# 厚生労働科学研究費補助金

## 健康科学総合研究事業

健康度の測定法及び計算式の開発に関する研究

平成14年度　総括・分担報告書

主任研究者　川村則行

平成15(2003)年　3月

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# 総括研究報告書

# 健康度の測定法及び計算式の開発に関する研究

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研究要旨

過去の研究において, Exposure(曝露)として 800 項目の質問紙の情報(生育歴, ストレッサー, 気質, 性格, 服薬歴, 緩衝要因), Surrogate(エンドポイントの代用:細胞性および液性免疫, 健康診断データ)と Outcome(エンドポイント:疾病休業日数, 各種生活習慣病の発症)に関する情報を蓄積した. これらを用い, 個人の健康度の指標を表現する目的で, Exposure, Surrogate と Outcome の subcategory の関係を繋ぐ数式・アルゴリズムを, discriminant analysis と general linear model を用いて, 非公開で作成した. この数式・アルゴリズムが, 同一集団および異なる集団にて, Surrogate と Outcome の subcategory の予測に役立つか否かを検証し, 適宜, 修正を加え, 簡略化し, 実用に耐えうる, 健康度の指標として確立することを目指す. そのために, (1) Exposure, Surrogate と Outcome の精度を高めること (2)Exposure に遺伝子多型の情報を含めること, (3)Exposure のうち主要なものに, 簡便な介入を加え, Surrogate と Outcome が, 介入後も同一の数式・アルゴリズムで表現できるか否か検討すること(4)非線形モデルを数式・アルゴリズムに活用すべきか否かの検討を行うこと, を4本柱として研究を進める。本研究の主なる成果である健康度:数式・アルゴリズムは, 厚生労働省の指導の元で開発し特許化する. 副次的なる成果として, Exposure, Surrogate と Outcome の相互関係や因果関係に関する新しい知見は, 国際学術雑誌に投稿し, 英文・日本文の書籍として刊行する. 数式については, 平成 14年度の報告書にて開示する方針であったが, 実用化に向けての社会的手続きを考案中で、一般には開示しない事に決定した。数式を記載することは、特許化する目的に反するので記載しない点につき了解を得たい。総括報告書中の図の緩衝要因(Buffereing System)に該当する項目の多くが、ストレッサーのレギュレーションを変え、健康度数式の分岐点を形成することが明らかとなった。今後、この点に注意して、開発を進めたい。

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## A 研究目的

過去の研究において，Exposure（曝露）として 800 項目の質問紙の情報（生育歴，ストレッサー，気質，性格，服薬歴，緩衝要因），Surrogate（エンドポイントの代用：細胞性および液性免疫，健康診断データ）と Outcome（エンドポイント：疾病休業日数，各種生活習慣病の発症）に関する情報を蓄積した．

これらを用い，個人の健康度の指標を表現する目的で，Exposure，Surrogate と Outcome の subcategory の関係を繋ぐ数式・アルゴリズムを，discriminant analysis と general linear model を用いて，非公開で作成した．この数式・アルゴリズムが，同一集団および異なる集団にて，Surrogate と Outcome の subcategory の予測に役立つか否かを検証し，適宜，修正を加え，簡略化し，実用に耐えうる，健康度の指標として確立することを目指す．

主任研究者は、The rise in medical care expenditures in Japan: 1977-81. Am J Public Health. 1985 において，国民の 2/3が罹患する，がんおよび循環器の死に至る病が日本の医療費の多くを消費することを示した．

昨今では，これらを含む，生活習慣病の予防法の開発が急務となった．

この事業に関わる、本研究の最終目的は，21世紀に望まれる order-made preventive medicine の構築である．

その第一段階として，いかなる個人からも，簡便に得ることの出来る必要最小限の情報によって，疾患の発症を何処まで予測できるか，何を変えれば，発症しないかという帰納的知見を，日本人集団で構築する必要がある．

本研究では，健康度を幾つかのサブカテゴリーにわけ，サブカテゴリー毎の健康度を，ある一時点の個人の情報から，一定の計算式および，アルゴリズムで数値化し，それらサブカテゴリー毎の数値に基づき，個別の個人用の order-made preventive strategy を作成し，個人においては，QOL が高く，active で vigorous な長寿命の達成を目指す．

地域や国家のレベルにおいては，新しい予防医学ビジネスや雇用の創出，医療費の削減を目指す．

そのために，(1) Exposure，Surrogate と Outcome の精度を高めること (2) Exposure に遺伝子多型の情報を含めること，(3) Exposure のうち主要なものに，簡便な介入を加え，Surrogate と Outcome が，介入後も同一の数式・アルゴリズムで表現できるか否か検討すること、(4) 非線形モデルを数式・アルゴリズムに活用すべきか否かの検討を行うこと，以上を4本柱として，本研究の主なる成果である，健康度：数式・アルゴリズムは，厚生労働省の指導の元で開発し特許化する．副次的なる成果として，Exposure，Surrogate と Outcome の相互関係や因果関係に 関する新しい知見は，国際学術雑誌に投稿し，英文・日本文の書籍として刊行する．

## B.研究方法

discriminant analysis と general linear model の独立要因として採用された項目（尺度等の制約をはずして選択されている）によって，Surrogate として発がんやウイルスへの抵抗力の指標として有用なNK活性の素点と順位数を説明する数式，同じくCD4数を説明する数式，アレルギーの程度をあらわすIgEを説明する数式，老化の指標としても使用できる可能性を持つTh1：Th2サイトカイン比やアポトーシスを説明する数式，Outcome として風邪引き日数，疾病休業日数、高脂血症、他を説明する数式をこれまでに開発している．

上記の健康度：数式アルゴリズムの検証と改良および統合の3つの側面からなるが、新たに自殺企図などの他の数式を開発中である．

検証は以下2つの方法によって行う．

①これまでに数式を開発するためにデータを収集したのと同じ集団の内の他の一部と，それとは地域も職種も異なる別の集団において，cross sectional study を行い，cross validation にて数式の再現性を見る．

②その集団で，介入可能な独立要因に，何らかの介入を行い，2時点目での予測値に変化をおこし，Prospective に数式と実測値との差異を見る．

改良は以下3つの方法により行う．

①discriminant analysis と general linear model に従った線形式に，非線形要素を取り入れる．

②項目の文言の変更や未測定の概念の追加による独立変数の変更と，従属変数の増加．(肥満，血圧、自殺企図他)

③遺伝子多型の情報を取り入れる．遺遺伝子多型は，全血からゲノム DNA を抽出し，それをPCR法によって増幅後，制限酵素で切断して，断片長から遺伝子変異を特定したり，PCR産物の直接シークエンス法を用いて調べる．更に，DNA アレイ法によって調べる．

統合は以下のように行う

Outcome としての疾患の発症と Surrogate の免疫系の関係をあらわす数式が，コホートの年数を追うごとに作成される．Exposure → Surrogate → Outcome の流れや Exposure → Outcome の流れなどの幾つかのモデルを比較し，最も個人の値を示す式を作成し，最終的に，それを，高免疫，中免疫，低免疫のように単純化して表現する．

**倫理面への配慮**

インフォームドコンセントおよび倫理関係書類は、昨年度の報告書参照。

平成13年度に文部科学省・厚生労働省・経済産業省からヒトゲノム・遺伝子研究に関する倫理指針が作成され，それに準拠し，倫理委員会を経て，充分なインフォームドコンセントのもとに研究を遂行する。

本研究課題に関する倫理委員会書類は、平成13年10月に国立精神・神経センター国府台地区倫理委員会に提出し、平成14年1月に条件付き承認を得て、平成14年4月14日に最終的に、承認を受けた。

その後、被験者からの研究協力の合意を得た。

**対象**

企業：国内の製造業、小売業、鉄鋼業に働く労働者　約4000人

地域：静岡県、兵庫県の地域住民　約800人

## C. 研究成果

この報告書の他の部分と、どのように関連づけるかをわかりやすくするために成果のそれぞれに通し番号を付けて記述した。

通し番号は①－⑳で、検証以降に記載された項目を意味する。

関連づけは以下の通り。

②の介入の内容は、c-1 から c-3 に記載している。いつでもどこでも、誰に対してもできるように、介入のマニュアル化を進めている。この介入を実施する理念、仮説は a-3,a-4 に記載した。

③の介入の一部は、c-1 に記載した。b-1 の自我強度尺度のうち、D1に該当する心の堅い強さが、一般的な健康教育の効果を事前に予測することができたので、健康度指標に応用する事を検討中。

⑦の尺度は、a-8,b-2 に記載した。

⑧不眠に関しては、surrogate との関係を a-7 に記載した。⑨トラウマ経験の有無と exposure や surrogate の関係は、a-1,a-6 に記載した。

⑪は、a-3,a-4,c-3 を参照。

⑫は、a-9,a-10,b-2,b-3 を参照。

⑯自我強度は b-1 参照。

⑲コーピングは、a-2 参照。

⑳感情同定困難は、a-5,分担研究報告書を参照。

数式については，平成14年度の報告書にて開示する方針であったが，実用化に向けての社会的手続きを考案中で、特許取得を目指すこととしたので一般には開示しない事に決定した。

数式を記載することは、目的に対し、方法があわない（非、目的合理的）ので、記載しない点につき了解を得たい。

①、④、⑤、⑥、⑨、⑩、⑬、⑭、⑮、⑱、⑲については、研究の規模、内容が膨大になるため、次年度に報告する。

検証について

①免疫の数式については、Cross Validation にて再現性を検討中であり、若干の変更を行った。
②介入研究は、2時点目の調査までを開始し、1 時点の研究は終了した。介入ターゲットは、知覚されたサポートに照準を絞った。
③一般的な健康教育(コレステロールの低下)による介入の効果の有無を、介入の事前に判定するExposureの項目も明らかにした。
④疾病休業に関して、心理社会的項目の予測能力が高い事を明らかにした。

改良について

⑤これまで協力を受けてきた企業において、項目の文言の変更や未測定の概念の追加による独立変数の変更と，従属変数の増加を行い成果を得た。14年度の評価コメントを受けて、自殺企図の数式に関しても成果を得た。
⑥遺伝子多型の情報を取り入いれるための研究を行った。3000人以上から同意を得た。

上記の結果、数式・アルゴリズムに取り入れるべき Exposure の項目は以下のように集約されつつある。
⑦overt aggression(攻撃性が外部に向かい顕在的であること) covet aggression (攻撃性が間接的であること)
⑧不眠
⑨トラウマ経験の有無
⑩海外派遣
⑪ネットワークサポートと知覚されたサポート
⑫ストレッサーと年齢と性
⑬遺伝子多型
(5－HTT、NPYY1R, DRD4など)
⑭生育歴(親の干渉)
⑮喫煙・運動・食事などの健康関連行動
⑯自我強度
⑰神経質
⑱家族環境
⑲コーピング
⑳感情同定困難
他、

統合について

これまでの線形式に，非線形要素を取り入れるべきかいなか検討すべく、数学者らと検討を行っている数式間に見られる共通な現象として、本人の⑳感情同定困難、⑰神経質傾向、⑲積極的なコーピング、⑪社会的支援を項目として用いた場合は、単純な線形式では表現できないことがはっきりとした。これらは、神経質傾向の高低などによって、2値化したうえでアルゴリズムの分岐点として用いる必要性が明らかとなった。

Exposureの主要なものに介入を加え，数式を検討するために，ソーシャルサポートの介入研究を開始し、サポート環境と主観的に知覚されたサポートの間に相関がないため、介入ターゲットを知覚されたサポートに照準を絞り実施中。

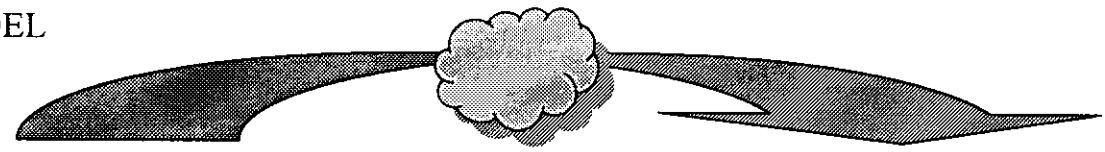
**D.E.考察と結論**

欧米を中心に、過去、疾病罹患と健康関連行動、性格、ストレスなどの健康影響が調べられてきた。acute and chronic stress は60年代から、hostility は70年代から、depression は50年代から、social support は70年代から、socioeconomic status は、50年代から、報告が始まった。

これらの成果を日本で検証する仕事も近年盛んであるが、日本人と、欧米人では影響度がことなることが明らかになりつつある。我々も、欧米の尺度を日本語化したり、日本人向けに多数の尺度を開発して、日本人向けの成果を得ようと努力の途上にある。

常に使用している思考モデルは下記の図の通りである。

MODEL



**Stressors Exposure**

Psychosocial
Daily Hassles
Life Events
Job Stressors

Biological
Infection
Exposure to substances

**Buffering System Exposure**

Psychosocial
Temperament TCI
Character NEO TPQ
Early Life Experiences
Coping
problem focused
emotion focused
Social Support
Social Network
Perceived Support
Behavior related to health
daily habits: smoking
Biological
Gender
Genetic Predisposition
Circadian rhythm

**Reactions Surrogate**

Psycho-emotional
Depression
Anxiety
Fear
Dissociation
Insomnia
...

Biological
Immune alteration
Endocrine change
ANS alteration

**Outcome**

**Diseases**
**Social Dysfunction**

前記のモデルの中で、緩衝要因(Buffereing System)に該当する項目が、多くの場合、ストレッサーのレギュレーションを変え、健康度数式の分岐点を形成することが、明らかとなっている。今後、この点に注意して、開発を進めたい。

F.健康危険情報

なし

G.研究発表

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一般口演

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2 安藤哲也, 小牧元, 成尾鉄朗, 瀧井正人, 苅部正巳, 原信一郎, 武井美智子, 黒川順夫, 川村則行, 兒玉直樹, 棚橋徳成, 立川直子, 野添新一, 久保千春, 石川俊男:摂食障害患者におけるuncoupling protein(UCP)遺伝子の多型解析 第43回日本心身医学会総会ならびに学術講演会, 東京 口頭 平成14年5月

3 宮崎隆穂, 小牧元, 石川俊男, 川村則行:知覚されたソーシャルサポートと免疫系の関連(2). 第43回日本心身医学会総会ならびに学術講演会, 東京 口頭 平成14年5月

4 立川直子, 棚橋徳成, 成尾鉄朗, 瀧井正人, 川村則行, 石川俊男, 小牧元:摂食障害患者におけるグレリン遺伝子の多型解析 第29回日本神経内分泌学会高知市 口頭 平成14年10月

5 朴商会, 小牧元, 川村則行, 鄭晋郁, 金基雄:中高年労働者の職業性ストレスおよび生活習慣がTh1/Th2比に及ぼす影響 第18回日本ストレス学会学術総会, 東京 口頭 平成14年11月

6 酒見正太郎、中田光紀、山村隆, 川村則行:心理的ストレスによるヒトの末梢Tリンパ球のin vitroアポトーシスの増加 第15回日本神経免疫学会学術大会, 長崎口頭 平成15年3月

3. その他

講演

1 川村則行:心と体:メンタルヘルスを高める 静岡県庁 口頭 平成14年.6月

2 N.Kawamura: Stress and Immunity.(ストレスと免疫)Kollokium. Max Planck Institute of Psychiatry Germany 口頭 平成14年8月

3 川村則行:心で始まる病気:社会生産性本部メンタルヘルス研究所.渋谷区 口頭 平成14年11月

4 川村則行:看護婦のメンタルヘルスエキスパートナース研修会,埼玉県立がんセンター,埼玉 口頭 平成15年2月

5 川村則行:成長を人生の目標にしよう後期:母親のためのセミナー,小金井市 口頭 平成15年3月

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H. 知的所有権の出願・登録状況

1 特許取得
なし
2 実用新案登録
なし
3 その他
なし

# Relationship between a Traumatic Life Event and an Alteration in Stress Response

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**Abstract**

Objective: Investigate the influence of a past exposure to trauma to strain and other mental health indexes, and to consider their relationships.

Method: Experience of traumatic life events, depression, anxiety and job strain were assessed in 2959 male and 279 female workers, and relations analyzed.

Results: Past exposure to a traumatic experience was shown to increase later anxiety for both male and female subjects, and increase depression and job strain in male subjects. Because job strain can be regarded as an indication of sensitivity to stressors in this study, people with past traumatic experiences more strongly felt a stressor's influence. Here, sex, presence of traumatic experience, and severity of strain had complex influences and interacted with each other. Further, those influences differed with types of trauma.

Conclusion; Strain was shown to be an important element in the mechanism of trauma and later mental health.

Key Words;
Traumatic life event; strain; job stress; stress tolerance; depression

## Introduction

People who have experienced past traumatic life events have been reported to be more likely to have depression (1, 2) and anxiety disorders (3, 4) than people without such experiences. Further, depression and anxiety disorders have been shown to be related to cognition of daily stressors (5); research using Karasek's Job Content Questionnaire has indicated people who acknowledged high job stress tend to have depression and anxiety (6).

Research that focuses on the relationship between past traumatic experience and cognition of a stressor is scarce, and has only been done on specific subjects such as breast cancer patients, where patients with past traumatic stress reported a current stress status that was worse than patients without such an experience (7) or on specific events

like earthquakes, which indicated people got higher job pressure after an earthquake experience (8). This cognition of stressors can be regarded, from another viewpoint, as an indicator of stress tolerance under the condition of being surrounded by same level of a stressor. There is a paucity of research on the relationship between past traumatic experience and this stress tolerance, apart from some research using Rorschach tests that showed that stress tolerance of Vietnam veterans who satisfied diagnostic criteria for PTSD was less than those who did not satisfy the diagnosis (9, 10). There has been no empirical research on the relationship between traumatic experience and later stress tolerance.

However, the examination of whether past traumatic stress influences later cognition of a stressor, and if these two factors affect levels of stress responses such as depression and anxiety, is necessary for an understanding of the mechanisms and influences of traumatic stress on human mental health, and for the better management of traumatic stress. This research examines the relationship among past experiences of a traumatic life event, later cognition of a stressor by using job strain, and mental problems such as depression and anxiety in a large sample of non-clinical subjects utilizing retrospective and cross sectional design.

## Material and Methods

### Subjects

Subjects were workers at an industrial company located in a suburban city in Japan. A questionnaire was distributed to all workers at the time of a health check in 2001, and collected. Written informed consent was obtained. There were no objections to answering the questionnaire. Subjects were 2959 males (mean age; 39.30, SD; 11.08) and 279 females (37.14, 9.33). There was a significant difference of age between the sexes. ($p<0.05$)

### Scales

To assess depressive symptoms, the Zung self-rating depression scale (SDS) Japanese version (11) was employed. The SDS developed by Zung (12) is one of the best-known instruments for evaluating the severity of depression. It includes twenty items with four-grade response sets each; the reliability and validity of the Japanese version of this scale has been established.

For evaluation of their anxiety symptoms, Sheehan patient rated anxiety scale (Sheehan) (13) Japanese version (14) whose reliability and validity has already been verified was used.

Additionally, Karasek's job content questionnaire (JCQ) Japanese version (15) was applied to evaluate subjects current stress cognition, since this study's data collection was done in an industrial company to acquire a large sample of a general population. The JCQ of Karasek (16) is an instrument for assessing job stress, and contains sub scales such as job demands, job control, co-worker's support and supervisor's support. Also job strain can be calculated through dividing job demands by job control. We used this job strain as an indicator of cognition of the stressor in this study. Reliability and validity of the JCQ Japanese version has been previously confirmed (15).

Moreover, to obtain information on

subjects' past traumatic life events, we made an event checklist that consisted of thirteen items with yes/no response sets. If a worker answered yes for any of the traumatic experiences in the checklist, they were regarded as in the "trauma-exposed group"; and we then asked to indicate the most traumatic event and also to describe the duration from the time of the event. Subjects who did not answer yes to any of the 13 items were grouped in the "non-exposed group". The checklist consisted of life events that seemed to contribute to constructing a traumatic influence, however events not necessarily traumatic but easy to encounter in daily life and having strong impacts were included. For the sake of statistical convenience, each event was categorized into three groups, "frequent traumatic event", "other event" and "violence", guided by our decisions as authors based upon our clinical experiences. (Table 1 shows the contents of each traumatic event group and the total number of persons who experienced these events.)

We administered the impact of event scale-revised (IES-R) Japanese version for those who had answered that they had been exposed to any of the past traumatic life events. IES-R developed by Weiss et al. (17) amended from IES is a self-reporting questionnaire containing twenty-two items that are valued with five-graded response sets. The IES-R Japanese version was standardized by Asukai et al(18).

**Analysis**

1) an analysis of covariance (ANCOVA) was employed to compare the above noted scales between the trauma exposed and non exposed groups for each sex. Age was put as a covariate. 2) The General Linear Model procedure (GLM) in which scores of each scale were put as dependent variables; sex, presence of a traumatic experience (having experienced a traumatic life event in the past or not), and severity of strain (high strain or low strain divided by average score) were put as fixed factors, while age was put as a covariate for the detection of the main effects of each of the factors and the interactions between/among factors. For multiple comparisons of interactions, ANCOVA putting age as a covariate was employed. 3) We discussed whether each score on the scales would be different among event types with ANCOVA putting age as a covariate. 4) The Pearson product moment correlation coefficient was calculated between duration from event and each scale's score. For statistical data analysis, SPSS version 11.0 was used.

**Results**

First, among male subjects, the trauma-exposed group had significantly higher scores than did the non-exposed group in SDS, Sheehan and strain as shown in Table 2. ($p<0.01$) In female subjects, the scores of the trauma-exposed group were significantly higher than those of the non-exposed group only in Sheehan. ($p<0.01$)

Table 3 summarizes the results of the main effects and interactions obtained by GLM for each scale's scores. As shown in the table, the main effects of the presence of a traumatic experience and the severity of strain were detected in SDS and Sheehan. ($p<0.01$) Additionally, we found interactions between the presence of a

Table 1. Total Number of Subjects Who Experienced Each Event

| | | Male (n=2959) | Female (n=279) |
|---|---|---|---|
| frequent traumatic events | natural disaster | 167 | 9 |
| | fire or explosion | 57 | 4 |
| | trauffic accident | 355 | 25 |
| | witness murder | 112 | 6 |
| other events | exposure to poisonous substance | 7 | 0 |
| | other accient | 71 | 7 |
| | verbal violence | 141 | 23 |
| | accident of friend | 65 | 4 |
| | shock | 29 | 4 |
| violence | assault | 30 | 3 |
| | physical abuse | 16 | 3 |
| | assault with weapon | 22 | 0 |
| | confinement | 7 | 0 |
| | sexual assault | 16 | 10 |

Table 2. Comparison between Non-Exposed and Trauma-Exposed Groups for Each Scale

| | | non-exposed group (n=2256) Mean(SD) | trauma-exposed group (n=703) Mean(SD) | F | odds ratio |
|---|---|---|---|---|---|
| Male | SDS | 41.20 (7.08) | 42.48 (7.05) | 17.70 * | 1.03 |
| | Sheehan | 5.86 (10.73) | 10.84 (10.74) | 115.48 * | 1.85 |
| | strain | 32.55 (0.14) | 33.49 (0.16) | 7.43 * | 1.03 |
| Female | SDS | 41.51 (6.91) | 42.88 (6.92) | 2.07 | 1.03 |
| | Sheehan | 5.88 (9.44) | 10.49 (9.45) | 12.68 * | 1.78 |
| | strain | 29.37 (0.13) | 31.27 (0.13) | 3.50 | 1.06 |

ANCOVA with age put as a covariate * p<0.01

SDS=Zung self-rating depression scale; Sheehan=Sheehan patient rated anxiety scale;

strain=job strain: a subscale of job content questionnaire

Table 3.Main Effects and Interactions for SDS and Sheehan

| | | type Ⅲsum square | d. f. | F | |
|---|---|---|---|---|---|
| SDS | age | 593.73 | 1 | 12.54 | |
| | sex | 1.00 | 1 | 0.00 | |
| | presence of traumatic event | 369.26 | 1 | 7.80 | ** |
| | severity of strain | 1463.26 | 1 | 30.91 | ** |
| | presence of traumatic event*severity of strain | 232.89 | 1 | 4.92 | * |
| | presence of traumatic event*severity of strain*sex | 218.58 | 1 | 4.62 | * |
| Sheehan | age | 1892.72 | 1 | 16.97 | ** |
| | sex | 56.03 | 1 | 0.50 | |
| | presence of traumatic event | 4821.25 | 1 | 43.22 | ** |
| | severity of strain | 1086.70 | 1 | 9.74 | ** |
| | presence of event*severity of strain | 525.77 | 1 | 4.71 | * |

GLM with age put as a covariate * $p<0.05$ ** $p<0.01$ as for interactions, only significant were shown

SDS=Zung self-rating depression scale; Sheehan=Sheehan patient rated anxiety scale

traumatic experience and the severity of strain; and among the presence of a traumatic experience, the severity of strain and sex in SDS; and the presence of a traumatic experience and the severity of strain in Sheehan. ($p<0.05$) Figure 1 shows these main effects for each sex. For male subjects, scores of both SDS and Sheehan in the trauma-exposed group were significantly higher than those in the non-exposed group within both high severity of strain groups (SDS: non-exposed group; estimated mean=43.30, SD=6.77, trauma-exposed group; estimated mean=44.51, SD=6.78, Sheehan: non-exposed group; estimated mean=7.16, SD=11.70, trauma-exposed group; estimated mean=13.12, SD=11.70) and lower severity of strain groups (SDS non-exposed group; estimated mean=39.97, SD=6.95, trauma-exposed group; estimated mean=41.09, SD=6.96, Sheehan non-exposed group; estimated mean=5.10, SD=10.00, trauma-exposed group; estimated mean=9.29, SD=10.01). The scores of the high severity of strain group were significantly higher than those of the low severity of strain group regardless the presence of a traumatic experience. (all $p<0.01$ except for SDS score in the high severity of strain group $p<0.05$) For female subjects, the scores of SDS and Sheehan of the high severity of strain group with a past traumatic experience (SDS; estimated mean=44.89, SD=6.95, Sheehan; estimated mean=12.14, SD=10.23) were significantly higher than those without a past traumatic experience (SDS; estimated mean=41.50, SD=6.89, Sheehan; estimated mean=5.50, SD=10.16) and the low severity of strain group with a past traumatic experience (SDS; estimated mean=40.99, SD=6.81, Sheehan; estimated mean=8.74, SD=8.85). (all $p<0.01$ except for SDS scores in the high severity of strain groups and Sheehan scores in the trauma-exposed group $p<0.05$) For the female non-exposed group, scores were not different between the high strain and the low strain groups. As for SDS in which interactions among the presence of a traumatic experience, the severity of strain and sex were shown, main effect comparisons between sexes showed significant differences in the low severity of strain groups without trauma exposure (male; estimated mean=41.11, SD=7.43, female; estimated mean=40.30, SD=7.56), and in the high severity of strain groups without trauma exposure (male; estimated mean=43.28, SD=6.66, female; estimated mean=41.42, SD=6.70), and scores of male subjects were higher for both ($p<0.05$ for both).

In addition, the outcome of comparisons among trauma types with age as a covariate for each sex is shown in table 4. As is shown in the table, in male subjects, significant differences between trauma types were seen between no events and other events, and frequent traumatic events and other events for SDS, no events and frequent traumatic events, other events and violence, and between frequent traumatic events and other events for Sheehan, between frequent traumatic events and other events for IES-R, and between frequent traumatic events and other events, and between other events and violence in periods from events. For female subjects, significant differences were shown between no events and other events in Sheehan and strain, between frequent

Table 4. Comparison of Scales and Time from Event among Event Types

| | | no events | | | frequent | | | other | | | violence | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | mean (SD) | | | mean (SD) | | | mean (SD) | | | mean (SD) | | | |
| | | (n=2463) | | | (n=444) | | | (n=282) | | | (n=49) | | | |
| Male | SDS | 41.19 | (7.03) | a | 41.67 | (7.06) | b | 43.62 | (7.05) | ab | 44.15 | (7.05) | | 1 |
| (n=2959) | Sheehan | 5.86 | (10.69) | abc | 9.51 | 10.71) | ad | 12.67 | (10.7) | bd | 13.97 | (10.71) | c | 4 |
| | strain | 0.52 | (0.14) | | 0.53 | (0.14) | | 0.54 | (0.16) | | 0.56 | (0.15) | | |
| | IES-R | | | | 8.40 | (13.14) | a | 15.15 | (13.13) | a | 11.10 | (13.20) | | 2 |
| | time from event | | | | 14.15 | (10.43) | a | 7.02 | (10.43) | ab | 18.20 | (10.53) | b | 3 |
| Female | SDS | 41.51 | (6.89) | | 43.27 | (6.90) | | 43.73 | (6.89) | | 39.39 | (6.89) | | |
| (n=279) | Sheehan | 5.88 | (9.44) | a | 8.06 | (9.45) | | 11.39 | (9.44) | a | 11.52 | (9.43) | | |
| | strain | 0.51 | (0.13) | a | 0.52 | (0.13) | | 0.57 | (0.13) | a | 0.47 | (0.12) | | |
| | IES-R | | | | 11.36 | (16.19) | | 21.56 | (16.18) | | 23.20 | (16.21) | | |
| | time from event | | | | 8.10 | (8.57) | a | 4.53 | (8.56) | ab | 17.53 | (8.60) | b | |

ANCOVA with age put as a covariate, and Bonferroni was employed for multiple comparisons $^{**}p<0.01$ $^{*}p<0.05$
same alphabet in the same line indicate significance
SDS=Zung self-rating depression scale; Sheehan=Sheehan patient rated anxiety scale;
strain=job strain: a subscale of job content questionnaire; IES-R=impact of event scale-revised

Table 5. Correlation between Time from Event and Each Scale

| | | | SDS | | Sheehan | Strain | | IES-R | |
|---|---|---|---|---|---|---|---|---|---|
| Male | frequent | (n=424) | -0.14 | ** | -0.04 | -0.13 | * | -0.13 | * |
| | other | (n=242) | -0.11 | | -0.08 | -0.05 | | -0.16 | * |
| | violence | (n=37) | -0.38 | | -0.46 | * | -0.24 | -0.09 | |
| Female | frequent | (n=20) | 0.14 | | -0.07 | 0.21 | | -0.50 | * |
| | other | (n=40) | -0.26 | | -0.19 | -0.22 | | -0.19 | |
| | violence | (n=12) | 0.07 | | 0.24 | 0.09 | | 0.17 | |

Pearson product moment correlation coefficient $^{*}p<0.05$ $^{**}p<0.01$
SDS=Zung self-rating depression scale; Sheehan=Sheehan patient rated anxiety scale;
strain=job strain: a subscale of job content questionnaire; IES-R=impact of event scale-revised

traumatic events and other events, and between other events and violence in periods from events. In these multiple comparisons, for all scales, each trauma type was higher than no events, other events was higher than frequent traumatic events except for periods from events, for people with other events, and periods from events were longer than frequent traumatic events and violence.

Correlation between each scale score and the period from events in each trauma type is shown in table 5. For male subjects, SDS, strain and IES-R in frequent trauma, IES-R in other trauma, and Sheehan in violence, and for female subjects, IES-R in frequent trauma had significant correlations. All correlations that had significance were negative correlations.

## Discussion

The present study comprehensively examined the effect of past exposure to traumatic life events on stress responses with a large working population in Japan. First, comparison of scores of each scale between trauma-experienced subjects and non-experienced subjects showed past trauma increased later anxiety scores for both sexes, and depression scores and strain scores for male subjects. The result that a past experience of trauma increased later

depression and anxiety is the same as in previous studies outcomes, but the increase of strain in subjects who experienced past trauma is shown for the first time in this study. This outcome of strain being higher in the trauma exposed group may reflect those subjects' sensitivity toward stressors is accelerated because companies usually do not arrange their employees' posts taking regard of their past traumatic experiences. Thus, this outcome may indicate exposure to past traumatic life events deteriorates later stress tolerance; this is a new and interesting discovery regarding the later influence of trauma.

Secondly, by GLM examination of each factor variables' main effects and the interactions for each scale score as dependent variables, the main effects of the presence of a traumatic event, and the level of strain for both SDS and Sheehan was seen; there was also an interaction between the level of strain and the presence of a traumatic experience. By regarding strain as an index of stress tolerance, as discussed above, it can be said that a past traumatic experience gives a negative impact especially on a person with strong stress. Additionally, the existence of the interaction means that the level of strain is different depending on whether the subject has the experience of a past exposure to trauma or not. As is shown in figure 1, scores of SDS and Sheehan increase in subjects with a past traumatic experience more than in those not exposed to trauma for both severity of strain groups, and in subjects with a high strain despite the presence of trauma in male subjects; while for female subjects, scores are not significantly different between the high strain and low strain groups in the group not exposed to trauma, but the status worsens for those exposed to trauma when strain is high. This indicates that further research on gender differences is required.

Thirdly, scores were shown to be different among trauma types. Especially the status of subjects who had experiences of "other events" constituted from exposure to poisonous substance, other accidents, verbal violence, accident of friend and shock was worse than other trauma types. Though correlation between the experience of trauma and mental problems in some trauma types decreased with years from the trauma experience, many scores did not show significant correlation between duration from trauma and its score. This also shows the influence of past trauma on depression, anxiety and strain differs with the type of trauma. The outcomes here for depression and anxiety were the same as past studie; however, an effect on strain was shown for the first time.

Thus, past exposure to a traumatic experience was shown to increase later anxiety for both sexes, and for depression and job strain for male subjects. Because job strain can be regarded as an indication of sensitivity to a stressor in this study, people with past traumatic experiences feel a stressor's influence more strongly is indicated for the first time. Here, sex, the presence of a traumatic experience, and the severity of strain had complex influences through interacting with each other, and the influence differed with the type of trauma. The influence of trauma tended to decrease with time; in some trauma types and scales, correlation between time from the event and

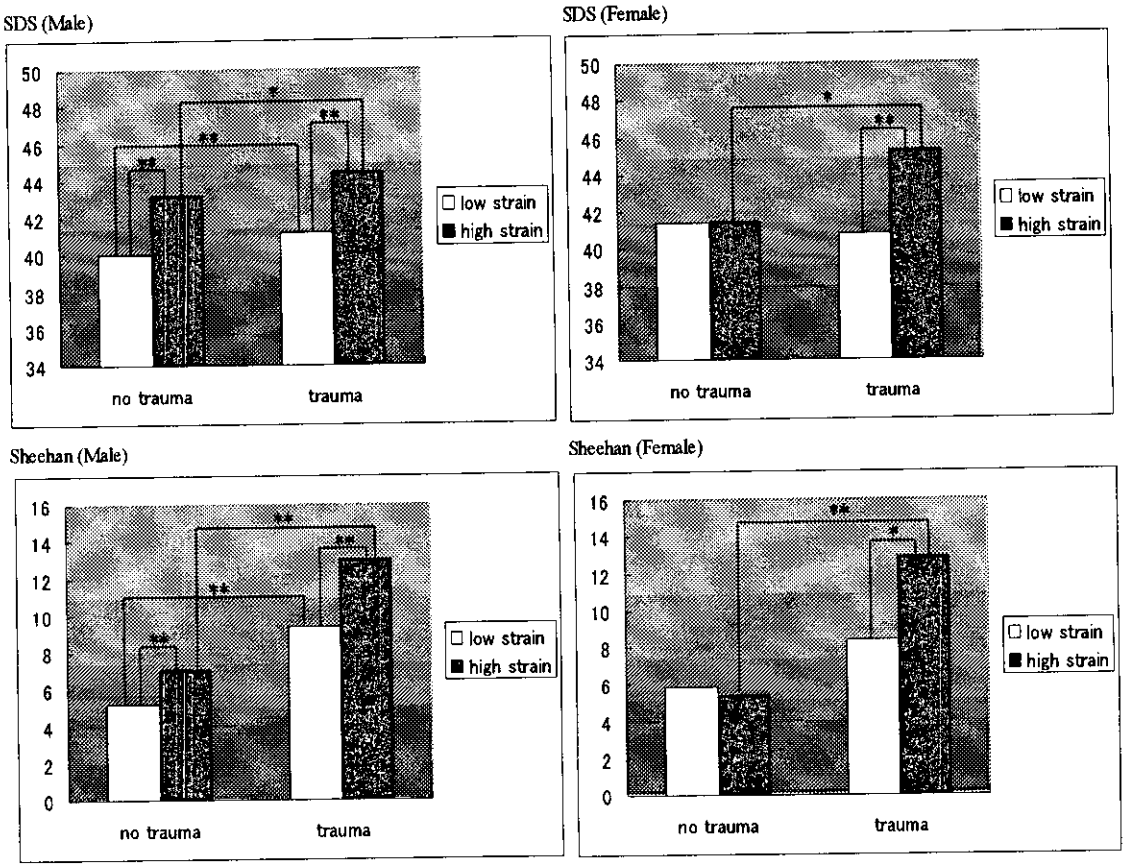


Figure 1. Interactions between Presence of Traumatic Event and Severity of Strain

the score were not detected. This was more prominent in females.

Above, we have discussed the outcomes of this study from the viewpoint of a stress model of trauma. At the same time, this outcome using JCQ is also important from an industrial health viewpoint. After the September 11, 2001 terrorist attack in America, countries and companies are being urged to institute systems for dealing with employee trauma and its influence. Further, issues regarding trauma and mental problems after trauma within the workplace and compensation for industrial accidents are presently controversial. However, there has been little research on traumatic life events and their influence on industrial health, though there has been some research on non traumatic life events using the social readjustment rating scale (19), and research on firefighters who are occupationally susceptible to traumatic occasions (20). As shown in table 1, in Japanese workers, traffic accidents were the most common traumatic event, as 355 out of 2959 males and 25 out of 279 females responded. After traffic accidents, in male subjects, natural disasters were experienced by 167 subjects, and verbal violence by 141; while in females, verbal violence by 23 and then sexual assault by 10. That 13 out of 279 female subjects experienced some form of violence was a somewhat shocking statistic. At the same time, in male subjects, 16 noted an experience of being sexually assaulted. As shown above, many general type workers have many types of traumatic experiences. Having regard to traumatic experiences of