

## **PROCEEDINGS OF THE 31ST ANNUAL CONFERENCE OF THE HUMAN ERGOLOGY SOCIETY**

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Secretary: Tatsuro Matsuda, *President of the Human Ergology Society*

### **Growth secular change in Tokyo infants**

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Twenty-two measurements were obtained in 1994-1995 from 117 female and 130 male infants aged 1 to 7 living in the central region of Tokyo. The results are summarized as follows:

1) Differences between standing stature and laid-down body length: On the average, the latter was 1.6 cm larger in girls and 1.9 cm larger in boys than the former. But the difference decreased with age until 4 years old.

2) Sex differences: For each of the age groups, the measurements in the trunk were smaller in girls than in boys for height and breadth, but vice versa for circumferences and skinfold thickness. Head length was a little smaller and head circumference and head breadth were remarkably smaller in girls than in boys. This means that the boys are more brachycephalic than the girls. Foot circumference and breadth were remarkably smaller in girls than in boys. Statistically significant differences (boys>girls) were detected in sagittal chest depth, head circumference, foot sizes, and head breadth.

3) Regional differences: Comparing with the Fukaya infants in Saitama Prefecture, the Tokyo infants were larger except for hip circumference and triceps skinfold thickness in both sexes.

4) Secular changes: Comparing with infants in Tokyo and its outskirts measured in 1950-1951, the infants in the present day are taller but slimmer in both sexes, whereas head measurements are almost similar.

### **Evaluation of muscle fatigue using evoked and volitional myoelectric potentials**

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Surface electromyography has been used extensively as a measure to evaluate muscle fatigue non-invasively. The purposes of this study are to examine the mechanism of muscle fatigue progression using evoked and volitional myoelectric potentials, and to identify the muscle-specific pattern of fatigue progression.

Ten healthy males aged 20-27 participated in this study. Tibialis anterior (TA) and first dorsal interosseous (FDI) muscles were examined. Both muscles were stimulated with 1 Hz square-wave pulse of 0.1 msec duration and supramaximal intensity. Subjects were seated on a chair and exerted isometric voluntary contractions of TA and FDI, respectively, at 70% of MVC for 1 min. The contraction force was measured at the ankle with an electrical force transducer for TA and at the phalangeal joints with strain gauges for FDI. Using a four-bar electrode, bipolar surface EMGs and supramaximal M-waves were obtained from FDI and TA during the isometric voluntary contractions. The myoelec-

tric signals were processed with a personal computer, and mean power frequency (MPF) and instantaneous frequency (IF) were calculated for the volitional EMG and superimposed M-wave, respectively. The IF was determined at the first peak, zero cross, and second peak of the superimposed M-wave.

MPF of the volitional EMG decreased consistently during the isometric contraction in all subjects, indicating the development of fatigue in the muscle. With progression of fatigue, the amplitude of the superimposed M-waves showed a tendency to decrease, whereas the duration of the M-waves showed an opposite tendency. MPF of the volitional EMG and IF of superimposed M-waves were correlated with each other. The decline of MPF and IF within 1 min was greater in FDI than in TA, suggesting higher fatiguability in FDI, presumably caused by its abundance of fast twitch fibers. Correlations between MPF and IF were fairly high, especially at the first peak of superimposed M-waves. This high MPF-IF correlation in the early stage of contraction gradually declined with progress of muscle fatigue. These observations suggest that muscle fatigue progression in the final stage of contraction depends on central as well as peripheral factors.

### **Analysis of walking using a newly developed system for detecting foot contact**

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We developed a system to detect foot contact with the ground, and applied it for the analysis of walking with bare feet or with various footwears.

This system can continuously record the conditions of foot contact with the ground using sensors which are flat switches of on-off type. In the present study, the sensors were attached at four locations on the sole of foot: (1) the great toe, (2) the first metatarsal head, (3) the fifth metatarsal head, and (4) the heel, and the data from the sensors were recorded at an interval of 0.1 sec. In this system, a signal from the sensor indicates the "ON" condition if the sensor keeps contact with the ground, and a signal is under the "OFF" condition if the sensor loses contact with the ground. Using this system, we recorded the data during walking with bare feet, sneakers, flat-heeled shoes, high-heeled shoes, and indoor shoes (slippers), respectively.

The data of walking with bare feet were similar to those with sneakers, except that the frequency of heel contact with the ground was somewhat higher with sneakers than with bare feet. This result suggests that the wearing of sneakers more or less influences the walking pattern, even though sneakers are regarded as one of the good shoes for walking. The data of walking with high-heeled shoes were different from those with bare feet. This result shows that walking with high-heeled shoes is in itself an unnatural condition. The unnatural walking may be one of the causes of the fact that wearing high-heeled shoes brings about foot troubles.

We consider that this system will provide very useful data to solve various problems associated with the feet.

### **Sequential changes of baby-carrying posture**

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In order to clarify the characteristics of sequential changes of baby-carrying posture, an experiment was conducted by using a baby dummy whose body height and weight were similar to the

average for Japanese 6-month-old female babies (66 cm and 7.5 kg). The subjects were 22 female students aged from 20 to 21. They were instructed to pick up the dummy sitting on a chair, and then to stand in front of a video camera carrying the dummy in the arms for 5 min. The motions and changes of the posture of each subject were analyzed by using videotapes in which the time counters were recorded for each frame of view. The results were as follows:

(1) Most of the subjects (N=19, 86.4%) picked up the dummy and carried it in a face-to-face position. More than half of them (N=11, 57.9%) carried the dummy on the left side of the chest and the others (N=8, 42.1%) carried it on the right side.

(2) Only three subjects (13.6%) carried the dummy in a face-to-side horizontal position. One of them carried the dummy supporting its upper part with her right arm on its back and its lower limbs with her left arm. The others supported the upper part of the dummy with the left arm and its lower limbs with the right arm.

(3) More than half of the subjects (N=13, 59.1%) changed the carrying position during the five minutes, while the others (N=9, 40.9%) continued the initial position throughout.

(4) The subjects slightly lifted up the dummy in order to adjust its position in their arms. The frequencies and intervals of this adjustment were different among the subjects.

(5) Some of the subjects (N=7, 31.8%) swayed while carrying the dummy in their arms. Two of them (28.6%) kept swaying for longer than 4 min and the others (N=5, 71.4%) swayed intermittently by short time intervals.

(6) While the subjects used their upper limbs to carry the dummy on their chest, they frequently patted on the back or the haunch of the dummy with either of the right or the left hand.

(7) The legs of the subjects rarely moved. However, the subjects who stood with their feet placed somewhat apart (N=3, 13.6%) occasionally shifted their weight on each foot alternately.

(8) The subjects looked at the dummy and turned their faces to the right or the left repeatedly, that is, the movements of face and eyes were frequently observed in all the subjects.

### **Age-related changes in the ability to maintain postural balance**

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Our study aimed to investigate the age-related changes in the ability to maintain postural balance under various sensory conditions. Healthy 93 males and 97 females, ranging in age from 18 to 83 years, served as subjects. We used the apparatus produced by Neuro Com International Inc. This apparatus consists of a platform, visual surround, and a computer. Dual force plate in the platform can produce rotation at the ankle joint, inducing subject's anterior-posterior sway. The enclosure (i.e., visual surround), which completely surrounds the subject's field of view, can also tilt synchronizing with the subject's anterior-posterior body sway. The subject stood quietly with bare feet upon the platform, and was instructed to maintain an upright posture and to focus their gaze straight ahead.

Six conditions were presented in the following order; 1) normal sensation (eyes open and stable force plate), 2) no vision (eyes closed and stable force plate), 3) misleading vision (sway-referenced vision and stable force plate), 4) misleading support (eyes open and sway-referenced force plate), 5) no vision and misleading support (eyes closed and sway-referenced force plate), 6) misleading vision and support (sway-referenced vision and sway-referenced force plate). Subject's anterior-posterior sway angles were calculated by a computer based on the data from transducers on the force plate and the body height of subject.

It was observed that females tended to sway more than males, especially among elderly subjects. Body sway increased with advancing age. Subjects over fifty-years of age swayed more than those under twenty-years of age. Overall, body sway more increased during conditions wherein the

force plate swayed than during conditions wherein it fixed. Particularly, this tendency was obvious in older subjects, suggesting that control of postural balance considerably depends on somatosensory inputs. In conclusion, there were substantial differences between the older and the younger when visual and somatosensory inputs were insufficient and/or inappropriate. Our results are in agreement with those of the previous studies (Woollacott et al., 1982; Stelmach et al., 1989; Wolfson et al., 1992), that is, the elderly rely more heavily on somatosensory cues for postural stabilization.

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### **Generalization and maintenance of social skills of a girl with visual impairment using self-evaluation procedures**

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Most social skill interventions have been effective during training conditions, but there is a gap between the increase in desirable peer interactions, and their generalization and maintenance. The treatment cannot be considered to be successful unless the treatment gains are generalized and maintained. Generalization of appropriate behavior was found to be enhanced by self-evaluation procedures (Webber et al., 1993). The present study investigated whether self-evaluation is effective in generalization and maintenance of social skills, and whether the verbalization prior to self-evaluation plays any role.

The study was conducted in an integrated school in India. The target subject (Child Y) was a girl with visual impairment with SA of 4.5 (Vineland Social Maturity Scale, Indian adaptation). Two sighted peers also participated. Their ages were in the range of 7 to 9 years. Target behaviors were conversation skill and positive play, while initiation was non-target behavior. Multiple baseline design across behaviors was used. There were three phases of external reinforcement, self-evaluation with prior verbalization, and self-evaluation without prior verbalization. Role-plays were undertaken (Jindal and Kato, 1994).

The conversation skills increased during reinforcement phase but could not be maintained during the generalization probe. However, conversation increased again during the phases of self-evaluation with and without prior verbalization and was seen to generalize and maintain. Similar results were observed in the case of play organizing. Initiation also increased with the introduction of the intervention. Exceedingly good maintenance was visible at follow-up, 8 months later.

Self-evaluation was effective in generalizing and maintaining social skills. Once the appropriate behavior increased during self-evaluation with prior verbalization, it was maintained similarly during the phase without prior verbalization. However, as at times Child Y tried to verbalize before self-evaluating in the third phase, the role of prior verbalization is not clear, which supports the results of other studies.

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### **Influence of mental stress on cognition of space**

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When we try to find the correct route in an unfamiliar space, we go on with getting visual information and proprioceptive sensibility. We previously investigated such a relationship between the visual and motor information during walking while finding route in a small maze. Learning ability of finding route was higher with motor information than with visual information only. In the previous experiments, however, the subjects relaxed and were not restricted by time. Various situations are supposed to be encountered in the real route findings. Therefore, the purpose of this study was to investigate the influence of time pressure, for example, hurry and emergency, on the route findings.

Eight students were asked to find the route with experimenter's conduct by the following ways: 1) "walking"(pursuit after the experimenter) and 2) "chair" (moving chair controlled by the experimenter; "chair" doesn't provide motor information). After resting for two second, the subjects repeatedly walked at a certain rhythm in the maze until they find the correct route. ECG was recorded during the experiments. In the case of time restriction ("restriction" condition), the subjects were asked to arrive at the goal of maze within 25 seconds, and the countdown call started before 10 seconds of the time up. In another case, the subjects were asked to arrive at the goal without time limit ("non restriction" condition). Two mazes with the same structure were established.

Similar tendencies of errors were observed regardless of the ways of movement. In the case of "walking", order effects were observed, and the mental stresses were detected in the "restriction" from the heart rate variability (HRV). Questionnaires showed that the subjects felt impatient under "restriction". In the case of "chair", by contrast, order effects were not observed, and no difference was estimated from HRV in the mental stress between "restriction" and "non restriction". Questionnaires also showed that the subjects felt impatient regardless of time limit. In the case of "chair", since the subjects did not really walk in order to find the route, it is considered that there were mental stresses regardless of time limit.

### **A study on the workload of employees and improvement of working condition in the Futon-mattress factory**

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Futon-mattress is Japanese traditional bedding. Most of Futon user in Japan used to recycle it when it had worn out, employing a treatment called Uchi-naoshi, i.e. hitting the cotton pad to blow up fibers, reweaving the revived cotton, and covering it with new cloths. These services were provided by retail shops of Futon in town, most of which were household industry. Recently, however, major manufacturers provide most of Futon-mattresses, because the demand of their market has changed to "waste and use newer ones". This study focused on making effective improvements (KAIZEN) of working and health-related conditions in a Futon factory by using ergonomic approaches. Some of those KAIZEN may be useful not only in Futon industry but in any fiber and fabric industries.

The methods used in this study were as follows: 1) Observation of works and postures of 12 workers in a Futon factory using time/motion study. 2) Measurements of physical conditions in the factory, i.e. temperature, lighting, and the amount of dust in the air. 3) Questionnaire using Today

Health Index about fatigue, health, and daily life of the employees.

Because the amount of fiber dust increased after the weaving machine started, all of the dust was considered to be made at the weaving section. The amount of the dust in the weaving area, which was not visible but felt as pressure to respiratory organs, was 5 times as high as in other areas (Max. 300cpm.). The dusts in the weaving area decreased in lunch-rest time during which all machines were stopped, while such a change did not occur in other areas. Although installing ventilators and filter machines was not enough to fully eliminate the dust, a KAIZEN, i.e. isolating the weaving area by enclosing it with vinyl sheets and modifying the layout of other working areas, caused a more favorable airflow, thus leading to an improvement in the dust conditions.

Temperatures everywhere in the premises were almost the same as outside, because the factory had large space in it. Distribution of local temperatures also depends on the airflow, but a comprehensive air-conditioning system was not installed in the factory. Local coolers or heaters should be set for workers. Lighting conditions did not have so serious problem in the daytime, but in the evening, it was a little dim with the whole lighting located at high ceiling. Setting of local lighting with convertible switches was a useful KAIZEN, particularly for the sewing area (local lighting near hands) and stock area (lighting not always needed).

Persistent postures and static contractions are important causes of workload, reduction of which any KAIZEN has to aim at. We administered to the employees a questionnaire on feeling of fatigue with 30 items in three categories, i.e. drowsiness and dullness, difficulty in concentration, and projection of physical disintegration. As a result, the ratio of responding employees increased after work for most of the items. The increment exceeded 5% in 7 items, i.e. heavy legs, brain muddled, strained eyes, unsteady standing, lack of interest, stiff shoulders, and low back pain. These results suggest possible relations between the invisible pressure of fiber dust and mental responses (muddled brain, etc.), and between static load in bad working postures and physical disorders (heavy legs, etc.).

### **A study of operation error in using ticket vending machine**

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It is important to study the usability of vending machines in order to improve man-machine interfaces available for aged people, because vending machines are used by many aged people every day. Vending machine users must pay attention to a variety of visual information, choose the correct item and judge the results by themselves. We carried out time/motion studies by the direct observation method to analyze behavioral errors in buying a ticket.

The outline of the experiment was as follows. Experiment 1: We added an explanatory board (i.e., "Not for JR lines") at the upper left part of an automatic ticket vendor. This board displays that the machine is not available for getting tickets for JR lines. The experiment was carried out from 9:00 to 18:00 on July 24th, 1995. Experiment 2: In addition to the explanatory board, we added directions for using the machine at a position where users can easily recognize them. The second experiment was carried out from 9:00 to 18:00 on July 25th, 1995. These experiments were done at Sugamo station on the JR Yamanote Line, because the station is well known to many aged people visiting the famous Togenuki-Jizo shrine. Two automatic ticket vendor machines not available for buying JR line tickets were used in the experiments.

We observed users of the experimental vendor machines focusing on two patterns of hesitant behavior. Behavior 1: A user couldn't get a ticket by one of the experimental vendor machines. Then the user had to be at the tail of a queue in order to get a ticket by another machine. We call this

behavior as “change a machine”. Behavior 2: A user didn’t understand how to use the automatic vendor machine, so the user had to ask someone how to use it. Here we call this as “ask another person”. We recorded the sex and age of users by observation.

More than 10% of users showed the hesitant behaviors. Percentages of the individuals showing “ask another person” and “ask another and change a machine” behaviors decreased, particularly in middle-aged and elderly people, by the addition of the explanatory board or usage directions. Mean time to get tickets was shorter in Experiment 2 than in Experiment 1.

These results suggest that an improvement on indications like in this study, i.e. an improvement on the software part of indications, can help the users of vending machines. Since communications between the machine and users are not enough in the present day, we hope that vending machine designers consider in future the improvement on the software part of indications for aged users.

### **Basic consideration of interface design for building appliances**

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Many building appliances have been introduced into dwellings recent years. Needs toward more effective house-keeping and support of independent living of the aged will make it necessary to integrate the switches for these appliances all under a unified console for user’s control. Currently, however, the operating interfaces for these appliances are individually designed and provided. We report a preliminary result of simple experiments on the design legibility of switch arrangements.

A LCD touch panel controlled by a computer was used to show simulated switches. An original software was developed to display a variety of switch arrangement. The experimental subjects were requested to choose and touch a button on the LCD panel in response to the instruction of control. Subjects’ responses were then recorded by the computer. Seven healthy aged females (aged from 67 to 80, a mean age of 71) participated in the experiments.

Eighteen operations within dwellings were chosen. The experimental procedures were as follows. 1) A certain condition was given, a required operation was instructed, and then a simulated arrangement of switches was shown on the LCD. 2) The subject chose one among the switches to respond the request. 3) This process was repeated under different conditions. The eighteen operations under experimental conditions can be grouped into following seven categories: Lighting control; TV control; faucet control; gas cooker control; bath temperature control; heating / air-conditioning control; and window operation.

There was a general tendency that the subjects chose top or right switches for starting and increasing, while bottom ones for stopping and decreasing. However, the latter tendencies were more consistently found, suggesting that people’s idea about the operation for decreasing is very strong. Subjects’ choices for the faucet control or window operation were fairly variable, which could have resulted from that some subjects assumed the switch as a controller to initiate some devices, while the others tried to imagine physical connection between the operation and its response (e.g., water control means water falling, etc.). The fact that subjects’ responses to the circle-shaped switches tended to be more unified than those to the arrow-shaped ones, suggests that the “circle” gives the subjects an impression that it is just for triggering some action. Colored switches tended to be chosen more than white ones. However, in stopping running water, decreasing cooker heat, or putting on cooling, the white switches were more preferred. For cooker and cooling, white switches were placed at the bottom, possibly being interpreted to lower something. For stopping running water, colored switches may have meant for some subjects triggering some motion, which should have been avoided.

Prior to the experiment, it was hypothesized that specific colors may induce specific responses,

e.g., the red induces the operation to start or increase. However, the present results did not show clear tendencies regarding color-dependent responses. The arrangement of the switches in our experiment could have prevented the color-dependent responses.

### **How to set up the standards for the solution of the various social incidents or accidents: In expectations of human ergology**

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#### 1. Preface

From the point of legal study (especially labour law), the main interest of the legal procedure are placed in the way of “after the event solution” such as claims for various damages due to the infringements his or her rights, or claims for the compensation due to the industrial accidents. We think that the social function of jurisprudence is not so strong and speedy from the standpoint of the preventive solution. We need to reconsider the industrial accidents and the general disasters from the viewpoint of the preventive solution.

#### 2. Mutual relations between the facts (accidents or incidents) and the standards (for the solution or settlement)

Professor Dr. Rosco Pound formerly proposed the new legal study method as the “social engineering” in regard to reformation of the social systems. Now in our country, we would intend to establish a new idea in the legal study method, concerning the mutual adjustment between the accidents or incidents and the various standards for the solution or settlement.

#### 3. Some important problems for reviewing the past bitter experiences

During past fifty years, we have experienced many important problems concerning the legal processing systems in Japan as follows:

- 1) Deviation from the fact-finding works in the Minamata Pollution case and conversation to the compensation problems for the fishermen and other people etc.
- 2) Prevention of the harmful effects of various medicines.
- 3) Pros and Cons of acknowledgment method of the employer’s liability about the industrial accident.
- 4) Human ergonomics problems in the settlement of the accident-responsibility of motorcar driving.
- 5) Risk-management and estimation or prevention of a big natural disaster.
- 6) Rapidity and expertise in labour-disputes resolving procedures, etc.

### **Free-living energy expenditure and time allocation of rural- and urban-dwelling Papua New Guinea Highlanders**

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Papua New Guinea (PNG) has been rapidly modernized both in rural and urban sectors. Since 1970s, there has been an increasing number of migrants from the rural villages to Port Moresby, the capital city of PNG. Most of them face difficulties of obtaining paid jobs, then they engaged “the informal sector” jobs such as collecting bottles, selling betel nuts and/or cooked food at markets or roadside.

This study aims to clarify behavioral adaptation of migrants of Huli-speakers from the High-



lands by comparing heart rate (HR), time allocation and energy expenditure (EE) between the Huli farmers in the homeland and the urban migrants. Married males and females were chosen as the subjects for the study of 24-hours HR monitoring and time allocation. The rural sample included 27 adults (15 males and 12 females) and the urban sample included 29 adults (14 males and 15 females). The findings are summarized as follows.

1) The urban subjects had larger body weight and higher basal metabolic rate (BMR) than the rural subjects, although a significant difference was found only in females. There was no significant difference in total energy expenditure (TEE) between the two groups. However, the physical activity level ( $PAL=TEE/BMR$ ) tended to increase in the males (1.79 in the rural area and 1.89 in the urban area), but tended to decrease in the females (1.85 in the rural area, and 1.77 in the urban area) with the migration. The male/female ratio of PAL differed between the two groups: 0.96 in the rural group and 1.07 in the urban group.

2) Comparing HRs between sexes and between the rural and urban dwellers, males tended to have higher values, and the urban subjects tended to have higher values. However, the HRs in work hours were lower in the urban dwellers.

3) The time allocation patterns of males differed remarkably between the two residential groups. The work hours of the urban subjects was 3.6 times as much as that of the rural subjects. The active time (defined according to HR level) was significantly shorter in the urban subjects than in the rural subjects.

4) Comparing the rural and urban subjects, the same tendency was found both in the time allocation data and the energy expenditure data.

In conclusion, the behavioral adaptation due to the change of living and work conditions between the rural and urban dwellers was examined by heart rate, time allocation and energy expenditure. The influence of urbanization differed between the sexes.

### **Survey of medical behavior of minority nationalities in northern Thailand (1)**

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Thailand is a medically pluralistic society embracing many types of medicines and cures, and thus enabling people to choose among a variety of medical treatments and techniques. Most hospitals have modern medical systems, but the number of doctors per population (2.3/10,000 in 1992) was extremely insufficient. To make up for the serious shortage of doctors and medical facilities, health centers have been set up in local districts. Some villages also have village health volunteers (VHVs). They teach and practice traditional Thai medicine, called the Royal Tradition of War Pho, and folk medicine. Minority nationalities, in particular, have ethno-medical doctors (moo yaa) who prescribe herbs to patients and cultivate such herbs. Shamans (Khaathaa and moo phii) who practice magic are also an integral part of ethno-medicine indigenous to minority nationalities. This report focuses on the medical behavior of people in rural areas of northern Thailand and minority nationalities.

Questionnaires were distributed in November 1994 in Chiangmai city and a rural mountain village in northern Thailand, at schools having students of minority nationalities (i.e., Karen, Hmong, Lisu, and Chin) and Thai. A total of 1,875 students answered the questionnaires. Some interviews were also done for minority nationalities in March 1996. The questionnaires covered, in addition to age, nationality, and religious belief, illness and injury at three levels of severity, i.e. light, intermediate, and serious.

The results of this survey were as follows; 1) People in rural areas of northern Thailand and

minority nationalities effectively use health centers and VHVs to obtain medicine; 2) they have used and taught folk medicine; 3) for incurable disease, they depend on shamans (Khaathaa and moo phii) for healing.

### **An experimental study on the work load of continuous sign language interpretation**

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Our nationwide investigation in 1990 demonstrated that about 20% of the professional sign language interpreters in Japan required medical treatment for occupational cervicobrachial disorders (OCD). This situation shows the necessity to establish a limit for the continuous interpretation period for prevention of OCD, for which we conducted the following experiment.

Subjects were 20 professional sign language interpreters. All subjects were classified into three subgroups by medical check-up. Group 1 consisted of 5 healthy interpreters, Group 2 consisted of 9 interpreters slightly affected with OCD, and Group 3 consisted of 6 interpreters moderately affected. Two kinds of tests and choosing subjective symptoms in a questionnaire were conducted every 5 min during the 50-min interpretation to observe fatigue. One of the tests was 35-sec finger spelling test to observe position and locus of the right elbow. The indexes of observation were the vertical coordinate, horizontal coordinate and locus. The second test was 15-sec straight forward arm-holding test to measure the root mean square (RMS) and mean power frequency (MPF) of EMG for the upper trapezius muscles. Choosing subjective symptoms in the questionnaire was finished within 10 sec. Subjective symptoms consisted of localized muscle fatigue and a feeling of deterioration of one's own interpretation.

The complaint rate of localized muscle fatigue increased significantly in Group 2 and 3 within about 20 to 30 min. The complaint rate for a feeling of deterioration of interpretation increased significantly in all groups within 20 to 30 min. Right elbow descending and locus shortening in Group 3 showed a tendency towards fatigue. The elbow ascending in Group 1 suggests an effort against fatigue. The elbow ascending and locus shortening in Group 2 seem to be in the intermediate state between Group 3 and 1. However, none of these changes was statistically significant. Increased RMS was observed in all groups, which was marked and significant in Group 3. Decreased MPF was observed in Group 1 (significant) and Group 2 (non-significant), but not found in Group 3.

The fatigue phenomena appeared about midway in the 50-min experiment. This time corresponded to the tolerable interpretation spell of 20 to 30 min appraised by sign language interpreters in our previous investigation. The subjects with the more severe OCD showed the fatigue phenomena earlier and more markedly.

### **Relationships between wakefulness of mothers and their infants' movement during night sleep in postpartum periods: Differences of mother's adaptation to postpartum periods**

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In our previous study in 1995, we showed that percentages of mothers' waking time at night in the first postpartum week was 25.1%, and did not change across the first, third and sixth weeks from delivery. In the present study, relationships between mothers' wakefulness and their infants' movements during night sleep were studied, focusing on differences between mothers' adaptation and non-adaptation to postpartum periods.

Subjects were ten primiparae (mean age of 26.8) and their infants. The mothers' polysomnograms and their infants' ankle actigrams were simultaneously recorded at home during one night in the first, third and sixth postpartum weeks. The infants' movements were classified into four states, i.e. Mov 0, Mov 1, Mov 2, and Mov 3, which were defined as states with 0, < 20, 20-40, 40-60 sec activity, respectively. While eight mothers satisfactorily adapted themselves to postpartum periods (group A), two had difficulties in adaptation (case B and C). In case B, the day-night rhythm of infant seemed to have been reversed. In Case C, mother was irritated with her infant, and unwilling to take care of the infant.

In group A, mean and SD values of waking time from sleep onset to final awakening were for 1 week: 102.7±26.6 min, 3 weeks: 76.5±39.2 min, and 6 weeks: 71.5±34.1 min, respectively. The waking time of case B was larger than that of group A by more than +1 SD, while that of case C was similar to that of group A. In the infants of group A, mean and SD values of percent of Mov 2+3 for time in bed were for 1 week: 15.5±5.7%, 3 weeks: 14.2±6.4%, and 6 weeks: 10.4±3.7%, respectively. Both Mov 2+3 of the infants of cases B and C were larger as compared with those in group A. In group A, there was a high synchronization between the mothers' wakefulness and their infants' movements. In case B, mother was awake before her infant's movements. In case C, mother woke up more than 10 minutes after the beginning of her infant's movements. According to the questionnaire, subjective sleep-ratings were lower in cases B and C than in group A.

In conclusion, differences between mothers' adaptation and nonadaptation to postpartum periods appeared in infants' movements and subjective sleep-ratings of mothers. We should collect more nonadaptation cases in order to clarify its reasons.

### **How effective is health counseling with continuous shiftworkers?: A controlled evaluation**

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The aim of the present study was to evaluate a 3x1 hour counseling intervention intended to improve the self-reported health of continuous shiftworkers.

An initial short questionnaire generated 139 replies (25%) from an electronics factory, and 380 (66%) from a large chemical works. Those who volunteered to meet a member of the counseling team, and who reported at least some health problems, were split into two demographically matched groups: "early" and "late". A detailed questionnaire was completed before the first meeting, and then repeated between the early and late intervention, and at the end.

In the electronics works, 48 shiftworkers were seen three times, but there was severe attrition in completing subsequent questionnaires that would permit evaluation. In the chemical works, 68 shiftworkers were seen and completed all questionnaires. They were all working rotating 12-hour shifts, with 4 days, 4 off, 4 night, 4 off, and an extra 6-day break after 3 cycles of this. Each shiftworker was interviewed by a trained counselor for three separated hours, during working time, following the brief therapy model. These interviews were each separated by at least one new batch of night shift. The interviews focused on the shiftworker's chosen problems, and as well as client-centered counseling, practical help was given with materials like ear-plugs for day-sleep, decaffeinated coffee and tea, relaxation tapes, and public health literature.

Significant improvements were found in 2 out of 7 planned comparisons in the early group: GHQ 12, and PHQ cardio-vascular: and there was a general trend towards improvement in other areas of sleep, eating and social problems. In the late group, there were no statistically significant improvements, but again a positive trend on most measures. Most shiftworkers rated the intervention positively: 28% thought their health was better; and two-thirds would recommend it "a lot" or more to a friend.

The intervention appeared at the time to be successful, was evaluated favorably by the shiftworkers, but did not seem to improve the situation substantially. The median length of shiftwork experience was 18 years, and the basic hardships of shiftwork remained, so that it may be over-optimistic to expect much significant change in the short term. An alternative, cheaper, intervention might be just as effective.

### **Workload of social welfare facility workers engaged in irregular shift systems**

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The intervention study (Sakai et al., 1993) was carried out to improve a shift system of social welfare facility workers. The existing system was investigated, especially concerning workload.

The present study was done in an institution in which 40 mentally-handicapped children lived. Of 38 employees (20 males and 18 females), 28 were working in an irregular shift system. They worked 42 hours per week. The shift system was based on a seven-day cycle with an anti-clockwise rotation, i.e. in the order of two afternoon shifts, two morning shifts, half morning shift and night shift, and two day off. However, the actual rotation shift was more complicated. Measurements of urinary catecholamine levels as a stress indicator, observation of work by a motion-time study, continuous heart rate monitoring and so on were conducted.

Catecholamine (norepinephrine NE and epinephrine E) levels during night shift (for the first half of shift: NE=30.3±3.0 ng/mg of creatinine and E=6.76±1.49; for the latter half of shift: NE=33.6±3.1 and E=7.84±2.21) were as high as those during morning shift (for the first half: NE=33.6±3.6 ng/mg of creatinine and E=6.77±1.06; for the latter half: E=28.1±3.0, E= 8.02±1.20). The subjects' physical workload as evaluated by using a motion-time study was heavier during morning shift (sitting postures, 37.7%; standing postures, 32.8%) than during night shift (sitting postures, 74.5%).

The night-shift workers spent much time for making their reports. The heart rate of Subj.A in morning shift distributed between 70 and 130 bpm. On the other hand, the heart rate of Subj.B in night shift distributed roughly between 70 and 90 bpm and increased until 120 to 140 bpm a few times every hour for taking care of children having epilepsy seizures, cleaning up children after defecation, or other kinds of special care. Catecholamine levels during day sleep between half morning shift and night shift were significantly higher than those during night sleep between two morning shifts. The subjects reported that they had a good night sleep, and a poor and short day sleep. One of these subjects did not succeed in getting a day sleep.

Conclusions in this study were as follows: 1) In general, epinephrine level during awakening at night are somewhat lower than those in the daytime due to circadian rhythms. In this study, the catecholamine levels during night shift were as high as those during morning shift. However, there were individual differences depending on the workload in each subject. 2) The higher levels of catecholamine in night shift and other results obtained from questionnaires suggest that the workload in the present shift rotation is relatively heavy. 3) During sleep, catecholamine levels, especially epinephrine, are usually low. In this study, the catecholamine excretion were higher during day sleep than during night sleep, implying a poorness of the day sleep.

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