Is high job control a risk factor for poor quality of life in workers with high autism spectrum tendencies? A cross-sectional survey at a factory in Japan

Norika HAYAKAWA¹, Takashi OKADA², Kenji NOMURA³, Tsukimi TSUKADA⁴ and Mieko NAKAMURA⁵

¹Faculty of Policy Studies, Nanzan University, Japan, ²Department of Psychiatry, Nagoya University Graduate School of Medicine, Japan, ³Nagoya University Center for Developmental Clinical Psychology and Psychiatry, Japan, ⁴Department of Nursing, School of Health Sciences, Nagoya University Graduate School of Medicine, Japan and ⁵Department of Community Health and Preventive Medicine, Hamamatsu University School of Medicine, Japan

Abstract: Is high job control a risk factor for poor quality of life in workers with high autism spectrum tendencies? A cross-sectional survey at a factory in Japan: Norika HAYAKAWA, *et al.* Faculty of Policy Studies, Nanzan University—**Objectives:** To examine the effect of autism spectrum (AS) tendencies and psychosocial job characteristics on health-related quality of life (HRQOL) among factory workers. **Methods:** A questionnaire survey was administered to 376 Japanese factory employees from the same company (response rate: 83.6%) in 2010. Psychosocial job characteristics, including job demand, job control, and social support, were evaluated using the Job Content Questionnaire (JCQ). AS tendencies was assessed using the Autism-Spectrum Quotient (AQ), and HRQOL was assessed using the Medical Outcomes Study Short-Form General Health Survey (SF-8). Associations were investigated using multiple logistic regression analysis adjusted for confounders. **Results:** In the multivariate analysis, AQ was positively (odds ratio [OR]: 3.94; 95% confidence interval [CI]: 1.70–9.73) and social support in the workplace was inversely (OR: 0.25; 95% CI: 0.10–0.57) associated with poor mental HRQOL. No significant interaction was observed between AQ and JCQ subitems. Only social support was inversely associated with poor physical HRQOL (OR and 95% CI for medium social support: 0.45 and 0.21–0.94), and a significant interaction between AQ and job control was observed ($p=0.02$), suggesting that high job control was associated with poor physical HRQOL among workers with high AQ, whereas low job control tended to be

associated with poor physical HRQOL among others. **Conclusions:** Our results suggest that AS tendencies have a negative effect on workers' HRQOL and social support is a primary factor in maintaining HRQOL. Moreover, a structured work environment can maintain physical HRQOL in workers with high AS tendencies since higher job control will be stressful. (J Occup Health 2015; 57: 419–426)

Key words: Autism spectrum tendencies, HRQOL, Job control, Psychosocial job characteristics, Social support, Workers

Psychosocial aspects of the working environment, namely, job demand, job control, and social support at work, have an effect on workers' health-related quality of life (HRQOL)^{1,2}. In the Job Demand-Control (JDC) model proposed by Karasek, the greater the job demand and the lower the job control latitude, the more likely the prevalence of exhaustion, depression, and other physical ailments³. The third important dimension of the JDC model is social support from coworkers and supervisors; low social support from coworkers and supervisors in the demand-control-support model⁴ has been found to be related to poor HRQOL⁵. Silva and Barreto found that lack of social support at work and low job control were associated with poor HRQOL in the physical domain⁶. Lerner *et al.* also showed that job strain as measured on the Job Content Questionnaire (JCQ) was an independent risk factor for HRQOL⁷. The Whitehall II study by Stansfeld *et al.* revealed that high psychological demand was one of the best predictors for poor physical HRQOL in women. Poor psychological HRQOL was predicted by low social support at work in both

Received Oct 10, 2014; Accepted May 13, 2015

Published online in J-STAGE Jun 25, 2015

Correspondence to: N. Hayakawa, Faculty of Policy Studies, Nanzan University 27 Seirei-cho, Seto, Aichi 489-0863, Japan (e-mail: norizo@nanzan-u.ac.jp)

men and women; however, it was predicted by low decision latitude in men only and by high psychological demands in women only¹⁾.

On the other hand, workplace adaptation by high autism spectrum (AS) tendencies in regular employment has recently become a focus of attention in occupational mental health, as an increase has been observed in the number of cases experiencing difficulty in adaptation to work. AS is characterized by difficulties with social interaction and communication, as well as restricted, repetitive patterns of behavior, interests, and activities⁸⁾. Within the spectrum, high functioning refers to individuals with high AS tendencies and an intelligence quotient (IQ) of 70 or over with no mental retardation. In longitudinal research on AS conducted over a 20-year period, Howlin *et al.* noted that a substantial number of cases of individuals with IQs over 100 experiencing difficulties in continuing work due to AS tendencies have been reported⁹⁾.

Due to their AS traits such as difficulty with imagination and social communication, executive function deficits¹⁰⁾, and weak central coherence^{11–13)}, it is well known that social support from coworkers and supervisors, low job demand (i.e., avoidance of multiple simultaneous job tasks and assurance of individual control over work pace), and a low job control working environment are required in the work places of individuals with high AS tendencies. A low job control working environment, in other words, a structured environment with some type of external framework that defines work procedures, work schedules, and workloads tends to be more adaptable rather than a high job control working environment for these individuals¹⁰⁾. The structure enables more predictability and reduces stress. While such a structure is necessary even for people with normal to higher intelligence who have AS tendencies, lower job control is generally considered to reduce HRQOL¹⁾. That is, the relationship between psychosocial job characteristics and HRQOL is thought to be affected by the level of AS tendencies.

Therefore, working environments that have low social support, high job demand, and high job control may lead to decreases in HRQOL of workers with high AS tendencies. However, to the best of our knowledge, no epidemiological research investigating the effects of AS tendencies or the interaction between psychosocial job characteristics and AS tendencies on the physical and mental health of workers has been reported. In order to clarify environmental work factors that help general workers with high AS tendencies maintain a high HRQOL, this study investigated the relationships between both AS tendencies and psychosocial job characteristics (job demand, job control, and social support) and physical and mental

HRQOL.

Subjects and Methods

Participants and ethical considerations

The study participants comprised Japanese employees working at the main factory of B Company in A City, Japan. First, a written explanation was provided to B Company, and the company's consent to participate in the study was obtained. A written explanation of the aims and methods of the study and its use of the data was provided on the front page of the questionnaires, and submission of the questionnaires was considered consent to participation in the study; the participants submitted the questionnaires anonymously. The research protocol was approved by the Research Ethics Committee on human subjects research of Nanzan University, and the study was conducted in accordance with the protocol.

Methods

An overview explanation of the study and the questionnaires were distributed to employees through the Human Resources Department of the main factory of B Company in August 2010. After anonymously completing the questionnaires, participants returned them to the Human Resources Department in sealed envelopes. Those who did not participate in the survey returned blank questionnaires to the Human Resources Department in the same manner. The sealed questionnaires returned to the Human Resources Department were then collected for analysis. A total of 450 questionnaires were distributed, and 376 were returned (response rate: 83.6%). Of these responses, those with missing values for sex ($n=18$), age ($n=18$), history of depression ($n=18$), Physical Component Summary (PCS) ($n=17$), and Mental Component Summary (MCS) ($n=17$) were excluded, as were responses from those who had a history of depression ($n=28$).

Measurements

The survey was composed of eight self-administered questionnaires, including a demographic questionnaire, the Autism-Spectrum Quotient (AQ)-Japanese version, the Japanese version of the JCQ, and the Medical Outcomes Study 8-Item Short-Form Health Survey (SF-8).

Autism-spectrum quotient

The AQ is a scale which was developed with the aim of measuring the degree of AS tendencies for adults within the normal range of intelligence¹⁴⁾. The reliability of the AQ-Japanese version was confirmed and standardized by Wakabayashi *et al.*¹⁵⁾. It is composed of 50 questions, with 10 in each of the

five areas of AS characteristics, namely, social skills, attention switching, attention to detail, communication, and imagination. The scale uses the forced choice method in a 4-choice multiple choice format, allocating 1 point for each answer suggesting AS tendencies. Scores range from 0 to 50 points, with higher scores representing stronger AS tendencies. Total AQ scores and quartile scores were then calculated. Those in the top quartile were labeled the “high” group, those between the top and bottom quartile scores were labeled the “medium” group, and those in the bottom quartile were labeled the “low” (reference) group.

Job content questionnaire

The short version of the JCQ-JDC model was adapted and validated for Japanese by Kawakami *et al.*¹⁶⁾. The JCQ is a standardized instrument used to assess social and psychological characteristics of jobs based on the theoretical models developed by Karasek. It comprises 22 questions with response options ranging from “strongly disagree” to “strongly agree” scored on a Likert scale¹⁻⁴⁾. The block regarding social support is composed of eight questions on relationships with coworkers and supervisors. These variables were coded according to the Job Content Questionnaire User’s Guide¹⁷⁾. Scores for each quartile on job demand variables were calculated; scores in the top quartile were labeled the “high” (reference) group. The bottom quartile was the “low” group, and scores between the top and bottom quartiles were classified as the medium group. The job control and social support variables were divided into three quartile-based groups in the same way. The low groups for workers’ own job control and low exposure to social support in the workplace were taken as reference.

The medical outcomes study 8-item short-form health survey

HRQOL was measured using the Medical Outcomes Study Short-Form General Survey (SF-8). SF-8 is a scale that is much shorter and easier to understand than the SF-36¹⁸⁾. The SF-8 is composed of one item from each of the eight health concepts in the SF-36; it infers an MCS for mental QOL and a PCS for physical QOL. The Japanese version was translated and validated by Fukuhara and Suzukamo¹⁹⁾. In the present study, MCS and PCS components were divided into quartiles, with the lowest quartile representing poor HRQOL.

Statistical analysis

First, simple tabulation was conducted. Next, since poor MCS and poor PCS were dependent variables and AQ and JCQ were independent variables, logistic

regression analyses adjusted for age and sex were conducted to clarify the effect of AQ and JCQ on HRQOL. To avoid multicollinearity, no adjustment was made for position because its associations with sex and age were strong (each $p < .0001$ in a chi-square test). In model 1, AQ and three JCQ subitems (job demand, job control, and social support) were taken as independent variables, and ORs for poor MCS and poor PCS were obtained using univariate analysis. In model 2, AQ, each subitem of the JCQ and the interaction between AQ and each subitem of the JCQ were analyzed. In model 3, AQ, all subitems of the JCQ, and statistically significant interactions observed in model 2 were analyzed using multivariate analysis. If a significant interaction was confirmed, an additional OR was obtained for poor HRQOL according to JCQ subitems stratified by AQ status. Trend tests were performed using logistic regression analyses with the AQ and three JCQ subitems quartiles analyzed as continuous variables. All analyses were conducted with JMP version 10.0.0 for Macintosh (SAS Institute Japan, Tokyo) and the level of significance was set at $p < 0.05$.

Results

The responses from the remaining 316 participants (241 males and 75 females) were analyzed. The characteristics of the participants are shown in Table 1. The total AQ scores ranged from 3 to 42, with a median and mean ($\pm$ SD) of 20 and 20.2 ($\pm$ 7.0), respectively. The upper quartile score of the AQ was 25 while the bottom quartile score was 15.

The scores for job demand variables ranged from 21 to 48, with a median and mean ($\pm$ SD) of 33 and 33.4 ($\pm$ 5.5), respectively. The upper quartile score of the job demand variables was 37 while the bottom quartile score was 29. The job control scores ranged from 36 to 96, with a median and a mean ($\pm$ SD) of 68 and 67.9 ($\pm$ 10.4), respectively. The upper quartile score of job control was 74 while the bottom quartile score was 62. The social support scores ranged from 8 to 32, with a median and a mean ($\pm$ SD) of 23 and 22.2 ($\pm$ 3.6), respectively. The upper quartile score of social support variables was 24 while the bottom quartile score was 20.

The MCS scores for the SF-8 ranged from 18.8 to 58.8, with a median and mean ($\pm$ SD) of 46.6 and 45.8 ($\pm$ 7.2), respectively. The PCS scores for the SF-8 ranged from 18.0 to 62.2, with a median and mean ($\pm$ SD) of 49.7 and 48.6 ($\pm$ 6.6), respectively. Poor MCS was most prevalent among workers in their 40s (39.2%), whereas poor PCS was most prevalent among those in their 30s (38.0%).

The effect of AQ and JCQ on poor MCS is shown in Table 2. The age- and sex-adjusted OR for poor

Table 1. Characteristics of participants according to MCS/PCS status

	MCS ¹				PCS ²			
	Poor ≤41.55 ^a (n=79)		Not poor >41.55 ^a (n=237)		Poor ≤45.47 ^b (n=79)		Not poor >45.47 ^b (n=237)	
Age /yr	n	%	n	%	n	%	n	%
20–29	8	28.6	20	71.4	4	14.3	24	85.7
30–39	22	21.2	82	78.8	30	28.8	74	71.2
40–49	31	27.2	83	72.8	26	22.8	88	77.2
50–59	18	25.7	52	74.3	19	27.1	51	72.9
Male	58	24.1	183	75.9	52	21.6	189	78.4
Female	21	28.0	54	72.0	27	36.0	48	64.0
Position								
Management	8	19.5	33	80.5	7	17.1	34	82.9
Technical/supervisory	41	24.8	124	75.2	44	26.7	121	73.3
Planning/office	22	24.7	67	75.3	24	27.0	65	73.0
Nonpermanent	7	36.8	12	63.2	4	21.1	15	78.9
No response	1	50.0	1	50.0	0	0.0	2	100.0

¹MCS: Mental component summary. ²PCS: Physical component summary. ^aLower quartile of MCS score. ^bLower quartile of PCS score.

Table 2. Odds ratios for having a poor MCS¹ according to AQ² score and JCQ³ status

		Model 1 ^{a)}			Model 2 ^{b)}						Model 3 ^{c)}		
		OR ^d	95% CI ^e	Trend <i>p</i> ^f	OR	95% CI	<i>p</i> ^g	OR	95% CI	<i>p</i>	OR	95% CI	Trend <i>p</i>
AQ scores	Low	1		<.001	1			1			1		<.001
	Medium	1.73	0.80–4.01		1.28	0.33–5.61		1.13	0.26–5.95		1.80	0.51–7.49	
	High	4.83	2.22–11.32		5.08	1.39–22.04		3.71	0.85–20.31		2.41	0.64–10.52	
Job demand	High	1		0.02	1						1		0.10
	Medium	0.55	0.30–1.02		0.48	0.16–1.40					0.67	0.32–1.42	
	Low	0.42	0.20–0.88		0.33	0.09–1.15					0.48	0.20–1.16	
AQ scores × job demand					0.30								
Job control	Low	1		0.09				1			1		0.26
	Medium	0.71	0.38–1.34					0.50	0.16–1.55		0.80	0.39–1.66	
	High	0.54	0.25–1.15					0.93	0.23–3.64		0.55	0.22–1.40	
AQ scores × job control								0.33					
Social support	Low	1		<.001							1		0.001
	Medium	0.87	0.47–1.62								1.25	0.42–3.77	
	High	0.30	0.15–0.60								0.57	0.16–1.99	
AQ scores × social support											0.41		

^aAge- and sex-adjusted univariate model. ^bThe AQ score, one component of the JCQ status, and interaction of the AQ score and JCQ status were included in the model adjusted for age and sex. ^cThe AQ score and 3 components of the JCQ status were included in the model adjusted for age and sex. ¹MCS: Mental component summary. ²AQ: Autism-Spectrum Quotient. ³JCQ: Job Content Questionnaire. ⁴OR: Odds ratio. ⁵CI: Confidence interval. ⁶*p*: *p* value.

MCS (Model 1) was significantly higher in the high AQ group (OR: 4.83; 95% CI: 2.22–11.32) compared to the low AQ group. OR was significantly lower in the low job-demand group (OR: 0.42; 95% CI: 0.20–0.88) compared to the high job-demand group, and the lower job-demand group tended to be associated with a lower likelihood of having a poor MCS. Regarding social support, the group with greater social support from coworkers and supervisors in the

workplace had approximately one-third the chance of having a poor MCS (OR: 0.30; 95% CI: 0.15–0.60) compared to the group with less social support. In model 2, high AQ was significantly associated with having a poor MCS (OR: 5.08; 95% CI: 1.39–22.04) after adjusting for job demands. Moreover, no statistically significant interaction was found between AQ and job demand, job control, or social support, whereas a significant positive association was found between

Table 3. Odds ratios for having a poor PCS¹ according to AQ² and JCQ³ status

		Model 1 ^{a)}			Model 2 ^{b)}									Model 3 ^{c)}			
		OR ⁴	95% CI ⁵	Trend <i>p</i> ⁶	OR	95% CI	<i>p</i> ⁶	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	Trend <i>p</i>
AQ scores	Low	1		0.25	1			1			1			1			0.41
	Medium	2.31	1.11–5.12		5.52	1.22–39.56		2.46	0.62–12.42		1.76	0.51–7.23		2.81	0.69–14.59		
	High	1.68	0.73–4.00		4.33	0.89–32.08		0.70	0.11–4.40		1.52	0.40–6.67		0.57	0.09–3.68		
Job demand	High	1		0.61	1									1			0.49
	Medium	0.64	0.34–1.21		0.41	0.10–1.49								0.53	0.24–1.16		
	Low	0.80	0.39–1.63		0.65	0.15–2.58								0.58	0.24–1.34		
AQ scores x job demand					0.63												
Job control	Low	1		0.04				1						1			0.10
	Medium	0.94	0.51–1.74					2.01	0.52–10.10					2.92	0.71–15.30		
	High	0.41	0.18–0.92					2.10	0.38–12.82					2.64	0.45–17.15		
AQ scores x job control					0.04												
Social support	Low	1		0.06							0.04					0.02	
	Medium	0.47	0.24–0.90								0.56	0.16–1.86		0.45	0.21–0.94		0.11
	High	0.55	0.29–1.03								0.26	0.04–1.25		0.66	0.31–1.38		
AQ scores x social support					0.50												

^aAge- and sex-adjusted univariate model. ^bThe AQ score, one component of the JCQ status, and interaction of the AQ score and JCQ status were included in the model adjusted for age and sex. ^cThe AQ score and 3 components of the JCQ status were included in the model adjusted for age and sex. ¹PCS: Physical component summary. ²AQ: Autism-Spectrum Quotient. ³JCQ: Job Content Questionnaire. ⁴OR: Odds ratio. ⁵CI: Confidence interval. ⁶*p*: *p* value.

Table 4. Odds ratios for having a poor PCS¹ according to job control status stratified by AQ² status^{a)}

		Low AQ				Medium AQ				High AQ			
		Poor PCS (N) ³	(N)	OR ⁴	95% CI ⁵	Poor PCS (N)	(N)	OR	95% CI	Poor PCS (N)	(N)	OR	95% CI
Job control	Low	3	15	1		13	33	1		3	20	1	
	Medium	8	32	1.79	0.37–10.84	17	60	0.54	0.19–1.49	10	40	3.22	0.63–21.85
	High	0	31	0.00	0.00–0.76	5	33	0.20	0.04–0.76	4	16	3.19	0.43–29.87

^aAge- and sex-adjusted. ¹PCS: Physical component summary. ²AQ: Autism-Spectrum Quotient. ³(N): number. ⁴OR: Odds ratio. ⁵CI: Confidence interval.

AQ and poor MCS (OR: 3.94; 95% CI: 1.70–9.73), and an inverse association was found between social support in the workplace and poor MCS (OR: 0.25; 95% CI: 0.10–0.57) in the multivariate model (model 3).

The association of AQ and JCQ with poor PCS is shown in Table 3. In an age- and sex-adjusted model (model 1), workers with medium AQ scores were more likely than those with low AQ scores to have a poor PCS (OR: 2.31; 95% CI: 1.11–5.12). Conversely, those with high job control were less likely than those with low job control to have a poor PCS (OR: 0.41; 95% CI: 0.18–0.92). Furthermore, people having social support in the workplace were approximately 50% less likely than those without social support to have a poor PCS (ORs and 95% CI for medium and high social support: 0.47 and 0.24–0.90 and 0.55 and 0.29–1.03, respectively). In model 2, a statistically significant interaction was observed between AQ and job control ($p=0.04$). In the multivariate model (model 3), only social support was

inversely associated with poor PCS (OR and 95% CI for medium social support: 0.45 and 0.21–0.94), and the interaction between AQ and job control remained significant ($p=0.02$). The ORs for having a poor PCS based on AQ and job control status, the number of workers with a poor PCS in each AQ and job control status, and the numbers of workers in each AQ and job control status are shown in Table 4. The proportion of workers with a poor PCS in the low AQ group was 20.0% for those with low job control, 25.0% for those with medium job control, and 0.0% for those with high job control. In the medium AQ group, these proportions were 39.4% for workers with low job control, 28.3% for workers with medium job control, and 15.2% for workers with high job control. In the high AQ group, these proportions were 15.0% for workers with low job control, 25.0% for workers with medium job control, and 25.0% for workers with high job control. High job control was associated with a low OR for poor PCS among people with a low AQ (OR: 0.00; 95% CI: 0.00–0.76) or medium

AQ (OR: 0.20; 95%CI: 0.04–0.76). In contrast, high job control was associated with a high OR among people with a high AQ (OR: 3.19; 95%CI: 0.43–29.87).

Discussion

To the best of our knowledge, this is the first epidemiological study to investigate the association of AS tendencies and JCQ status with HRQOL among general Japanese workers. Our results suggest that the level of AS tendencies is linked to workers' HRQOL. Mental HRQOL tended to become lower as AS characteristics became higher. Independent from AS tendencies, social support in the workplace was positively associated with mental HRQOL, suggesting that social support may prevent the deterioration of mental HRQOL. For mental HRQOL, no interaction was found between AS tendencies and psychosocial job characteristics, i.e., job demand, job control, and social support. On the other hand, for physical HRQOL, a significant interaction between AS tendencies and job control was observed. High job control was linked preventively to poor physical HRQOL only for those who had a low level of AS tendencies; however, it was adversely linked to poor physical HRQOL in workers with a high level of AS tendencies.

The link between HRQOL and AS tendencies in this study suggests that high AS characteristics may exert a negative influence on mental HRQOL for general workers. Previous studies have reported that the overall self-reported HRQOL of patients with high-functioning autism is lower than that of healthy individuals²⁰. Although IQ is one of the prognostic predictors for AS^{21,22}, a substantial number of people with IQs over 100 still have poor social adjustment⁹. For example, in a five-year follow-up study, Cederlund *et al.*²¹ found that outcomes such as employment for people with Asperger syndrome with a mean IQ of 103.0 were suboptimal, despite their good intellectual capacity.

The basic difficulty for people with high AS characteristics is in sustained interpersonal relations/socialability problems and in obsessive and compulsive tendencies. Even for high-functioning individuals who have qualitative problems in interpersonal relations, their ability to understand social signs or intuitively grasp the emotions of others is limited. This often leads to frequent misinterpretations of what somebody else means, as well as difficulties in understanding social rules, a decline in self-esteem, and low appraisal by supervisors and coworkers. In addition, they also often have attention deficits and difficulties managing multiple sources of information simultaneously as required by the workplace. Many people

also find that oversensitivity in hearing or smell, as well as environmental changes, are distressing²³. The level of AS tendencies is suspected to be linked to the level of psychological stress induced by adaptation to the workplace, and the results of this study seem to reflect this type of psychological burden.

However, it has also been shown that workplace support offers a high chance of enabling employees with high AS tendencies to work appropriately. All participants in this study found their jobs through the open job market. With regard to work participation, Taylor and Seltzer²⁴ reported that competitively employed individuals had significantly fewer AS symptoms than those who had a supported job. However, even among such workers, interpersonal relations, ability to complete work, and work environment were influential predictors of work participation²⁵. In particular, the degree of social support offered by the work environment has been noted to be important^{9,23}. In addition, Renty *et al.*²⁶ found a link between the HRQOL of adults with high-functioning autism and social support. However, other reports have stated that this association could not be replicated²⁰, and as of yet, no definitive conclusion has been reached.

In this study, high job control was associated with reduced physical HRQOL among workers with high AS tendencies as opposed to those with low AS tendencies. High job control in the JCQ refers to the levels of the “allows own decisions”, “learn new things”, and “requires creativity” items. On the other hand, those who have a high level of AS tendencies tend to do better in a lower job control working environment¹⁰. The stress induced by high job control may be interpreted subjectively as physical health problem such as general fatigue or decreasing systemic vitality rather than as mental health problem such as depression, anxiety or irritation among people with high AS tendencies. Besides, it is possible that a high AQ score is associated with high “skill discretion”. Job control in the JCQ consists of skill discretion and decision authority²⁷. However, job control could not be divided into decision authority and skill discretion for analysis in this study, since more than 40% of the subjects were centered on the same score (36 points) of the decision authority scale (48 points comprising a full score). Therefore it was not possible to classify these objectives into three groups using quartiles. This may have been influenced by the fact that all of the workers were employees of the same company, meaning that they were of comparatively uniform quality as a group. A study with a larger and more diverse population is needed.

The participants in this study had a slightly lower HRQOL than the national average. In this study,

the median score was 46.6 for the mental component and 49.7 for the physical component, whereas the median standard scores for the SF-8 in Japanese citizens are 51.05 and 51.75 for the mental and physical components, respectively. We were unable to identify the factors that lowered the participants' HRQOL to below the national average. It is possible that relatively frequent overtime work may have had some influence on both MCS and PCS. In addition, the fact that the survey was carried out after reorganization of the company may have particularly affected MCS.

Limitations

This study did have a number of limitations. AS tendencies were identified with the AQ, and psychiatric problems other than AS were only evaluated by self-administered questionnaire, not by structured clinical interviews. This raises the possibility of a selection bias, as people with a low-quality psychosocial workplace environment resulting in poor HRQOL may have found it difficult to participate and information bias based on a self-administered questionnaire being used in this study. Furthermore, the effect of a confounding bias such as depressive mood remains possible. Also, the problem of generalizability needs to be pointed out since all of the workers who participated in this study were employees of the same company and the population was thus relatively homogeneous. This study was conducted as a cross-sectional study; therefore, only limited inferences can be made regarding temporality and causation. Furthermore, the power of the statistical analysis was limited because the sample size was relatively small. It is also possible that a significant dose-response relationship between AQ or social support and poor PCS was present but could not be detected because of the sample size.

Conclusions

Our results suggest that a high overall AS tendencies has a negative impact on workers' HRQOL. On the other hand, independent of the level of AS tendencies, social support from supervisors and coworkers appears to be a factor in maintaining HRQOL. Also, in workers with high AS tendencies, physical HRQOL is maintained by lower job control as opposed to workers with low AS tendencies. This study suggests that it is possible for people with high AS characteristics, who are thought to be at high risk of maladaptation to work, to perform regular work and maintain their HRQOL through organization of the work environment, including sufficient provision for social support and structured job control in the workplace.

Acknowledgments: This study was supported by grants from the Nanzan University Pache Research Subsidy I-A-1 for the 2009 and 2010 academic year. We would like to thank all of the employees at the main factory of B Company who participated in this study.

References

- 1) Stansfeld SA, Bosma H, Hemingway H, Marmot MG. Psychosocial work characteristics and social support as predictors of SF-36 health functioning: the Whitehall II study. *Psychosom Med* 1998; 60: 247–55.
- 2) Bottcher HM, Steimann M, Rotsch M, Zurborn KH, Koch U, Bergelt C. Occupational stress and its association with early retirement and subjective need for occupational rehabilitation in cancer patients. *Psycho-oncology* 2013; 22: 1807–14.
- 3) Karasek RA. Job demands, job decision latitude, and mental strain: implications for job redesign. *Adm Sci Q* 1979; 24: 285–308.
- 4) Johnson JV, Hall EM. Job strain, work place social support, and cardiovascular disease: a cross-sectional study of a random sample of the Swedish working population. *Am J Public Health* 1988; 78: 1336–42.
- 5) Rusli BN, Edimansyah BA, Naing L. Working conditions, self-perceived stress, anxiety, depression and quality of life: a structural equation modelling approach. *BMC Public Health* 2008; 8: 48. (doi: 10.1186/1471-2458-8-48.)
- 6) Silva LS, Barreto SM. Adverse psychosocial working conditions and poor quality of life among financial service employees in Brazil. *J Occup Health* 2012; 54: 88–95.
- 7) Lerner DJ, Levine S, Malspeis S, D'Agostino RB. Job strain and health-related quality of life in a national sample. *Am J Public Health* 1994; 84: 1580–5.
- 8) American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders Fifth Edition: DSM-5*. Washington, DC: American Psychiatric Publishing; 2013. p. 50–9.
- 9) Howlin P, Goode S, Hutton J, Rutter M. Adult outcome for children with autism. *J Child Psychol Psychiatry* 2004; 45: 212–29.
- 10) Ozonoff S, Pennington BF, Rogers SJ. Executive function deficits in high-functioning autistic individuals: relationship to theory of mind. *J Child Psychol Psychiatry* 1991; 32: 1081–105.
- 11) Burnette CP, Mundy PC, Meyer JA, Sutton SK, Vaughan AE, Charak D. Weak central coherence and its relations to theory of mind and anxiety in autism. *J Autism Dev Disord* 2005; 35: 63–73.
- 12) Briskman J, Happe F, Frith U. Exploring the cognitive phenotype of autism: weak “central coherence” in parents and siblings of children with autism: II. Real-life skills and preferences. *J Child Psychol Psychiatry* 2001; 42: 309–16.
- 13) Jolliffe T, Baron-Cohen S. A test of central coher-

- ence theory: can adults with high-functioning autism or Asperger syndrome integrate fragments of an object? *Cogn Neuropsychiatry* 2001; 6: 193–216.
- 14) Baron-Cohen S, Wheelwright S, Skinner R, Martin J, Clubley E. The autism-spectrum quotient (AQ): evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *J Autism Dev Disord* 2001; 31: 5–17.
 - 15) Wakabayashi A, Tojo Y, Baron-Cohen S, Wheelwright S. The Autism-Spectrum Quotient (AQ) Japanese version: Evidence from high-functioning clinical group and normal adults. *The Japanese Journal of Psychology* 2004; 75: 78–84.
 - 16) Kawakami N, Kobayashi F, Araki S, Haratani T, Furui H. Assessment of job stress dimensions based on the job demands- control model of employees of telecommunication and electric power companies in Japan: reliability and validity of the Japanese version of the Job Content Questionnaire. *International Journal of Behavioral Medicine* 1995; 2: 358–75.
 - 17) Job Content Questionnaire Scoring Manual Japanese version. Morioka (Japan): the third JCQ/NIOSH Shokugyosei Stress Chosahyou Users Club; 1998 (in Japanese).
 - 18) Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992; 30: 473–83.
 - 19) Fukuhara S, Suzukamo Y. Manual of the SF-8 Japanese version. Kyoto: Institute for Health Outcomes & Process Evaluation Research; 2004.
 - 20) Kamp-Becker I, Schroder J, Remschmidt H, Bachmann CJ. Health-related quality of life in adolescents and young adults with high functioning autism-spectrum disorder. *Psychosoc Med* 2010; 7: (doi: 10.3205/psm000065)
 - 21) Cederlund M, Hagberg B, Billstedt E, Gillberg IC, Gillberg C. Asperger syndrome and autism: a comparative longitudinal follow-up study more than 5 years after original diagnosis. *J Autism Dev Disord* 2008; 38: 72–85.
 - 22) Gillberg C. Outcome in autism and autistic-like conditions. *J Am Acad Child Adolesc Psychiatry* 1991; 30: 375–82.
 - 23) Hanebuth D, Meinel M, Fischer JE. Health-related quality of life, psychosocial work conditions, and absenteeism in an industrial sample of blue- and white-collar employees: a comparison of potential predictors. *Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine* 2006; 48: 28–37.
 - 24) Taylor JL, Seltzer MM. Employment and post-secondary educational activities for young adults with autism spectrum disorders during the transition to adulthood. *J Autism Dev Disord* 2011; 41: 566–74.
 - 25) Holwerda A, van der Klink JJ, Groothoff JW, Brouwer S. Predictors for work participation in individuals with an Autism spectrum disorder: a systematic review. *J Occup Rehabil* 2012; 22: 333–52.
 - 26) Renty JO, Roeyers H. Quality of life in high-functioning adults with autism spectrum disorder: the predictive value of disability and support characteristics. *Autism* 2006; 10: 511–24.
 - 27) Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* 1998; 3: 322–55.