Scand J Work Environ Health 1988;14(4):257-264

<https://doi.org/10.5271/sjweh.1923>

Issue date: Aug 1988

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by [Harenstam AB](#), [Theorell TP](#)

Affiliation: Swedish Foundation for Occupational Health and Safety for State Employees, Norrköping.

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/3175559

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Work conditions and urinary excretion of catecholamines — A study of prison staff in Sweden

by Annika B Härenstam, MA,^{1,2} Töres PG Theorell, MD, PhD²

HÄRENSTAM AB, THEORELL TPG. Work conditions and urinary excretion of catecholamines — A study of prison staff in Sweden. *Scand J Work Environ Health* 14 (1988) 257–264. The hypothesis to be tested was whether characteristics of work situations affect the physiology of people when the effects of individual differences in medical/behavioral factors are minimized. Four prisons with different objective work conditions were chosen. The psychosocial work situation was recorded in a self-administered questionnaire. Morning plasma cortisol, blood pressure, and urinary excretion of catecholamines were measured. Analyses of variance showed that the four prisons differed significantly as to mean levels of decision latitude and skill discretion. Analyses of variance also showed significant differences between the prisons with regard to mean levels of noradrenaline at night during leisure time and a tendency towards differences in work time. The rank order of mean levels of noradrenaline in the four prisons was the same as the inverted rank order of mean levels in self-reported work conditions. Thus it seems that when collective data are used and when adjusted for other variables which might have an association with the dependent variables, differences in self-reported work conditions are reflected in the urinary excretion of noradrenaline. Of the three physiological variables used as dependent variables, urinary excretion of noradrenaline reflected arousal as an effect of work conditions more accurately than the other variables.

Key terms: blood pressure, cortisol, prison personnel, psychosocial work environment.

To work in a prison is considered to be psychologically demanding. Several studies have reported that prison guards describe a high degree of role conflict, few possibilities to see results, and difficulties in their daily contact with criminals and drug addicts (2, 7, 8, 13, 15).

In Sweden there are about a hundred prisons of various sizes (10–400 employees) ranging from open institutions to closed, high-security ones. The prisons take different categories of prisoners. Some take mainly those who have long sentences and with a strong criminal identity and others take prisoners with short sentences for crimes like driving under the influence of alcohol, economic crimes, etc. Thus the staff's objective work conditions vary greatly (4, 5). Because of the wide variations in objective work conditions despite the homogeneity in kind of employment and work culture, the prison world was considered optimal for exploring the association between psychosocial climate and physiological parameters. Four widely different prisons were selected for this purpose.

Several aspects of self-reported work conditions might be associated with stress and health status, eg, a low level of decision latitude and an unsupportive psychosocial climate. According to physiological theory (6, 12, 14), conditions associated with a low level of decision latitude and poor social support may result

in a sense of threat of losing control, and this phenomenon may activate the adrenocortical system. Such an activation should be reflected by an elevated level of plasma cortisol. The degree of objective arousal is reflected in the urinary excretion of catecholamines (11), as well as by elevated blood pressure during activity (16).

The main hypothesis to be tested in this study was whether characteristics in work situations affect the physiology of the people when the effects of individual differences in other variables which might have an association with the dependent variables are minimized. Since self-reports of the psychosocial work environment may be distorted by individual personality traits, collective measures were used in the present study. Therefore the average opinion of the personnel in the studied prisons was used as a basis for analysis rather than the person's opinion. In order to make comparisons with results from analyses with data on an individual level, such analyses were performed as well.

Subjects

Four different prisons were chosen so that their size, security level, and category of inmates varied. All four were situated in or close to small or medium-sized towns (the largest with a population of 110 000). The prisons can be described as follows (assessments of climate, etc, were based on interviews with staff and direct observation): Prison A was an open medium-sized prison (70 places) for mainly young prisoners with good prognosis. The prison had possibilities for vocational training in farming, forestry, and gardening, as well

¹ The Swedish Foundation for Occupational Health and Safety for State Employees, Norrköping, Sweden.

² The National Institute of Psychosocial Factors and Health, Stockholm, Sweden.

as education. There were 53 employees, ie, 29 guards, 8 supervisors, 4 administrators, and 13 persons as maintenance staff. Prison B, a closed small prison (40 places), had a high turnover of prisoners from the local region. The prisoners had short sentences (not more than one year) and were occupied in a small-sized industry. There were 31 employees, ie, 22 guards, 3 supervisors, 2 administrators, and 4 persons as maintenance staff. Prison C was a closed maximum security prison with a relatively large number of inmates (170 places) with medium to long sentences. The staff was small in relation to the number of inmates. There were 146 employees, ie, 91 guards, 35 supervisors, 6 administrators, and 24 persons as maintenance staff. The inmates were occupied in the mechanical and woodware industries. Prison D, a closed but small security prison (40 places), had a maximum security wing taking long-term prisoners. The sentences averaged seven years. Security was a major requirement. The inmates were occupied in studies and small-sized industry for assembly work. The size of the staff was large in relation to the number of inmates. There were 98 employees, ie, 78 guards, 4 supervisors, 3 administrators, and 13 persons as maintenance staff.

Stratified samples of the male staff members were selected on the basis of the number of years of employment. Out of the total number of persons ($N = 77$) asked to participate, 11 (14 %) refused to take part in the study. Thus 66 men participated. They belonged to three categories of employees, namely, administrators ($N = 4$), supervisors ($N = 25$), and guards ($N = 37$). Some of the guards (eight persons) worked the dayshift only, while the others (29 persons) were on a rotating day-night schedule.

Methods

A self-administered questionnaire was used which comprised several groups of questions. On the basis of factor analysis, the following dimensions were obtained: (i) decision latitude, (ii) skill discretion, (iii) job demands, and (iv) psychosocial climate. (See the appendix.) Each item was graded from 1 to 4. For each dimension a total score was computed by simple addition. Thus for decision latitude the scores ranged from 2 to 8, for skill discretion from 6 to 24 (high score = high decision latitude and skill discretion), for job demands from 14 to 56 (high score = low job demands), and for psychosocial climate from 14 to 56 (high score = good climate). The basis for the construction of the dimensions has been presented in a previous paper (10). The original "decision latitude," which included nine items, had an eigen value of 3.05. For the present study, seven items were excluded because they were not applicable to this population. The dimensions "skill discretion," "job demands," and "psychosocial climate" were slightly changed. One item was excluded from the original skill discretion dimension,

three were excluded from job demands, and two from the psychosocial climate dimension. Their eigen values were 3.44, 7.95, and 6.48, respectively. In addition to these dimensions, type of work (administrator, supervisor, guard), shift work schedule (day-night rotation or day work only), and self-reported physical activity during the studied period were recorded as factors of possible importance to the physiological variables.

Semi-structured interviews about the work and life situation were also used. Each interview lasted for approximately 2 h. They were tape-recorded and typed. The answers were analyzed and categorized by two persons independently. Each answer was treated separately from other information about the subject, for example, which prison he worked at. Some results from the analyses of the interviews are used in this paper in order to add qualitative data to the statistical results from the quantitative data. The following medical/behavioral factors which could be associated with the physiological factors were studied: number of cigarettes/day, estimated self-reported weekly consumption of alcohol (grams of pure alcohol), estimated self-reported daily consumption of coffee.

The physiological factors used as dependent variables were average systolic and diastolic blood pressure during workhours and leisure time, morning plasma cortisol, and urinary excretion of catecholamines (picomole per minute during the day and night). The measurements of these variables took place in three different 24-h periods during the same week. One period was leisure time. The subjects were off-work during two to three 24-h periods every week. The last of these periods was chosen as leisure time. The other two periods covered a full 24 h each, including work (8–12 h of the period). They were the first and the last 24-h period during the studied week. The mean of the two work periods was calculated. During the last period 19 subjects were on the nightshift and the rest worked during the day.

For all six periods the urinary excretion of catecholamines, noradrenaline, and adrenaline was analyzed. The analyses were made according to Euler & Lishajko (3) after modification by Andersson et al (1).

Blood for analyzing morning plasma cortisol was drawn twice during the studied week. The subjects were instructed not to eat, drink, or smoke within 12 h of the blood tests. The first blood sample was taken in the morning just before the start of the first workday in the week. The second was taken in the morning just before the start of the last workday in the week for those who worked only days and just after the last work period in the morning for those who were on the nightshift.

Blood pressure during the workhours and leisure time was measured by means of a self-triggered apparatus. The men were instructed to measure their own blood pressure in the sitting position once every hour without previous rest (16). The systolic pressure measured in this way correlates highly with conventional

blood pressure measurement (interrater reliability $r = 0.8-0.9$) made on the same occasion.

Statistical methods

Stepwise multiple regression was used in the analysis of the data of the individuals. No variables were forced into the equation. A conventional "forward" procedure was used. One-way analysis was used in the analysis of differences between prisons. Two variables, namely, age and social status in one of the analyses (table 1) and reported alcohol consumption, as well as night work, in the other (table 2), were used as covariates. The rationale of using these covariates was to explore whether significant differences between the prisons with regard to the dependent variable could be explained by these factors.

Results

As a test of the main hypothesis a series of comparisons between the four prisons was made (collective analysis). The *first step* was to test whether there were statistically significant differences in the mean levels of medical/behavioral variables between the four prisons. Analyses of variance were used for this purpose. These analyses showed that there were no significant differences with regard to the mean levels of relative weight (body mass index), age, coffee consumption, smoking habits, and degree of physical activity during leisure time and work between the four prisons. However, there tended to be different proportions of men working at night during the studied period ($F = 2.64$, $P = 0.06$), and there were significantly different mean levels of alcohol consumption in the prisons ($F = 3.07$, $P = 0.03$). By means of a chi-square analysis it was further tested if there were differences between the four prisons with regard to proportions of the three staff categories, and no significant differences were found.

The *next step* was to test whether there were statistically significant differences in self-reported work conditions between the four prisons (table 1). These analyses of variance were adjusted for age and social status (staff category). The social status scale was not a proper ordinal scale but was treated like one in the analyses presented in tables 1 and 4. Social status was adjusted for because in earlier analyses there had been significant associations between category of staff and self-reported work conditions (5). The mean levels of the self-reported work condition scales were lowest (=least favorable) for the guards. The men in this group also had the least education and the lowest salary (after shift-work compensation was excluded). The mean levels of the scales for self-reported work condition were the highest (=most favorable) for the administrators. The men in this group also had the most education and the highest salary. Therefore it was considered to be important to adjust for social status. The

staff in prison A, the only open prison, seemed to have the highest skill discretion and decision latitude, and the staff in prison B the lowest. The psychosocial climate seemed to be the most favorable in prison A and the least favorable in prison B. The staff in prison B also reported the highest job demands.

The *third step* was to test whether there were statistically significant differences in the means of catecholamine excretion between the four prisons during work-hours (day and night) and leisure time (day and night), systolic blood pressure during work, and leisure time and morning plasma cortisol (table 2). The means were not only adjusted for age, but also for night work and alcohol consumption, as there were differences between the four prisons in the distribution of night-workers and in the means of alcohol consumption. The results of the analyses showed that there was a statistically significant difference between the four prisons only with regard to noradrenaline output during the night after a day of leisure, ie, the night before a work period. Prison A had the lowest adjusted mean level of noradrenaline, and prison B the highest. There tended to be a difference also with regard to the daytime noradrenaline output during the periods of work and leisure. Again, the mean levels were lowest in prison A, and highest in prison B. There were no significant differences between the four prisons in the mean levels of the systolic blood pressure or in the mean levels of morning plasma cortisol.

Corresponding analyses were subsequently performed on the individual level. For this purpose, all the subjects were "pooled." It therefore became possible to explore the differences in the collective and individual characteristics explaining the physiological factors. Therefore, the *fourth step* was to test whether body mass index, self-reported coffee and alcohol con-

Table 1. Results of the one-way analyses of variance of the means of the four prisons with skill discretion, job demands, decision latitude, and psychosocial climate as the dependent variables and also the results as adjusted for age and social status.

Dependent variable	Adjusted mean	N	
Skill discretion			
Prison A	16.32	16	
Prison B	12.76	15	$F = 3.57$
Prison C	14.26	21	$P < 0.05$
Prison D	15.22	13	
Job demands			
Prison A	36.61	16	
Prison B	34.14	15	$F = 2.02$
Prison C	34.26	21	$P < 0.10$
Prison D	38.16	13	
Decision latitude			
Prison A	5.24	16	
Prison B	3.79	15	$F = 4.71$
Prison C	4.32	21	$P < 0.01$
Prison D	5.23	13	
Psychosocial climate			
Prison A	42.75	16	
Prison B	38.50	15	$F = 2.40$
Prison C	39.61	21	$P < 0.10$
Prison D	42.47	13	

sumption, smoking habits, and physical activity during the studied period had a statistically significant association with the excretion of catecholamines during the workhours and leisure time (day and night), systolic blood pressure during work and leisure time, and morning plasma cortisol (table 3). The *final step* included multivariate analyses with levels of catechola-

mine excretion during the different periods and systolic blood pressure during activity as dependent variables and self-reported work conditions, night work, age, and social status as the explaining variables (table 4).

The objective of these statistical procedures was to explore whether the observed physiological differences between the prisons could be due to psychophysiological reactions to the environment rather than to differences between individual characteristics that could be differently distributed among the employees in the four prisons.

Table 2. Results of the analyses of variance with the physiological variables as dependent variables and the four prisons as the explaining variables. The analyses were adjusted for reported alcohol consumption and night work as there were significant differences between the four prisons with regard to these factors.^a

Dependent variable	Adjusted mean	N	
Noradrenaline (pmol/min), nighttime (leisure-time measurement)			
Prison A	86.0	14	F = 4.92 P = 0.005
Prison B	147.9	12	
Prison C	95.7	19	
Prison D	100.1	11	
Noradrenaline (pmol/min), daytime (mean of two workdays)			
Prison A	166.0	14	F = 2.30 P = 0.09
Prison B	237.7	12	
Prison C	220.0	20	
Prison D	197.3	13	

^a There were no significant differences between the four prisons for the following variables: noradrenaline, daytime (leisure-time measurement); adrenaline, daytime (leisure-time measurement); noradrenaline, nighttime (leisure-time measurement); noradrenaline, nighttime (mean of two workdays); adrenaline, daytime (mean of two workdays), and adrenaline, nighttime (mean of two workdays).

Discussion

As individuals differ with regard to life style and personal characteristics and these differences could influence how they describe work conditions, collective measures were used in the main analyses. For the testing of the main hypothesis it was important to determine whether there were any significant differences between the four very different prisons with regard to other factors which could have an association with the physiological variables.

Two variables showed differences between the prisons, namely, proportion of night workers and mean level of self-reported alcohol consumption. These two variables were adjusted for in the aggregated analyses. Neither degree of physical activity nor smoking habits differed significantly between the four prisons. These

Table 3. Significant ($P < 0.05$) results of the multivariate regression analyses with the physiological variables as dependent variables and body mass index, self-reported coffee consumption (number of cups per day), self-reported number of cigarettes per day, physical activity during leisure time, and workhours (arbitrary units) as the explaining variables.^a

Dependent variable	Step	Significant explaining variable	Standardized regression coefficient	t	P	Direction
Noradrenaline, nighttime (leisure-time measurement)	1	Physical activity in leisure time	0.49	3.05	0.005	The more activity, the higher the noradrenaline
Adrenaline, daytime (mean of two workdays)	1	Smoking (number of cigarettes/day)	0.78	2.00	0.05	The more smoking, the higher the adrenaline
Systolic blood pressure, leisure time	1	Age	0.52	3.52	0.001	The older, the higher the blood pressure
Systolic blood pressure, workhours	1	Age	0.51	3.41	0.002	The older, the higher the blood pressure
Cortisol, early morning of first workday in the period	1	Night work	-0.56	2.12	0.04	Subsequent night work associated with lower morning cortisol
Cortisol, early morning of first workday in the period	2	Physical activity in leisure time	-0.37	-2.27	0.03	The more physical activity, the lower the morning cortisol

^a None of the explaining variables showed a statistical association with the following dependent variables: noradrenaline, daytime (leisure-time measurement); adrenaline, daytime (leisure-time measurement); adrenaline, nighttime (leisure-time measurement); noradrenaline daytime (mean of two workdays); noradrenaline, nighttime (mean of two workdays); adrenaline nighttime (mean of two workdays); cortisol, early morning during last workday in the period.

Table 4. Results of the multivariate regression analyses with the physiological variables as dependent variables and self-reported work conditions, night work, social status scale, and age as the explaining variables.^a

Dependent variable	Step	Significant explaining variable	Standardized regression coefficient	t	P	Direction
Noradrenaline, nighttime (leisure-time measurement)	1	Age	0.30	2.13	0.04	The older, the higher the noradrenaline
Adrenaline, nighttime (leisure-time measurement)	1	Psychosocial climate	-0.31	-2.0	0.05	The worse the climate, the higher the adrenaline
Noradrenaline, nighttime (mean of two workdays)	1	Skill discretion	-0.34	-2.09	0.04	The lower the skill discretion, the higher the noradrenaline
Adrenaline, daytime (mean of two workdays)	1	Staff category (social status)	0.45	2.83	0.01	The higher the status, the higher the adrenaline
Adrenaline, daytime (mean of two workdays)	2	Skill discretion	-0.40	-2.53	0.01	The lower the skill discretion, the higher the adrenaline
Systolic blood pressure, leisure time	1	Age	0.48	4.22	0.0001	The older, the higher the blood pressure
Systolic blood pressure, leisure time	2	Skill discretion	-0.53	-3.73	0.0005	The lower the skill discretion, the higher the blood pressure
Systolic blood pressure, work time	1	Age	0.51	4.22	0.0001	The older, the higher the blood pressure
Systolic blood pressure, work time	2	Skill discretion	-0.45	-3.07	0.004	The lower the skill discretion, the higher the blood pressure

^a None of the explaining variables showed a statistical association with the following dependent variables: noradrenaline, daytime (leisure-time measurement); noradrenaline, daytime (mean of two workdays); adrenaline, daytime (leisure-time measurement); adrenaline, nighttime (mean of two workdays); cortisol, early morning of first workday in period; cortisol, early morning of last workday in period.

factors, however, could have an impact on catecholamine excretion — which was shown in the individually based analyses.

Evidently, from the results of the individually based analyses, self-reported work conditions and known factors such as age, degree of physical activity and smoking had an impact on the physiology of the individuals in this study.

The results from the aggregated analyses showed that the work conditions as they were described by the studied personnel differed significantly between the prisons in two of the dimensions, namely, skill discretion and decision latitude. One of the prisons (prison A) had the most favorable means with regard to three of the dimensions. Prison A was the only open prison in the sample. This fact may explain why a rather good work situation was reported in comparison with what was reported for the closed prisons.

The employees in prison B described the worst work conditions with regard to all four dimensions, that is, the lowest decision latitude and skill discretion, the most unsupportive psychosocial climate, and the

highest job demands. The results of the interviews confirmed this finding. The majority of the staff in prison B considered their work meaningless. They also reported that they seldom or never see any results of the work (4). Examples of statements from the interviews at prison B:

“The only real hard thing about the work is that you see no meaning in it. I feel very disappointed most of the time. I wonder how many of the others have said so. It is so psychologically straining as you take that feeling with you home and cannot get rid of it.”

“The most negative thing about the work is that there is so little one can do for the inmates. Some of them do not even have a place to live when they are released. We [prison officers] can do nothing about that. They [managers and treatment staff] do not ask us about anything except when they want a report.”

“I do not know what the meaning of this job is. I thought it was to resocialize the inmates, but they return over and over again and remind us that we do not succeed.”

The majority of the staff in prison A and D described their work as rather meaningful and reported seeing results to some extent in doing something posi-

tive for the inmates. Examples of statements from interviews at prison A:

"One of our tasks is to give the inmates meaningful work while they are here. I think we can do that. Everybody from the governor to the officers and workshop staff are engaged in that and discuss with the inmates what could be best for them. We have so much we can offer here."

"The rules we have are meaningful. This is a collection of people so there must be rules. It wouldn't work if there were no rules for good order, hygiene, and discipline. This is routine here, and it makes the work much easier, as everybody agrees to have these rules."

"It is most important to show respect to the inmate's human value and that we try to help him return to society. We spend a lot of time together with the inmates here. We treat them as ordinary people, and they treat us in the same way. We have a tradition at this prison that there should be a good and open atmosphere between all categories of staff and between staff and inmates."

The dimension skill discretion used in the present study is an important component of the decision latitude dimension introduced by Karasek (9). It is interesting to note that the two dimensions decision latitude and skill discretion in the present study showed the same pattern in the four prisons.

In the last aggregated analyses it was found that the prisons differed significantly with regard to mean levels of night excretion of noradrenaline after leisure time. A tendency towards significant differences was seen during two other periods as well. The rank order of means of noradrenaline output levels in the four prisons was the same as the inverted rank order of mean levels of self-reported work conditions in the significant analyses. The prison with the worst work conditions also had the workers with the highest mean level of noradrenaline output, especially during the night after a leisure-time day. This night was also the night before a new work period started. As it is well known that the catecholamine output is associated with arousal, it seems as if the staff at the prison with the lowest skill discretion, decision latitude, high demands, and unsupportive psychosocial climate had more difficulties in relaxing during leisure time than the staff of prisons with better work conditions. They may be more worried and distressed by work during their leisure time. The difference is not so evident during work. It may be that there is more arousal for everyone at work; they have to be alert and prepared if difficult situations with the inmates should occur. The difference during leisure time may have been influenced by differences in the possibilities to see results in the work. There was also less support in difficult situations at the prison with lower skill discretion, etc. The unsupportive climate could mean that the staff tend to "carry the work" home with them, a situation which may lead to more arousal during leisure time.

There are not enough data in this study to establish why the self-reported work conditions differed between

the prisons. Prison A, the only open prison, which takes inmates with a better prognosis, was supposed to have the best work conditions and the results also confirm that it did.

It is interesting though that the staff at the most security-oriented prison (prison D) described rather good work conditions and had the next lowest mean level of noradrenaline output during two of the study periods. It may be easier for the staff at the open prison and the most closed prison with inmates with longer sentences to have more realistic expectations about what they can do for the inmates during their sentence. It is probably more rewarding to be more active in contact with these inmates than with those of prisons with a high turnover. Example from an interview at prison D:

"We try to make the best of the situation. It is the best thing to do both for us [staff] and for the inmates. We spend a lot of our time here, and the inmates often stay for many years. This situation would be intolerable if the climate would be hard and tense. We talk to them a lot. They are not used to that and some of them don't like it when they come from other prisons. But we are proud of having succeeded with even the hardest of them. They always relax after a while and become more open. We have succeeded with those who have had severe psychic problems too."

Prison B with the worst work conditions and highest mean level of noradrenaline has a very high turnover of inmates, as it takes prisoners with short sentences (seldom more than six months). There is little time to get to know the inmates, and therefore contact with them could be more demanding. Examples of statements from interviews at prison B:

"There is no discipline here. Only the walls are limits. You could as well let them be in a large cage without us [staff] and throw in the food. It is the inmates who run everything here. If we [the officers] try to get some discipline, they only go to the governor and complain. They often get support from him. He is old and does not want any conflicts."

"We give them food, service and clothes. They are physically improved when they are released after a couple of months here. But they are not better adjusted to society. It is because no demands are made on them in the prison. I think they should have the same demands inside the prison as outside."

Prison B was the only local prison in the study, which means that the prison takes prisoners from the local region. The staff see many of them return to the same prison after a short period of freedom. In the interviews with the staff at this prison many of them told that they often see discharged prisoners in their leisure time as many of them live in the area. Some of the interviewed persons from this prison find this very unpleasant, especially if it happens when they are together with friends or family. Consequently, feelings of hopelessness might be more common at this prison and may contribute to higher arousal during leisure time for the staff in prison B in comparison with that of others, who very seldom or never meet prisoners

outside prison after discharge. Examples of statements from interviews at prison B:

"I have to be alert even outside work. I am very disturbed when I meet them [discharged inmates] in the town. One of them came up to me once when I was in the park with my little daughter. The women on the bench looked at me as if I was a criminal too. One woman said 'Poor child'. An assistant in a store watched me carefully after I had talked to an inmate on the stairs before entering. It is as if I were one of them. These things happen now and then."

"You meet them all the time in the town. I try to avoid them if I can. I am afraid of getting into trouble. They know and I know what could happen if there is an argument."

It was only the mean levels of catecholamine excretion that differed significantly between the four prisons. There were significant associations, however, between self-reported work conditions and systolic blood pressure when individually based data were used. These differences were not seen in this study in the aggregated analyses. Urinary excretion of catecholamines may be more relevant in measuring the effects of these work conditions than blood pressure and morning plasma cortisol. The differences between the individuals with regard to systolic blood pressure were more obvious than the differences in mean levels between the four prisons. This result may be explained by the small number of prisons in this study and will therefore be tested in another study with a large number of prisons.

It should be pointed out that the size of the standard regression coefficients is always difficult to interpret, in particular when psychosocial factors are used as explaining variables. Thus the emphasis should be on *which* variables had significant explaining power rather than on the size of the coefficients.

None of the psychosocial environment variables was associated with level of morning plasma cortisol in this study. A possible explanation, in spite of what was expected, could be that the mean levels of the four prisons were all high. Another factor that may contribute to the absence of an association was the great variation between the individuals. The relation between morning plasma cortisol and psychosocial work environment will be further studied in a follow-up investigation of a large sample of prison staff.

Of particular importance were the outcome variables that were significantly "explained" by the studied variables, both collectively and individually. In this study, skill discretion was the only dimension of self-reported work conditions that was significantly associated with physiological reactions in both series of analyses. The conclusion is that differences in self-reported work conditions, especially skill discretion, are reflected in differences in the noradrenaline level during work and leisure time when collective data are used. Skill discretion appears as a significant explanatory variable in relation to catecholamine excretion both in collective and individual analyses. It seemed in this study as if the differences in the mean levels

of the four prisons could have been due to psychophysiological reactions to the environment rather than to differences between individual characteristics which were differently distributed between the prisons. The results also showed that self-reported work conditions and better known factors such as age and physical activity are associated with physiological reactions such as systolic blood pressure and the urinary excretion of catecholamine when individually based data are used.

Acknowledgments

This research was funded by the Swedish Work Environment Fund.

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Received for publication: 17 November 1987

Appendix

Items included in the four dimensions of self-reported work conditions used in the analyses

Decision latitude

Being able to foresee what will happen during a work period
Possibility of planning the work to be done

High demands of attention and awareness
Attention on many things at the same time
Large variation in work tempo
Psychological strain
Role conflicts
Feelings of tension while at work

Skill discretion

Meaningful work tasks
Possibility of learning while at work
Professional pride
Possibility to see results
Possibility to take initiatives
Possibility to decide independently on the carrying-out of work tasks

Psychosocial climate

Possibility to get a sense of cohesiveness while at work
Good atmosphere at the workplace
Feelings of joy while at work
Harmony among the staff
Open communication
My colleagues think that there is good atmosphere
Possibility to give and take criticism
No rumor behind one's back
Trust among the colleagues
Good cooperation with superior colleagues
Good cooperation with subordinate colleagues
Seldom conflicts with colleagues
Possibility to talk to someone at work about problems at work
Possibility to talk to someone at work about private problems

Job demands

Absence of feeling safe while at work
Absence of clear expectations
Difficulties in living up to expectations
Absence of calmness while at work
Absence of rest and relaxation pauses
High level of responsibility
High quantity of work
Feelings of inadequacy