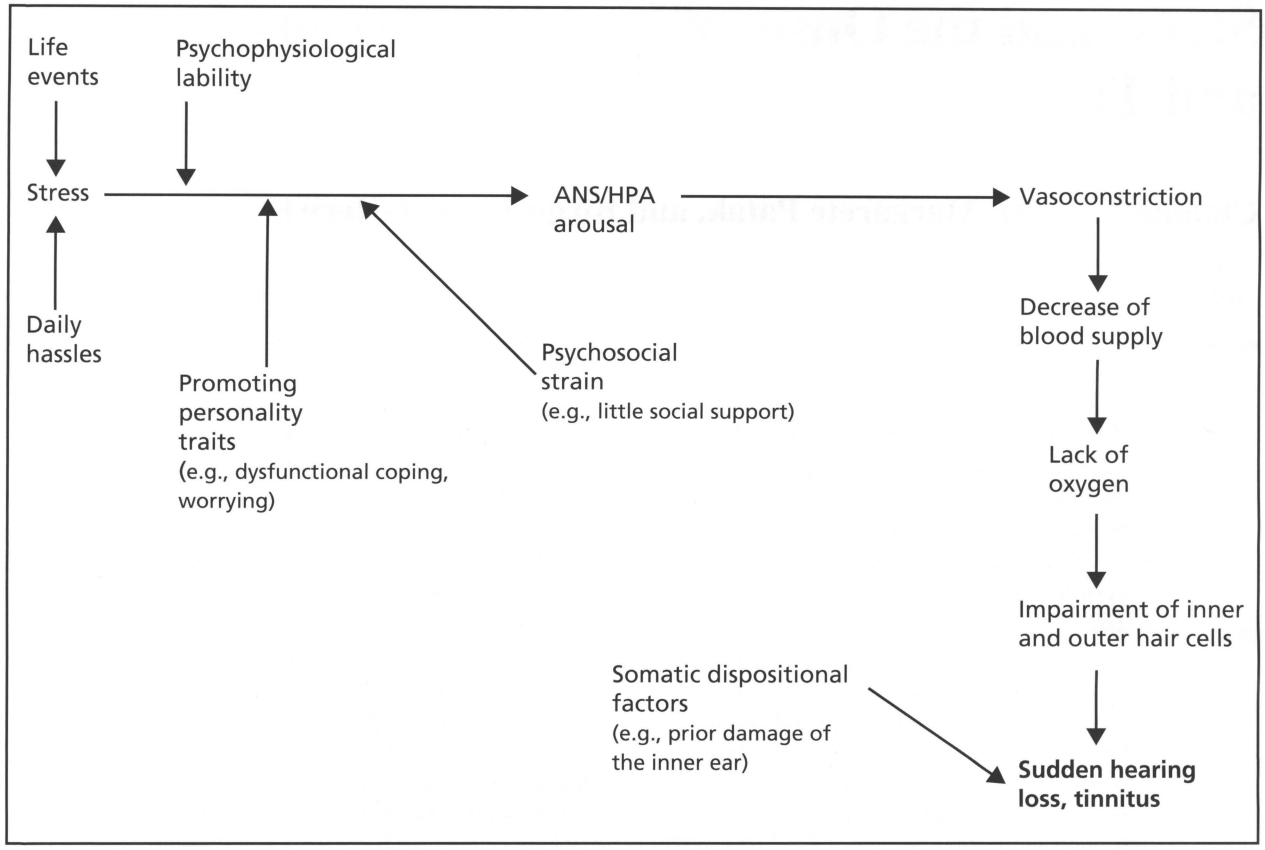

Figure 1. Etiology of sudden hearing loss and tinnitus: a biopsychosocial model. (ANS = autonomic nervous system; HPA = hypothalamic pituitary adrenal axis.)

ogy of these hearing disorders; in general, all lack sound empirical support and somehow differ in their views of the functional role attributed to stress. Because of the abundant clinical evidence for the importance of stress, the simplified model illustrated in Figure 1 and derived from Hoffmeister [1] is used for the conceptualization of the presumed interplay of stress-related somatic and psychological factors.

The main objective of the current study is to examine the association between stress SHL and TIN in a control group design, using a comprehensive and methodologically refined assessment strategy. Stress is assessed by psychometrically validated inventories of life events and daily hassles. Because external stressors have no direct influence on health but are mediated by subjective evaluation and processing of the stressful situation [23], habitual coping strategies also are studied. Furthermore, worrying [24] is an important factor related to the processing of stressful information, a trait variable that has not yet been considered in regard to the onset of hearing disorders. Social support also will be assessed as a potential buffering factor against stress.

A further issue of this study relates to the chronicity process. The study examines whether psychological predictors exist for maintenance of hearing loss and TIN 3 months after onset. The variables examined as possible predictors are the same as those mentioned earlier as assessed at the time of the onset of the disorder. Additionally, locus of control assessed at the same time is included as a psychological trait variable, which has been studied often in the context of chronic disease [25–28].

Our study, therefore, tested the following assumptions: Onset of SHL and TIN is associated with a high level of stress defined by life events and daily hassles, habitual dysfunctional coping strategies, a high level of worrying, and a low level of social support. No hypotheses are formulated for the predictor analysis of chronicity.

METHOD

Because a prospective design relating to the stress hypothesis with hundreds of nonsymptomatic subjects was beyond our research capacities, a control group design was used. The main guideline for the selection of the control group was to assess patients with maximal similarity to those in the experimental group of patients with SHL and TIN so as to rule out threats to internal validity, as addressed by Kazdin [29]. Additionally to

Table 1. Inclusion Criteria for the Experimental and Control Group

Factor	Inclusion Criterion	Experimental Group	Control Group
Treatment setting	Inpatient of the ear-nose-throat ward	X	X
Age	≥15 and ≤65	X	X
Day of illness onset	Clearly pinpointed by the patients	X	X
Time of illness onset	Not more than 10 days ago	X	X
Previous sudden hearing loss	At least 6 months ago and in remission	X	—
Tinnitus	Not more than 10 days before sudden hearing loss	X	—
Surgery	No pending operation	X	X
Cause of the illness	No morbus Méniere, multiple sclerosis, or loss of balance	X	X
	No noise trauma or infections	X	—

the disorder itself being different in the control group, the disease should *not* be associated conceptually with stress in its etiology. Most setting variables were kept equal (Table 1).

The study was conducted at a university hospital and a community hospital. At the time of the assessment, all patients selected for the study were hospitalized in the ear-nose-throat ward. The experimental group consisted of patients suffering from SHL or acute TIN (or both) that could not be explained by extreme noise exposition or any underlying disease (e.g., morbus Ménière). For the control group, inpatients suffering from different conservatively treated illnesses of throat, ear, and nose were selected. We included in the control group only those subjects who did not await surgery because of their disorder (e.g., suffering from infections or nose bleeding). For both groups, illness onset occurred no more than 10 days previously. This selection criterion was used to reduce bias effects of memory on self-report measures [30].

The experimental group consisted of 40 patients, the control group of 28 patients. Patients were on the average approximately 40 years old, and nearly one-half (48.5%) were female. They had stayed in the hospital for 3 days on the average at the time of assessment. In the experimental group, 95% of the patients suffered from SHL *and* TIN. Only two complained of TIN alone. One-third had experienced hearing loss or TIN in the past. The groups did not differ significantly in any of the sociodemographic variables (Table 2). Well-being is the only variable differing significantly, with control patients feeling better than did the experimental subjects. Patients who fulfilled the established criteria were informed about the study and then were given the questionnaires, which they were supposed to complete within 2 days. All subjects gave their voluntary consent without receiving any money for participation. Only one person contacted in the experimental group and three in the control group refused to participate (see Table 2).

The questionnaires were presented in a fixed order. The first questionnaire asked for sociodemographic data (age, gender, family status, number of children, profession), information regarding the circumstances of the disorder (both groups), and a detailed description of SHL and TIN (experimental group only). Furthermore, patients rated their actual well-being (WB) on a 5-point scale from very good (5) to very bad (0). Life events (LE) were assessed by the German version of the Social Readjustment Rating Scale (retest-reliability after 10 weeks, Pearson's coefficient, $r = 0.71$) [31,32]. Patients were asked whether any of the 42 given life events took place within the last year. Additionally, they had to rate the subjective stressfulness (or strain) of each event on a rating scale from 0 to 100.

Daily hassles (DH) were assessed by the German questionnaire Alltagssorgen-Skala [33] (Cronbach's al-

Table 2. Characteristics of the Experimental and the Control Group

	Experimental Group (n = 40)	Control Group (n = 28)
Female gender	22 (55.0%)	11 (39.3%)
Age (yrs)		
Mean (SD)	40.90 (12.41)	39.64 (14.19)
Minimum and maximum	19 of 65	18 of 64
Current well-being (0–5)* [mean (SD)]	0.43 (3.64)	3.29 (2.18)
Noise exposure [mean (SD)]	2.81 (1.81)	2.61 (1.75)
Days of hospitalization at initial assessment	2.73 (3.61)	3.03 (1.97)
SHL	38 (95%)	Not applicable
SHL with TIN	34 (85%)	
TIN only	2 (5%)	
SHL incidents in the past	13 (32.5%)	Not applicable
TIN incidents in the past	13 (32.5%)	Not applicable
Disability due to TIN (0–4) [mean (SD)]	2.35 (0.16)	Not applicable
Disability due to SHL (0–4) [mean (SD)]	2.48 (0.2)	Not applicable

SHL = sudden hearing loss; TIN = tinnitus.
*Test for difference between groups is highly significant.

pha = 0.96), which is based on the Daily Hassles Scale by Kanner et al. [34]. The 56 items reflect a variety of everyday hassles concerning work, household, marriage, money, friends, and family. Number and stressfulness of hassles during the last 4 weeks before the onset of the illness were assessed. Stressfulness (strain) was rated individually on a 5-point rating scale.

A German coping inventory, the Streßverarbeitungsbogen [35] (78 items; a 5-point rating scale; Cronbach's alpha = 0.84–0.94), was used to assess different coping styles. This inventory separates negative (COPneg; e.g., resignation) and positive coping strategies (e.g., positive self-instruction), which are supposed to reduce the impact of stress. The Streßverarbeitungsbogen assesses the likelihood of various habitual coping behaviors in situations leading to discomfort, arousal, or tension.

To determine the level of worrying (W), the German version of the Penn State Worry Questionnaire [36] (16 items; a 5-point rating scale) was presented to the subjects. Stöber [37] found a Cronbach's alpha of 0.86 for the German version of the Penn State Worry Questionnaire, which is similar to the Cronbach's alpha found by Molina and Borkovec [38].

Social support was measured by the short version of the German Fragebogen zur Sozialen Unterstützung [39] (22 items; a 5-point rating scale; Cronbach's alpha = 0.70–0.92; retest-reliability after 12 weeks, $r = 0.65$). The questionnaire assessing locus of control (LOC) related to health and illness. Fragebogen zur Kontrollüberzeugung bzgl. Krankheit und Gesundheit [40] (21 items; a 6-point rating scale; Cronbach's alpha = 0.64–0.77; retest-reliability after 2 weeks, $r = 0.66$–0.78) was given only to the experimental group. It consists of three scales: internality (LOCint), powerful others–externality (LOCpow), and fatalistic externality (LOCfat).

The experimental subjects were contacted by telephone 3 months after they had been assessed for the first time. This approach was successful in 35 of the 40 cases. The contacted subjects were interviewed about the status of their hearing disorder, especially whether their TIN or hearing deficit still were present.

RESULTS

Differences Between Experimental and Control Group (Cross-Sectional Study)

Patients with SHL and TIN show significantly higher scores on both measures of stress, on the life event scale, and on the daily hassles scale than those in the clinical control group. This outcome is true for both aspects, the number *and* stressfulness of events (Table 3), though subjective strain differentiates more clearly between the groups. The correlation of DH and LE ranges from medium to high ($r = 0.40$–0.55). Well-being showing a significant difference between groups can be considered as a potentially confounding variable. The group differences in both aspects of LE and DH, however, remain significant after statistically controlling for well-being (see Table 3). To assess the relative importance of LE and DH, controls were applied for their common variance. After controlling for the effect of DH, the difference in LE between groups no longer was significant; on the other hand, after controlling for the effect of LE, the difference in stressfulness of DH was maintained (see Table 4).

As expected, significantly more negative coping strategies (COPneg) were found in the experimental group. However, in contrast to expectation, they also showed significantly more positive strategies (COPpos, see Table 3). Both results remained stable after statisti-

Table 3. Psychological Variables Before and After Controlling for Well-Being

	Experimental Group [Mean (SD)]	Control Group [Mean (SD)]	*p* (*t*-test)	After Statistical Control of WB
Life events				
Number	6.18 (5.51)	4.21 (2.9)	$p = 0.030^a$	$p = 0.051$
Strain	232.13 (283.72)	113.57 (107.17)	$p = 0.010^b$	$p = 0.048$*
Daily hassles				
Number	24.90 (12.98)	17.43 (15.01)	$p = 0.016^a$	$p = 0.088$
Strain	69.25 (39.59)	40.36 (34.92)	$p = 0.002^b$	$p = 0.021$*
Coping				
Negative	59.75 (13.35)	47.54 (13.56)	$p = 0.000^c$	$p = 0.018$*
Positive	95.00 (19.06)	84.89 (19.04)	$p = 0.018$	$p = 0.028$*
Worrying	49.85 (12.93)	42.46 (12.08)	$p = 0.010^b$	$p = 0.151$
Social support	4.27 (0.77)	4.45 (0.46)	$p = 0.136$	—

M = means; SD = standard deviations; WB = well-being.
Note: Results of independent *t*-tests.

Table 4. Life Events and Daily Hassles

	Experimental Group [Res. Mean (SD)]	Control Group [Mean (SD)]	*p* (*t*-test)
Life events			
Number	0.13 (4.90)	−0.25 (2.61)	.450
Strain	5.01 (225.87)	−4.39 (121.52)	.421
Daily hassles			
Number	1.97 (11.49)	−2.66 (14.40)	.073
Strain	6.82 (31.91)	−11.39 (33.41)	.013*

res. = residual; SD = standard deviation.
Note: Results of independent *t*-tests of life events and daily hassles after controlling for each other.

cal control for well-being. Worrying had a significantly higher level in the experimental group, but this difference was lost after statistical control for well-being. No difference was registered in the level of social support; both groups showed very high scores (Table 3).

A discriminant analysis, including all psychological variables entered at the same time, separated the groups significantly ($p = .012$) with a Wilks' lambda of 0.728 and an eigenvalue of 0.373. The percentage of correct classifications is 75%. Stressfulness and number of DH are the most influential variables ($\beta = 1.0$ and 0.64). Especially positive but also negative coping strategies contribute to the discrimination between the groups ($\beta = 0.55$ and 0.40), whereas worrying and LE (strain) contribute very little to the correct classification ($\beta = 0.09$ and 0.02).

Prediction of Chronicity of TIN and Hearing Loss

The prospective part of our study examined the connection of psychological test variables (LOCint, LOCpow, LOCfat and LE, DH, W, and social support), sociodemographic variables (age, gender, family status, number of children), and characteristics associated with the disorder (TIN in the past, acute TIN, disability due to TIN and SHL, and WB at the onset of the disorder), all measured at onset of the hearing disorder, to the chronicity of TIN and hearing loss 3 months later. At follow-up, 35 of 40 patients could be reached by phone: 54.3% (n = 19) of those still suffered from TIN.

The chronicity of TIN is correlated most closely to WB at disorder onset, COPneg, and LOCfat (Table 5). This finding indicates that the lower the state of well-being, the higher is the probability of TIN maintenance. Also, the more negative coping strategies individuals exhibit and the stronger a fatalistic locus of control in individual patients, the more probable is the maintenance of TIN. No other variable is correlated significantly to TIN chronicity (see Table 5).

In a discriminant analysis, the six variables of all three categories (WB, COPneg, LOCfat, acute TIN, age, disability due to TIN) associated most highly with chronicity of TIN were used to separate the group of patients with TIN from recovered patients. The number of predictors is limited to six, as the number of subjects should not be less than the number of predictors multiplied by five. The discriminant analysis discerns at a statistically significant level ($p = .003$) between the groups with a Wilks' lambda of 0.52 and an eigenvalue of 0.92. Eighty-three percent of the patients were classified correctly. WB and disability due to TIN and having TIN associated with SHL at first assessment are the most influential variables ($\beta = 0.73$, 0.73, and 0.66). Considering the psychological variables, especially COPneg and LOCfat contribute to the discrimination of groups ($\beta = 0.62$ and 0.54). Age adds very little to the correct classification ($\beta = 0.26$).

Chronicity of SHL (n = 18 of 35 subjects) is associated most closely with WB at the onset of the disorder,

Table 5. Correlation (Pearson's *r*) Between Chronicity of Tinnitus 3 Months After Onset and Psychological, Sociodemographic Variables, and Characteristics Associated with the Disorder

LOCint 0.24	LOCpow 0.12	LOCfat 0.39[a]	LE (no.) 0.02	LE (strain) 0.04	DH (no.) 0.11
DH (strain) 0.14	COPpos 0.03	COPneg 0.45[b]	W 0.22	SS −0.16	
Age 0.27	Gender 0.11	Family status −0.06	No. of children 0.23		No. of SHL 0.17
Anxiety related to SHL 0.23	TIN in the past −0.14	Acute TIN 0.28	Disability due to TIN 0.26	Disability due to SHL −0.17	WB at onset −0.50[b]

LOCint = internality; LOWpow = powerful others–externality ; LOCfat = fatalistic externality; LE = life events; DH = daily hassles; COPpos = positive coping strategies; COPneg = negative coping strategies; W = worrying; SS = social support; SHL = sudden hearing loss; TIN = tinnitus; WB = well-being.
[a] $p \leq .05$.
[b] $p \leq .01$.

Table 6. Correlation (Pearson's *r*) Between Chronicity of Sudden Hearing Loss 3 Months After Sudden Hearing Loss and Psychological and Sociodemographic Variables and Characteristics Associated with the Disorder

LOCint 0.108	LOCpow 0.14	LOCfat 0.34[a]	LE (no.) −0.17	LE (strain) −0.01	DH (no.) −0.1
DH (strain) −0.06	COPpos 0.01	COPneg 0.02	W −0.07	SS 0.07	
Age 0.23	Gender 0.02	Family status −0.02	No. of children 0.06		No. of SHL 0.27
Anxiety related to SHL 0.40[b]	TIN in the past −0.10	Acute TIN 0.09	Disability due to TIN 0.31[b]	Disability due to SHL 0.42[b]	WB at onset −0.46[b]

LOCint = internality; LOCpow = powerful others–externality; LOCfat = fatalistic externality; LE = life events; DH = daily hassles; COPpos = positive coping strategies; COPneg = negative coping strategies; W = worrying; SS = social support; SHL = sudden hearing loss; TIN = tinnitus; WB = well-being.
[a] $p \leq .05$.
[b] $p \leq .01$.

with disability due to TIN and SHL, and with the degree of anxiousness concerning SHL and LOCfat. Chronicity of hearing loss is not correlated to the other sociodemographic variables or characteristics attributed to the disorder (Table 6).

The six variables—WB, disability due to acute TIN, SHL, LOCfat, anxiety concerning SHL, and number of SHL—correlated most highly to the chronicity of hearing loss were entered into a discriminant analysis at the same time. The analysis discerns statistical significance ($p = .009$) between the groups with a Wilks' lambda of 0.57 and an eigenvalue of 0.76. Eighty percent of the patients were classified correctly. WB and disability due to SHL are the most influential variables ($\beta = 1.01$ and 0.82). Disability due to TIN and LOCfat also contribute to the discrimination between the groups ($\beta = 0.42$ and 0.38). Anxiousness concerning SHL contributes very little to the correct classification ($\beta = 0.08$), and the number of prior SHL does not have any influence ($\beta = 0.01$).

DISCUSSION

The hypothesis regarding the stress differences expected between SHL and TIN patients and the control group before the onset of the disorder was confirmed fully. Life events and daily hassles before the onset of the disorder were significantly more frequent, and their stressfulness was more distinct in the experimental group. Interestingly, the reported strain due to the stressful events differentiates more clearly between groups than does their number. Thus, the subjective evaluation of stressful events is more important than is the sum of events. Our data show, as is found often in other studies, that life events and daily hassles are not independent of each other but correlate to a large degree. To determine the independent effect of each variable, the other was partialed out. After this procedure, the discriminating function of life events, be it number or strain, was lost. On the other hand, daily hassles (especially their stressfulness) retain their differentiating function. Thus, what can be concluded is that life events probably give rise to various stressful daily hassles that undermine health status. Consequently, our study applying psychological instruments of satisfying reliability and validity in a control group design confirms findings by Hoffmeister [1], Kropp and Rad [10], Stange [11], and Neuser and Knoop [12].

The affective state of certain persons often has been shown to influence memory; in a negative state, more negative memory contents are activated and retrieved. As a marked difference in well-being was found between the two groups (worse mood in the experimental subjects), the variance between groups attributed to differences in well-being was eliminated by partial correlation. Otherwise, the reported higher amount of stress could be ascribed to the negative state of those in the hearing loss and TIN group at time of assessment. However, the difference in stressfulness of life events and daily hassles were shown to be maintained at a significant level. Thus, well-being had some effect on remembering and reporting negative events, especially on the number, but the difference between experimental and control group cannot be explained totally by their different state of well-being.

Positive and COPneg strategies also differentiated between groups. The hypothesis of more COPneg strategies in the experimental group was supported, but the level of positive coping endeavors also is much higher in the SHL/TIN group, a finding contrary to expectation. One can assume that the classification of coping behaviors into "bad" or "good" regarding their problem-solving or palliative capacity may be invalid, as some often have argued that the effectiveness of coping also

depends on the kind of stressor and other characteristics of the situation. Regardless, the fact remains that different coping behaviors, whether positive or negative, are used much more frequently by the experimental group. What might be posited is that the experimental group uses more coping strategies because they meet more life problems, as shown. A further assumption might be that they are trying hard to cope with stress most of the time but are not successful, as the reported strain by the events is higher in the experimental group. Thus, their potentially exhausting coping endeavors could also contribute to onset of the hearing disorders. This effect remained after controlling for WB.

At first glance, the data about worrying confirm our hypothesis that it is more intense in SHL/TIN patients. However, after controlling for well-being, this effect vanished, which demonstrates that the process of worrying is intensified markedly by an individual's negative state. The hypothesis of a deficit in social support in the experimental group was not confirmed. All subjects reported an extraordinary high degree of social support (high above the average of the norm group). Generally, social support may be very high in the special situation to which all subjects were exposed: being in the hospital for their first few days. This could be responsible for the ceiling effect in the data.

The discrimination analysis fully supported the foregoing conclusions, selecting daily hassles as the strongest variable in the prediction of group membership and coping as a further relevant aspect. All other variables did not exhibit any surplus power of prediction. The discrimination between groups was well above chance but, with an error rate of 25%, was not really very satisfactory.

The second part of our study was concerned with the prediction of chronicity of SHL or TIN 3 months after onset. The general assumption is that the probability of remission of these special hearing disorders at that time is rather low, so that a chronic state can be assumed.

None of the sociodemographic variables is an important predictor. The only psychological trait variable with some predictive power for TIN is negative coping. Such is also the case for a fatalistic locus of control regarding SHL. The most powerful predictor both for chronic TIN and for SHL is the state of subjective well-being at time of first assessment immediately after the onset of the disorders. Also very influential is the degree of disability due to TIN experienced at first assessment. In the prediction of chronic SHL, both disability due to SHL and TIN at onset are important. After all, 80–83% of the patients could be classified correctly by these variables.

Though the validity of these predictions cannot be guaranteed and has to be cross-checked, an interesting note is that the supposedly predisposing stress factors that seem important for the onset of the studied hearing disorders do not contribute to its chronicity. Only habitual processing variables (coping, fatalistic LOC) show some influence on chronicity, but the best predictor is well-being, probably an indicator of the subjective evaluation of the biopsychosocial state of an individual. Interestingly, this global self-evaluation is more important than is the rating of disability due to TIN and SHL and variables related to the history of the disorder. Furthermore, what should be mentioned is that the explained variance is higher in the prediction of chronicity than in the discrimination of the different clinical groups.

All in all, our study suggests that psychological variables related to stress and its processing are predisposing for TIN and SHL and that the actual subjective state of well-being shortly after onset of the disorder is a relevant predictor of chronicity of both disorders. Habitual psychological trait characteristics (coping, LOC) exhibit some, but not a strong, influence.

Though our data support the hypothesis of psychological influences on disease etiology and prognosis in SHL and TIN, some methodological limitations of the study have to be taken into account. The experimental group exists of patients suffering predominantly from both types of hearing disorders; very few persons were afflicted with TIN or SHL only. This finding probably is the consequence of recruiting patients in a hospital setting. "Pure" TIN patients are treated mostly in outpatient settings and only rarely in a hospital, probably limiting the generalization of data about single-syndrome patients.

The intent of our study was to sample similar groups maximally except for the disorder itself. This was successful in nearly all assessed variables, with the exception of well-being, which turned out to be an important variable. The definitely worse state of well-being in the experimental group points to the fact that the comorbidity of SHL and TIN probably is very stressing and annoying. This finding supports the notion that the study assessed a very special group of patients. One undesirable aspect of our study is the difference in the number of subjects in the experimental control group, due to the difficulty in recruiting control patients. The task of identification of patients for the study was allotted to the hospital staff, who then informed the psychologists of their potential subjects. Because the identification of potential control group patients was much more difficult than was the identification of SHL/TIN patients and because of the fact that pending surgery excluded many patients from the control group, the recruitment of the control subjects was very time-consuming and less successful. However, the number of subjects lies

within the range of statistical demands (number of subjects = 5 × number of variables) [41].

Furthermore, the conclusions drawn from the prospective part of the study, especially regarding the importance of psychological variables, are somewhat uncertain. As no audiological or other potentially relevant variables could be included in the prospective study (e.g., masking level of TIN, kind and severity of hearing loss), no assertions can be made regarding the *relative* significance of the assessed psychological variables in comparison to medical characteristics. Nevertheless, our data support the hypothetical role played by stress and related psychological factors in the etiology of SHL and TIN. The search for prognostic factors of chronicity must be continued, after this first attempt offering some challenging data.

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