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Original article

Sense of coherence, health locus of control, and quality of life in obese adults: physical limitations and psychological normalcies

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Summary

Objectives: To assess differences between overweight and normal-weight adults in sense of coherence (SOC), health locus of control (HLOC), and health-related quality of life (HQOL).
Methods: Cross-sectional population study (Augsburg, Germany). Random sample aged 25–74 (N = 947). Body mass index (BMI) was categorized into four groups (normal-weight: 18.5–25; pre-obesity: 25–29.9; moderate obesity: 30–34.9; severe obesity: ≥35). The associations between obesity classification and SOC-13T, MHLOC-Scales, and SF-12 summary scores were estimated via analysis of covariance.
Results: Adjusted for age and socio-economic status, no differences across BMI-groups related to SOC, internal HLOC, external HLOC-'chance', and SF-12-'mental health'. HLOC-'doctors' was marginally elevated in obese women. Larger differences pertained to SF-12-'physical health' in that it was considerably reduced in obese women and severely obese men.
Conclusions: In this adult population sample, obesity is not associated with SOC, HLOC, and HQOL in terms of mental health, but is associated with poorer physical health, which was reported by all groups of obese women, and by severely obese men. These results underline the need to treat and prevent obesity to restore and promote physical HQOL, and to distinguish moderate vs. severe obesity in obesity research.

Abbreviations: ANCOVA: analysis of covariance; BMI: body mass index; HLOC: health locus of control; HQOL: health-related quality of life; SOC: sense of coherence

Keywords: Obesity – Severe obesity – Sense of coherence – Health locus of control – Health-related quality of life – Gender differences.

Reviews regarding psychological differences between overweight and normal-weight people have conceded inconclusive evidence (Friedman & Brownell 2002). Also, there exist gaps in this research domain. First, while many studies have focused on psychopathological phenomena such as anxiety or depression, internal resources identified in work on health lifestyles (Abel et al. 1999), such as sense of coherence (SOC) and health locus of control (HLOC), have been insufficiently scrutinized with regard to obesity. Second, there seems to be no study thus far that has simultaneously analyzed psychological resources covering both relatively stable attributes vs. more changing features. For instance, once established, SOC and HLOC are conceptualized as rather unremitting resources. In contrast, health-related quality of life (HQOL) – associated with successful obesity treatment (Teixeira et al. 2005) – is usually seen as subject to stronger fluctuations. As body mass itself is both subject to change (e. g. weight-cycling (Lahti-Koski et al. 2005)) but often also perilously stable (Elfhag & Rössner 2005), it is relevant to explore associations between obesity and psychological resources.
Against this background, this study aims to determine obesity's interrelations with SOC, HLOC and HQOL in adults. First, SOC is defined as the "global orientation that expresses the extent to which one has a pervasive, enduring though dynamic, feeling of confidence that one's internal and external environments are predictable and that there is a high probabil-

ity that things will work out as well as can reasonably be expected" (Antonovsky 1979, p. 10). This orientation has been shown to be associated with reduced risks for all-cause, cardiovascular and cancer mortality (Poppius et al. 2003; Surtees et al. 2003). Also, it partially underlies the effects of hostility on health (Kivimäki et al. 2002), and mediates deteriorations in cellular immunity by behavioural factors such as smoking (Nakamura et al. 2001). Finally, it can be expected to be reduced in overweight people because a low SOC contributes to unfavourable weight reduction efforts (Bjorvell et al. 1994; Ray et al. 2003).

Second, HLOC, i. e. the degree to which people believe their health is caused by internal vs. external factors (Wallston 1992), may be unfavourable in obese groups since it is moderately associated with preventive behaviours (Norman & Bennett 1996), alternative medicine utilisation (Schäfer et al. 2003), and multi-morbidity (van der Linden et al. 2001). Also, in intervention studies it has been shown to be a pre-treatment predictor of successful weight control (Teixeira et al. 2005).

Third, of the dimensions scrutinized here, HQOL is the most widely studied regarding obesity. Specifically, recent reviews have concluded that among both women and men, obesity is associated with impaired self-perceived physical but not mental health (Seidell & Tijhuis 2002). This holds for different assessment methods, i. e. generic, obesity-specific, and symptom-/risk factor-focused (Yan et al. 2004; Kolotkin et al. 2002; Lean et al. 1998).

In sum, this study examines differences in these dimensions between severely obese, moderately obese, pre-obese, and normal-weight women and men. In particular, severely obese women are hypothesized to report most adverse levels of SOC, HLOC, and HQOL (Friedman & Brownell 2002). Also, by examining the hypothesized differences within the same sample, the study provides the opportunity to appraise extant differences against the background of inter-correlations among the scrutinized psychological resources. Finally, these hypotheses are put forward in a mindset deliberately open as to eventually emerging profiles.

Methods

Frame of study

This study is part of the "KORA-Survey 2000", a health survey of the adult population in Augsburg city plus adjacent administrative districts (Germany). Approval of the ethics committee (Bavarian Medical Association, Munich) was secured. Features of the protocol minor to this study are described in MONICA (1989).

Study population

The target population consisted of all German residents of the region born between July 1, 1925 and June 30, 1975. A total sample of N = 6 640 subjects was drawn in a two-stage sampling procedure. In the first stage, in addition to Augsburg city, 16 out of 70 communities from the adjacent counties were chosen by cluster sampling with probability proportional to size. Using public registry offices listings, stratified random sampling was performed within each community, yielding ten strata of equal size according to gender and age. Participants within each stratum were selected with the random number function RANUNI (SAS v8.1). N = 4 261 ultimately participated in the survey. The response rate was 67 %, comparing well to other surveys (Hoffmann et al. 2004). A non-responder survey via telephone, in which 49 % participated, revealed that non-responders more often had lower education (maximally secondary school with low academic level [German: „Hauptschule"]: 65 % vs. 54 %) and fair or poor self-rated health (28 % vs. 21 %), were more often unmarried (34 % vs. 29 %) and smokers (29 % vs. 26 %), and more frequently reported physician visits in the last four weeks (46 % vs. 38 %), myocardial infarction (6 % vs. 3 %), and diabetes (7 % vs. 4 %) (Hoffmann et al. 2004). Fieldwork lasted from October 1999 to April 2001.

Of the N = 4 261, a random sample of N = 1 186 with 30 nearly balanced strata by sex, age and BMI (BMI <25, 25 ≤ BMI <30, BMI ≥30) was drawn for a telephone interview survey after two, four and six months. N = 947 participated in all interviews (response rate: 80 %). Five participants with a BMI lower than 18.5 were excluded due to probable underweight-specific health problems. Non-responders were more often men (23 % vs. 17 %), from the lowest SES-stratum (23 % vs. 19 %), unmarried (27 % vs. 17 %), and smokers (29 % vs. 17 %), but did not differ in health care use or morbidity. Table 1 shows the resulting sample by the sampling design, but differentiates moderately obese (class 1) and severely obese groups (classes 2–3) to provide appropriate sample sizes for the subsequent analyses.[1]

Notably, the groups of moderately and severely obese people did not differ greatly in age, except that among men the severely obese were disproportionally often in the middle age group (45–54). Regarding SES (Helmert-index [see *Meas-*

[1] The relevance to distinguish the group "BMI: 35-highest" from "BMI: 30-34.99" had not been anticipated in sampling, but emerged when analyzing the data. This led to reduced statistical power at this point, but deemed justified by the benefit of shedding additional light on the specific situation of severely obese adults, as they have been shown to use health care services to a comparatively high degree (von Lengerke et al. 2005; 2006).

Table 1 Description of analysis sample by sampling design*

Sex	age	normal-weight	pre-obese	obese class 1	obese classes 2–3	TOTAL
women	**25–34**	34	29	19	11	93
	35–44	34	34	23	8	99
	45–54	29	34	24	15	102
	55–64	35	34	22	11	102
	65–74	31	33	23	9	96
	total	***163***	***164***	***111***	***54***	**492**
	row %	*33.1 %*	*33.3 %*	*22.6 %*	*11.0 %*	100 %
	column %	*53.6 %*	*50.6 %*	*47.6 %*	*66.7 %*	52.2 %
men	**25–34**	31	30	20	4	85
	35–44	25	29	28	6	88
	45–54	27	34	20	10	91
	55–64	26	35	28	3	92
	65–74	32	32	26	4	94
	total	***141***	***160***	***122***	***27***	**450**
	row %	*31.3 %*	*35.6 %*	*27.1 %*	*6.0 %*	*100 %*
	column %	*46.4 %*	*49.4 %*	*52.4 %*	*33.3 %*	*47.8 %*
	TOTAL	**304**	**324**	**233**	**81**	**942**
	row %	*32.2 %*	*34.4 %*	*24.7 %*	*8.6 %*	*100 %*

** Note: Originally, obesity classes 1 and 2–3 formed one stratum.*

ures]), most obese participants were from lowest echelon, especially among women, and except among severely obese men. Both age and SES will be considered as confounders in subsequent analyses.

Measures

Body mass. Body weight and height were assessed with anthropometric examinations. They were measured according to a standardised protocol with participants standing without shoes and heavy outer garments (Molarius et al. 1998), using steelyards (SECA 709) with integrated scales (SECA 221). Calibration of instruments was ensured by inspections using standard weights or resistors. BMI was computed by dividing weight in kilograms by the square height in metre. BMI groups were defined following WHO-classifications (normalweight: 18.5 ≤ BMI <25; pre-obesity: 25 ≤ BMI <30; obesity class 1: 30 ≤ BMI <35; obesity class 2–3: BMI ≥35 [WHO 2000; "class 1" is also referred to as moderate, and "classes 2–3" as severe obesity]).

SOC was assessed in the first telephone interview by the SOC-13T (Abel et al. 2002). This is a German adaptation for telephone interviewing of the Orientation-to-Life-Questionnaire SOC-13 (Antonovsky 1993; Schumacher et al. 2000). Via 13 items using 5-point Likert-scales, it addresses perception of the environments' comprehensibility, manageability, and meaningfulness. Example items are "Has it happened in the past that you were surprised by the behaviour of people whom you thought you knew well? (never happened – always happened)", "Many people – even those with a strong character – sometimes feel like sad sacks (losers) in certain situations. How often have you felt this way in the past? (very often – never)", and "How often do you have the feeling that there's little meaning in the things you do in your daily life? (very often – very seldom or never)". Sum-scores entered analyses as continuous data (higher values indicate stronger SOC). To enhance applicability in telephone interviewing, the SOC-13T uses modifed item scales (5-point instead of 7-point). To ensure comparability, sum-scores were linearly transformed to the SOC-13 range (13–91). The SOC-13T has been found to be reliable and valid by Abel et al. (1999) for a population quite comparable to that studied here (adults in Munich). In the present sample, reliability (internal consistency) was good (Cronbach's Alpha = .82), and correlations with other outcomes as expected (see Table 4).

HLOC was assessed in the second telephone interview by the MHLOC-Scales (Wallston et al. 1978) in the German adaptation for telephone interviewing (Lüschen et al. 1989; Janßen et al. 2000). Following Marshall (1991), this differentiates the degree to which people believe that their health is caused by internal factors into 'self-responsibility' and 'self-blame', and perceived external causation into 'powerful

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others' and 'chance' (three items each)[2]. Using Likert-scales from 'strongly agree' to 'strongly disagree', example items are "The main thing which affects my health is what I myself do", "Whatever goes wrong with my health is my fault", "Having regular contact with my physician is the best way for me to avoid illness", and "My good health is largely a matter of good fortune". For each subscale, a sum-score is constructed, with higher values indicating stronger belief, and analysed as continuous data. To enhance applicability in telephone interviewing, this MHLOC-version uses 5-point instead of 6-point Likert-scales. To ensure comparability, sum-scores were linearly transformed to the original range (3–18). The instrument has been found to be reliable and valid in the above-cited study by Abel et al. (1999). In the present sample, Cronbach's Alphas ranged from .65 ('powerful others') to .58 ('chance'); for 'self-responsibility' and 'self-blame', this statistic was .63. Thus, internal consistencies were as expected in HLOC-research (Wallston, 2005) (for inter-correlations with other outcomes, see Table 4).

HQOL was assessed via personal interviewing in the main survey using the German version (Bullinger & Kirchberger 1998) of the SF-12 (Ware et al. 1996), a generic instrument with well-documented reliability and validity. It yields one continuous summary score each for subjective mental and physical health. Example items (anchors) are "During the past four weeks, have you accomplished less than you would like as a result of your physical health? (no – yes)", and "How much time during the past 4 weeks have you felt down? (all of the time – most of the time – a good bit of the time – some of the time – a little of the time – or none of the time?)". Summary scores were constructed using the algorithm by Bullinger & Kirchberger (1998). Theoretically, scores vary from 0 to 100, with higher values indicating better HQOL.

Socio-economic status (SES). Education, occupational status and income were assessed following national recommendations (Jöckel et al. 1998), and algorithmised into the revised version of the SES-index by Helmert (Mielck 2000). Key to the national recommendations is the standard to consider, in indexing, the highest school and vocational education, equivalised income (net household income relative to number [and if possible age] of household members), current or former employment status (in terms of being employed, unemployed, on leave, housewife, [re]trainee, in conscription, or retired/pensioned), and current or former occupational status (own or of partner). Algorithmisation into the Helmert-index consists of parameterising respondents' education, occupational status and income with predefined point scores, and building an unweighted sum of the three resulting scores.

Statistical analysis

Following descriptive analysis, differences in SOC, MLOC and HQOL between sexes and BMI-groups were tested using analyses of covariance (ANCOVA). Specifically, general linear modelling was applied (procedure GLM, SPSS v11.5.1). SEX and BMI (four groups) were entered as fixed factors, and AGE and SES as covariates. To explore differences across BMI-groups between women and men, the BMI*SEX-interaction was fitted into each model. If this was significant, simple effects of the contrasts "25 ≤ BMI <30 vs. 18.5 ≤ BMI <25", "30 ≤ BMI <35 vs. 18.5 ≤ BMI <25" and "BMI ≥35 vs. 18.5 ≤ BMI <25" were computed within each sex, plus their interactions with SEX, thus elucidating specific patterns underlying significant interactions (Levine 1991).

Selection of the ANCOVA-strategy rested on five rationales. First, the outcome measures without exception render continuous scores, and are dealt with as such in the literature (SF-12 (Bullinger et al. 2003); SOC-13 (Volanen et al. 2004); MHLOC (Masters & Wallston 2005)). Second, no consequential departures from normality (defined as skewness of an absolute value lower .7) were identified, except for the SF-12. Specifically, negative skewness was observed for the 'mental'-score (–1.27) and the 'physical'-score (–1.05). Third, these were the only outcomes for which homogeneity of variances tests (Levene) were significant (mental score: $F_{(7,869)} = 5.78$, $p < .001$; physical score: $F_{(7,869)} = 2.56$, $p = .013$). Thus, these variables were transformed by subtracting each one from the highest score and adding 1 (which led to positive skewness), and taking the square-root of the transformed variables. This procedure rendered inconsequential departures from normality (reduced skewness: 'mental'-score: 0.66, 'physical'-score: 0.52), and homogeneity of variance in case of 'physical health' ($F_{(7,869)} = 1.57$, $p = .14$). For 'mental health', heterogeneity was not reduced totally ($F_{(7,869)} = 3.88$, $p < .001$), so results for this summary score should be interpreted with caution. Ultimately, when using the transformed variables, results changed only trivially. Therefore, untransformed data are reported.

Four, heterogeneity of slopes was tested by models with interactions between factors and co-variates. This yielded two significant findings, namely for the HLOC-subscale 'chance' for BMI*AGE ($F_{(7,860)} = 3.23$, $p = .022$), and the SF-12-measure 'mental health' for SEX*AGE ($F_{(7,860)} = 8.38$, $p = .004$). Closer

[2] In an earlier publication (Janßen et al. 2000), the term 'self-mastery' instead of 'self-responsibility' has been used. However, personal communication of the present first author with HLOC-theory's originator (Wallston 2004, Feb. 20) has revealed that 'self-responsibility' is more appropriate since it more precisely draws the distinction to 'health competence', i.e. beliefs in one's self-efficacy to behave healthily (see also Wallston 1992). Also, the scale-label "powerful others" is supplemented or used exchangably by the term "doctors" in the following, to indicate the specific type of "others" addressed in these items (see also Wallston et al. 1994)

Table 2 Description of outcomes across BMI-groups for women and men (unadjusted statistics)

outcome	sex	statistic	normal-weight	pre-obese	obese class 1	obese classes 2–3
sense of coherence (SOC)	*women*	**mean**	**71.4**	**72.5**	**71.0**	**70.0**
		std. dev.	10.7	9.4	9.3	9.7
	men	**mean**	**73.3**	**74.7**	**73.9**	**72.8**
		std. dev.	9.5	8.6	8.3	11.4
HLOC: 'self-responsibility'	*women*	**mean**	**12.0**	**12.0**	**12.0**	**12.2**
		std. dev.	2.1	2.0	1.8	2.0
	men	**mean**	**13.0**	**12.7**	**12.6**	**12.5**
		std. dev.	2.0	1.8	1.9	1.9
HLOC: 'self-blame'	*women*	**mean**	**9.5**	**9.7**	**9.7**	**10.0**
		std. dev.	2.2	2.0	2.0	2.4
	men	**mean**	**10.4**	**10.1**	**10.6**	**10.7**
		std. dev.	1.9	2.3	2.2	2.1
HLOC: 'doctors'	*women*	**mean**	**9.3**	**9.8**	**10.6**	**10.4**
		std. dev.	2.2	2.4	2.4	2.3
	men	**mean**	**10.0**	**9.9**	**10.3**	**10.3**
		std. dev.	2.3	2.5	2.4	2.5
HLOC: 'chance'	*women*	**mean**	**9.4**	**9.7**	**9.8**	**10.4**
		std. dev.	2.0	2.2	2.1	2.4
	men	**mean**	**9.4**	**9.4**	**10.0**	**9.5**
		std. dev.	2.5	2.3	2.4	2.2
SF-12: 'mental health'	*women*	**mean**	**50.5**	**49.7**	**48.7**	**48.5**
		std. dev.	8.6	10.4	11.0	10.9
	men	**mean**	**52.8**	**53.0**	**53.7**	**52.8**
		std. dev.	8.1	8.1	7.9	10.0
SF-12: 'physical health'	women	mean	48.7	47.2	43.8	44.6
		std. dev.	8.2	8.4	10.5	9.5
	men	mean	49.0	49.5	47.3	43.2
		std. dev.	8.9	8.2	8.2	9.6

inspection revealed in the former case that the association between age and the 'chance'-belief decreases with BMI (from 20% to 8% shared variance), and in the latter that age and mental health co-varied more strongly in women than in men (both, however, on a low level [<1% shared variance]). In all, and keeping in mind these patterns to not overinterpret related results, slopes can generally be said to be homogenous.

Five, experiment-wise error was corrected for. If there was conceptual or empirical indication that outcomes for which significant differences across BMI-groups were found co-varied in non-trivial ways, it was analyzed whether using a *p*-level defined by dividing $p = .05$ by the number of affected variables changed conclusions. If so, multivariate ANCOVA were conducted, and if these substantiated the univariate tests (i.e. were significant), the latter were considered as robust, and indicating valid, interpretable variations.

Regarding missing data, 9% of the N = 942 non-underweight participants had incomplete data. Analyses were run both for the N = 877 "complete cases", and for all N = 942, using imputations of means on unit and item levels. Since this led to trivial changes, "complete cases"-analyses are reported.

Results

Description. Table 2 reports outcome distributions across BMI-groups (as noted, statistical tests are reported in the subsequent section). For SOC, contrary to expectation the highest mean is found in those with pre-obesity among both sexes, not in those with normal-weight. As expected, the lowest mean within each sex pertains to the severely obese (classes 2–3).

Among HLOC-subscales, the largest variation is found for the externality-subscale 'doctors' among women. For 'self-responsibility' among women, the range of means is comparably small. Regarding directions, as expected higher means generally pertain to obese groups regarding external HLOC and internal 'self-blame'. Regarding 'self-responsibility', differences are in line with predictions for men only, among whom the highest mean pertains to those normal-weight.

Finally, for the 'mental health'-measure of the SF-12, ranges of means are smaller than for 'physical health'. Among both sexes, there is a trend in that the physical HQOL-feature decreases with BMI. Also, within each sex there are drop-offs. Among women, the largest decrease is found from the

	BMI (four groups)		SEX		BMI * SEX	
outcome	$F_{(3,869)}$	p	$F_{(1,869)}$	p	$F_{(3,869)}$	p
SOC	1.3	.277	6.0	.015	0.1	.943
HLOC: 'self-responsibility'	0.6	.618	18.5	<.001	1.0	.410
HLOC: 'self-blame'	0.5	.674	24.6	<.001	0.8	.522
HLOC: 'doctors'	2.9	.035	2.9	.089	2.7	.045
HLOC: 'chance'	1.2	.326	0.2	.644	0.6	.630
SF-12: 'mental health'	0.2	.881	22.9	<.001	0.9	.452
SF-12: 'physical health'	8.7	<.001	0.9	.326	2.8	.039

Table 3 Results of analyses of covariance (ANCOVA, two factors: BMI-group and SEX, adjusted for age and socio-economic status)

Table 4 Interrelationships between sense of coherence (SOC), health locus of control (HLOC), and health-related quality of life (SF-12)

		HLOC: 'self-responsibility'	HLOC: 'self-blame'	HLOC: 'doctors'	HLOC: 'chance'	SF-12: 'mental health'	SF-12: physical health'
SOC	*zero-order*	.07	–.02	–.12	–.09	**.39**	**.16**
		p = .031	p = .552	p < .001	p = .005	***p* < .001**	***p* < .001**
	*partial**	.06	–.03	–.11	–.07	**.37**	**.14**
		p = .096	p = .449	p = .001	p = .035	***p* < .001**	***p* < .001**
HLOC: 's.-res.'	*zero-order*		**.51**	.01	.11	.09	.11
			***p* < .001**	p = .836	p = .001	p = .009	p = .001
	partial	.	**.51**	.04	.13	.06	.08
			***p* < .001**	p = .291	p < .001	p = .061	p = .014
HLOC: 's.-bla.'	*zero-order*			**.15**	**.21**	.08	.06
				***p* < .001**	***p* < .001**	p = .016	p = .059
	partial			**.11**	**.20**	.05	.10
				***p* < .002**	***p* < .001**	p = .110	p = .004
HLOC: 'doctors'	*zero-order*				**.40**	.03	**–.23**
					***p* < .001**	p = .441	***p* < .001**
	partial				**.25**	–.01	–.07
					***p* < .001**	p = .930	p < .051
HLOC: 'chance'	*zero-order*					.01	–.08
						p = .762	p = .014
	partial					–.01	–.08
						p = .963	p = .020
SF-12: 'm. h.'	*zero-order*						–.07
							p = .032
	partial						–.08
							p = .017

Note: Pearson product moment coefficients are shown; coefficients representing ≥2 % shared variance are highlighted. * Partial correlations controlled for sex, age, BMI, and SES.

pre-obese to those in obesity class 1, while among men, a (numerically larger) drop-off is observed from moderate to severe obesity (see results of contrast analyses in Table 5 for significance of these trends).

Modelling. To rule out chance variations and confounding by age and SES, ANCOVA models were conducted as outlined. Table 3 presents the results. Contrary to expectations, differences across BMI-groups are not statistically significant for SOC, internal HLOC-subscales, external HLOC 'chance', and 'mental health' (SF-12). In contrast, significant associations are found regarding the externality-subscale 'doctors', and most notably HQOL in terms of 'physical health'. Also, both differences are modified by sex, indicated by significant BMI*SEX-interactions (also, this interaction turned out significant for these outcomes only).

To appraise these differences against the background of co-variations among the outcome variables, Table 4 shows these inter-correlations (Pearson), both zero-order, and as partial coefficients (controlled for sex, age, BMI, and SES). The SOC-indicator shows large associations with the two

(a) HLOC: 'doctors'

	simple effect among women		simple effect among men		interaction with factor "SEX"	
contrast	$F_{(1,870)}$	p	$F_{(1,870)}$	p	$F_{(1,873)}$	p
"25 ≤ BMI <30 vs 18.5 ≤ BMI <25"	1.3	.250	0.0	.971	0.1	.717
"30 ≤ BMI <35 vs 18.5 ≤ BMI <25"	15.3	<.001	0.1	.814	4.8	.029
"BMI ≥35 vs 18.5 ≤ BMI <25"	7.8	.005	0.0	.956	3.0	.082

(b) SF-12: 'physical health'

	simple effect among women		simple effect among men		interaction with factor "SEX"	
contrast	$F_{(1,870)}$	p	$F_{(1,870)}$	p	$F_{(1,873)}$	p
"25 ≤ BMI <30 vs 18.5 ≤BMI <25"	0.9	.330	0.2	.624	1.1	.302
"30 ≤ BMI < 35 vs 18.5 ≤ BMI <25"	14.9	< .001	0.8	.384	4.6	.033
"BMI ≥35 vs 18.5 ≤ BMI <25"	4.8	.028	17.3	< .001	3.7	.055

Table 5 Results of contrast analyses for external health locus of control in terms of 'doctors' and 'physical health'-related quality of life (simple effects of BMI-contrasts, and interactions of these contrasts with SEX, from ANCOVA; all adjusted for age and socio-economic status)

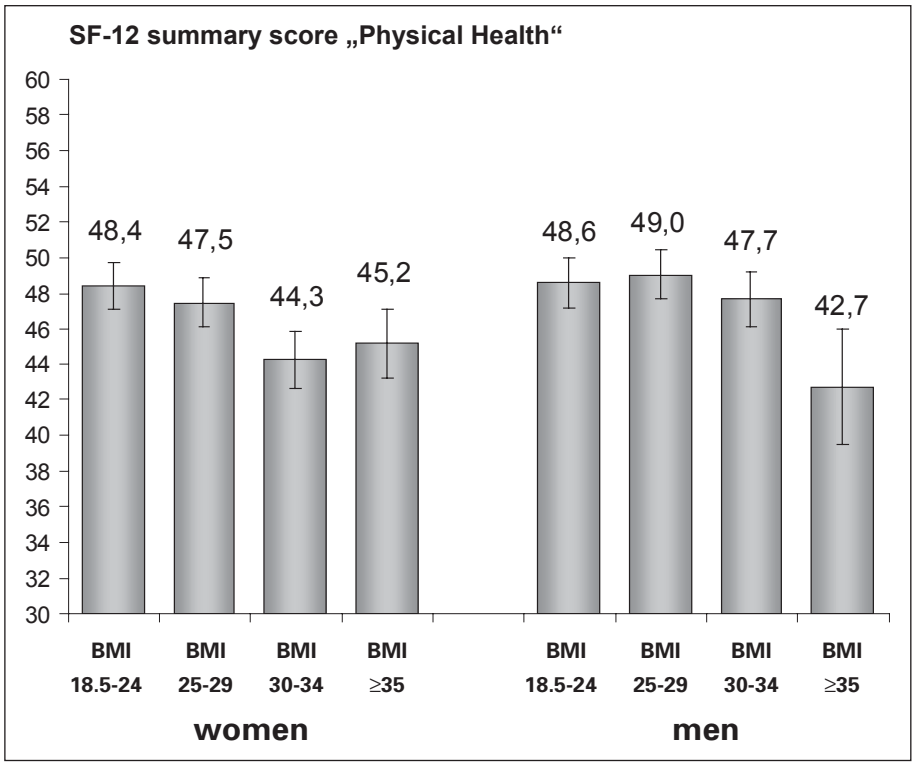

Figure 1 'Physical health'-related quality of life (SF-12 summary score) by BMI for women and men (means and 95 % confidence intervals all adjusted for age and socio-economic status)

HQOL-measures, especially with that for 'mental health'. HLOC-subscales by and large show significant associations only among each other, expectably with largest coefficients for 'self-responsibility' and 'self-blame', and 'doctors' and 'chance'. Finally, the externality-dimension of belief in doctors is negatively associated with HQOL in terms of 'physical health', however collapses in the partial correlation case (further inspection revealed that this is attributable to age).

Yet, the significant zero-order correlation between HLOC-'doctors'-subscale and the SF-12-'physical health'-score raises concerns about the significant results for BMI and the BMI*SEX-interaction in ANCOVA (i.e., about experiment-wise error). Specifically, on $p = .025$ ($p = .05$ divided by the number of affected variables), only the main effect of the BMI-factors retains significance. Thus, a multivariate ANCOVA was conducted for these two outcomes. As this analysis yielded sig-

nificant results for all effects significant in the ANCOVA (BMI: Wilks-Lambda = .96, $p < .001$; BMI*SEX: Wilks-Lambda = .98, $p = .016$), the latter were judged as robust, and indicative of interpretable differences between subgroups.

Contrast analyses. To clarify the meaning of the significant differences across BMI-groups and sexes in 'doctors'-HLOC and subjective physical health (SF-12), Table 5 shows the results of the respective contrast analyses. First, a nonsignificant variation across BMI-groups is found in the HLOC-scale among men. In contrast, women with 30 ≤ BMI <35 and BMI ≥35 significantly differ from those normal-weight in that they more strongly believe in doctors' control over their health.

Second, for 'physical health', comparable but more pronounced patterns are found. As Figure 1 illustrates, among women both obese groups differ significantly from those in normal-weight range in that they report significantly lower HQOL in this domain (see also Part (b), Table 5).

Among men, the pattern differs both from that regarding the HLOC-belief, and from that for 'physical health' among women. On one hand, the difference between the severely obese and those normal-weight is highly significant (again, see Fig. 1, and specific contrast in Table 5, Part (b)). On the other, comparing 'physical health' across the BMI-groups among men vs. women confirms the descriptive results mentioned before: while among both sexes, the severely obese report poorer quality of life in this domain than those normal-weight, this holds for those moderately obese among women only.

Finally, the question remains whether these sex-specific patterns indicate significant differential gradients. To test this, Table 5 (last column) reports the interactions of contrasts between the three overweight groups, respectively, and those normal-weight with the factor SEX. Evidently, interactions for the pre-obese ("25 ≤ BMI <30 vs. 18.5 ≤ BMI <25") are nonsignificant, and those for the severely obese ("BMI ≥35 vs. 18.5 ≤ BMI <25") marginally significant. On the contrary, contrasts of the obesity class 1-group ("30 ≤ BMI <35 vs. 18.5 ≤ BMI <25") yield significant tests both in case of the HLOC-belief, and physical health. This indicates that while obese men feel physically impaired and dependent on doctors only if severely obese, all obese women do so.

Discussion

In a population health survey in a Southern German region, and to our knowledge for the first time within the one sample, this study compared pre-obese, moderately obese, and severely obese adults with those normal-weight regarding SOC, HLOC, and HQOL. Differences were found on two dimensions. First, external HLOC regarding 'doctors' was elevated among obese women. Second, obese women and severely obese men reported impaired health-related quality of life as measured by the physical summary score of the SF-12. Also, co-variations between outcomes were generally small across psychological attributes. The highest association pertained to SOC and the HQOL-dimension 'mental health' (which is in line with previous reviews of the SOC-construct (Geyer 1997)).

A strength of this study is that it was conducted within a survey with rigorous quality assurance, and that it used standardized, validated instruments. Yet, some weaknesses remain. First, social desirability and negative affectivity could not be adjusted for. However, since the relevant survey module did not make explicit its scientific target, strategic responses to avoid stigmatization seem unlikely. Second, proportions of variance explained by BMI were small, even regarding outcomes with significant results (range: 1 %–3 %, plus 1 % each attributable to the BMI*SEX-interaction). However, explorative analyses showed that those reporting the poorest physical health, i. e. severely obese men, were almost as bad off as respondents with type-2-diabetes. Thus, this HQOL-burden does not seem all that minor in terms of clinical significance. Third, and most troublesome, the study is cross-sectional, and thus reversed or bi-directional causality are possibilities that cannot be ruled out.

Substantively, the study replicates findings which found little differences in SOC across obesity groups in a Swedish sample (Nilsson et al. 2003). A comparable assertion pertains to internal HLOC, i. e. the tendency to place the locus of causation for one's health into oneself. Probably, this relates to the quite moderate role internal HLOC has been acknowledged to play for health behaviours (Wallston 1992). That is, it connotes self-responsibility and self-blame for health, but does not imply self-mastery or self-efficacy for behaviours. At the same time, external HLOC regarding 'doctors' was slightly elevated, at least in obese women. Possibly, people with impaired physical health interact more often with health professionals, and may be more prone to believe these professionals are able to help, which may then reflect higher confidence. Also, that the effect is confined to women, who utilise health services more often (Bergmann & Kamtsiuris 1998), might add some validity to this tentative interpretation.

As for HQOL, the present results largely confirm earlier work in that physical but not mental health co-varies with BMI (Seidell & Tijhuis 2002; Kolotkin et al. 2002). Provocatively, one might conclude that obese individuals are physically impaired, but psychologically inconspicuous. Of course, this conclusion again is tentative. Notably, the present study comprised neither psychopathological outcomes (depression, anxiety) nor personality characteristics (neuroticism, dispositional optimism). However, conceptual and empirical overlaps e. g. of the SOC-construct with depression and anxiety (Geyer 1997) imply the need to further examine, and be critical of,

associations of obesity with (adverse) mental characteristics.
Finally, one last result merits discussion. While moderately and severely obese women (30 ≤ BMI <35 and BMI ≥35) presented significantly lower scores for physical HQOL than their normal-weight peers, among men this was found only for the severely obese group (BMI ≥35). Also, the interaction of the contrast "30 ≤ BMI <35 vs. 18.5 ≤ BMI <25" with the factor SEX turned out to be statistically significant. Thus, for this outcome, the predicted differential gradients across BMI-groups for women vs. men were confirmed. This may indicate that men "need" exposition to a higher degree of obesity (or make use of a different "threshold") than women before experiencing physical limitations. Of course, whether this reflects gender differences in body image, symptom awareness, or propensities to mask problems due to body size, remains to be determined. At any rate, these results advise obesity research to distinguish severe from moderate obesity. Recently, for instance, studies showed that severely obese adults utilize health services more often than their moderately obese peers (von Lengerke et al. 2005; 2006).
In more practical terms, the present study primarily implies to focus on psychological variables such as health competence and self-efficacy, known to facilitate health behaviours (Wallston 1992; Schwarzer 2001). Related to this, obesity's sometimes pronounced resistance to change may be more successfully overcome by targeting attributes less stable than SOC or HLOC. For instance, the improvement of low pre-treatment HQOL (Teixeira et al. 2005) may be a promising intervention.
Finally, future research should consider the following. First, community-level variables are important. For instance, McLaren and Gauvin (2002) found among Canadian women that, for a given body mass, body weight dissatisfaction was more likely in affluent neighbourhoods, despite higher obesity rates in less affluent neighbourhoods. Analogously, one may hypothesize that obese individuals living in communities with higher obesity prevalence might perceive lesser limitations in physical quality of life. Second, within the generational taxonomy of studies on psychological correlates of obesity (Friedman & Brownell 2002), the present study represents but a second-generation approach. Third-generation, especially longitudinal studies are needed to model causal or reciprocal relationships (Roberts et al. 2003).

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Zusammenfassung

Kohärenzgefühl, gesundheitsbezogene Kontrollüberzeugungen und gesundheitsbezogene Lebensqualität bei adipösen Erwachsenen: physische Einschränkungen und psychische Normalitäten
Ziel: Bestimmung von Unterschieden im Kohärenzgefühl (SOC), in gesundheitsbezogenen Kontrollüberzeugungen (HLOC) und in der gesundheitszogenenen Lebensqualität (HQOL) zwischen über- und normalgewichtigen Erwachsenen.
Methoden: Querschnittsurvey einer Zufallsstichprobe der Bevölkerung im Alter von 25–74 in der Region Augsburg (N = 947). Der Body Mass-Index (BMI) wurde in vier Gruppen kategorisiert (Normalgewicht: 18.5–25; Präadipositas: 25–29.9; moderate Adipositas: 30–34.9; starke Adipositas: ≥35). Die Zusammenhänge zwischen Adipositas-Klassifikation und dem SOC-13T, den MHLOC-Skalen und den SF-12-Summenskalen wurden durch Kovarianzanalysen analysiert.
Ergebnisse: Adjustiert für Alter und sozioökonomischen Status wurden keine Unterschiede zwischen den BMI-Gruppen im SOC, internalem und fatalistischem HLOC, und in der psychischen Lebensqualität (SF-12) festgestellt. HLOC-'Ärzte' war bei adipösen Frauen geringfügig erhöht. Größere Unterschiede betrafen die physische Lebensqualität (SF-12): die subjektive körperliche Gesundheit war bei adipösen Frauen und stark adipösen Männern im Mittel wesentlich reduziert.
Schlussfolgerungen: In dieser Bevölkerungsstichprobe Erwachsener war Adipositas weder mit SOC und HLOC noch mit psychischer Lebensqualität, jedoch mit eingeschränkter körperlicher Lebensqualität assoziiert, und zwar in beiden Gruppen adipöser Frauen sowie bei stark adipösen Männer. Diese Ergebnisse unterstreichen den Bedarf an Behandlung und Prävention der Adipositas zur Wiederherstellung und Förderung körperlicher Gesundheit, und die Bedeutung der Unterscheidung von moderater vs. starker Adipositas in der Adipositasforschung.

Résumé

Sentiment de cohérence, «health locus of control», et qualité de vie d'adultes obèses : limitations physiques et normes psychologiques

Objectifs: Evaluer différences présentées par des adultes de poids normal et en surpoids en matière de sentiment de cohérence (SOC), de « health locus of control » (HLOC) et de qualité de vie en lien avec la santé.

Méthodes: Etude populationnelle transversale (Augsbourg, Allemagne). Echantillon aléatoire (25–74 ans, N = 947). Les indices de masse corporelle (IMC) ont été répartis en quatre catégories: poids normal (18.5–25), pré obèse (25–29.9), obésité modérée (30–34.9), obésité sévère (≥35). Les associations entre cette classification de l'obésité et différentes échelles (SOC-13T, MHLOC-Scales, SF-12 summary scores) ont été estimées au moyen d'analyses de covariances.

Résultats: Après avoir ajusté pour l'âge et le statut socio-économique, aucune différence n'a été trouvée entre les groupes d'IMC en ce qui concerne le SOC, le HLOC interne, le HLOC-'hasard' externe, ainsi que le SF-12-'santé mentale'. Le HLOC-'médecins' était marginalement élevé chez les femmes obèses. De plus grandes différences ont été constatées dans le SF-12-'santé physique' qui était considérablement réduit chez les femmes obèses et chez les hommes sévèrement obèses.

Conclusions: Dans cet échantillon populationnel d'adultes, l'obésité n'est associée ni avec le SOC, ni avec le HLOC, ni avec le HQOL en termes de santé mentale. L'obésité est par contre associée avec une mauvaise santé physique, chez tous les groupes de femmes obèses et par les hommes très obèses. Ces résultats mettent en évidence de besoin de traiter et de prévenir l'obésité de manière à rétablir et à promouvoir la qualité de vie en lien avec la santé. Il importe également de distinguer entre l'obésité modérée et l'obésité sévère dans la recherche consacrée à l'obésité.

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