Time Series Investigation of Job-events and Depression in Computer Software Engineers

Yuko FUJIGAKI

Department of Information Science, General System Studies, Graduate School of Arts and Sciences, The University of Tokyo, 3-8-1, Komaba, Meguro-ku, Tokyo 153, JAPAN

(Received November 16, 1995 and in revised form January 24, 1996)

Abstract: The aim of the present study is to conduct an observation of a time series of job-event/life event and depressive symptoms, prospectively. Ten male computer software engineers were observed every two weeks for five months and every following week for two months. In total, one hundred and eighty-one observations were made. A semi-structured interview was conducted to survey the week-unit job-events on each sampling day. The depressive symptoms were measured using Zung's Self-reporting Depressive Scale (SDS). It was found that the events had a significant effect on the SDS raw score. It also showed that the effective time period of the events on depression is within two weeks. With a week-based analysis in a prospective approach, the present study showed the immediate effects of job events or life events on depressive symptoms.

Key words: Job event — Life event — Depression — Time series — Longitudinal study

INTRODUCTION

Although stress research in the general population has flourished during the last 30 years, most of these studies are cross-sectional studies which discuss the relationship between stressor and stress response based on data gathered at only one point in time\(^1\). However, cross-sectional studies have a major limitation in assessing the causal inference between the stressor and stress. To investigate the effect of the work-situation on workers’ stress, studies which observe the stressor/stress of everyday life in a time series are desired. There are longitudinal descriptions of bio-medical indicators\(^5,7\). However, few studies have been carried out on the longitudinal observation of depressive symptoms.

In most longitudinal studies examining the effects of life-event on depressive symptoms, recent life events during a period of six months or one year were assessed retrospectively\(^8,10\). The time lag between events and depressive symptoms is six or twelve months in most studies. It is indicated that the results from the several retrospective studies conducted in this field may be misleading because
depressive symptoms may lead to a maladjusted state related to over-reporting of job stress. Therefore, a longitudinal study examining the effect of life/job events is desired in prospective design.

On the detailed contents of life-events, there have been many previous studies and superior descriptions. Although we considered these descriptions, the present study focused mainly on the job-events in an occupational setting, especially in computer software engineers, since there had been reported mental health problems in this occupation caused by job-characteristics. To show the causal relationship between job-events based on job-characteristics and depressive symptoms, we focused on the immediate effect of job-events.

The present study conducted a longitudinal study to observe the week-unit events and acute depressive symptoms, prospectively. The time series of job-event/life events occurring each week were examined to see whether they have an immediate effect on subjective symptoms.

**METHODS**

The job/life events and stress reaction of ten healthy subjects were surveyed every two weeks for five months and every week for the following two months. The average age of the subjects was 27.8 years [23–32 years old]. They were all male subjects. Three of them were married. None of the subjects received any medical treatment during the observation period. They were engaged in software developing work, which is mainly desk-work with little physical activity. The job-events, and psychological reaction were observed at 19 sampling points for six subjects, 17 sampling points for three subjects, and 16 sampling points for one subject. A total of 181 observations was used for the following analysis.

The work-contents of each day and each week were surveyed using a diary-style. Semi-structured interview were also held on each sampling day. The subjects were asked about job events and life events that happened from the preceding sampling day until the current sampling day. The interview on job events was designed considering work characteristics based on a previous work-analysis. The questions were; “Do you have any deadlines in your job? Do you have job overload these days? Is there any increase in the amount of your work? Is there any increase in your responsibility in your job? Do you have any trouble with your clients?” Using these semi-structured interview and work content questions, the presence of job events that happened after the preceding sampling day till the sampling day was scored blindly, with no knowledge of the SDS score. The scored job-events are; time pressure of deadline, work-overload, amount of work increase, responsibility increase, and trouble with clients.

On the assessment of life events, the items in the Social Readjustment Rating Scale, discussion on life-events by Brown and by Tennants and his colleagues were referred to. There were only two events that scored as life-events; those were;
“birth of blood relatives” and “death of blood relatives”.

The instrument selected for the weekly assessment of depressive symptoms was the SDS (Self-reported Depression Scale) developed by Zung. This inventory has 20 items that ask about various symptoms of clinically significant depression. Each item has a four-point range, and the items are balanced for yes/no tendencies. It is a self-reporting measure that is practical and is used as a repeated measure. As it asks about the symptoms in a week, it is suitable for surveying an individual pattern by week. Furthermore, it is an instrument of wide use both in various patient groups and in normal persons. The reliability and validity of the Japanese Version of SDS have been already confirmed. We used a modified version reported by Sarai, since the response categories inquiring about the number of symptoms in this version are more suitable in the context of the Japanese language.

We decided to examine as a case-report the individual patterns of depression of the subjects, whose SDS raw score exceeded or come to the level 2 (48–55 in raw score). This level is categorized as depressive symptomatology present to a great degree, as expected in an outpatient group with a diagnosis of depressive neurosis.

RESULTS

Table 1 shows the descriptive statistics of the SDS raw score of each subject. Subjects A, B, C, D belonged to the same project developing programs for a stock firm, whereas subjects E, F, G and subjects H, I, J belonged to a telecommunication project and a gas controlling system project, respectively.

Effective time period of events on depression score

As mentioned in methods, using the results of the semi-structured interview and work content analysis, the presence of job/life events that happened from the preceding sampling day until the sampling day was scored blindly, with no knowledge of the SDS score. In total there were 70 observations where one or more

<table>
<thead>
<tr>
<th>Subject age</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>19</td>
<td>19</td>
<td>16</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Average</td>
<td>33.6</td>
<td>41.9</td>
<td>40.8</td>
<td>37.1</td>
<td>54.5</td>
<td>43.1</td>
<td>40.3</td>
<td>39.5</td>
<td>33.3</td>
<td>41.9</td>
</tr>
<tr>
<td>Variance</td>
<td>2.2</td>
<td>2.3</td>
<td>3.7</td>
<td>4.2</td>
<td>3.3</td>
<td>2.7</td>
<td>2.0</td>
<td>1.6</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Maximum</td>
<td>40</td>
<td>45</td>
<td>49</td>
<td>44</td>
<td>59</td>
<td>48</td>
<td>44</td>
<td>43</td>
<td>36</td>
<td>48</td>
</tr>
<tr>
<td>Minimum</td>
<td>30</td>
<td>36</td>
<td>34</td>
<td>27</td>
<td>46</td>
<td>37</td>
<td>37</td>
<td>37</td>
<td>32</td>
<td>38</td>
</tr>
</tbody>
</table>
of any of these events were present whereas in the other 111 observations there was no presence. As mentioned in methods, there were only two life-events scored, therefore, in the following analysis, we utilized only job events. The average value of the SDS raw score according to the event-presence is shown in Table 2. No seasonal change was observed in these SDS data. The two-way ANOVAs considering two factors (event effect and individual effect) performed on the SDS raw score assessed on the day of event scoring showed significant event effects \([DF = 1, F = 52.2, p < 0.001]\) and individual effects \([DF = 9, F = 109.3, p < 0.001]\).

The effective time period of events on depression was also analyzed. In the observations of two weeks time period (mainly first five months), the average SDS raw score on event-scoring day according to the event-presence and the average SDS score two weeks after the event-scoring day were also shown in Table 2. In these periods, the two-way ANOVAs performed on the SDS raw score of two weeks following the event scoring showed no significant event effects \([DF = 1, F = 1.49, p > 0.1]\), but an individual effect \([DF = 9, F = 54.1, p < 0.001]\).

For the observations of the latter two months (one week time period), Table 2 also showed the average SDS raw scores on the event-scoring day according to the event-presence, the average SDS scores one week after the event scoring, and the average SDS scores two weeks after the event-scoring. The two-way ANOVAs performed on the SDS raw score of two weeks following the event scoring showed no significant event effect \([DF = 1, F = 3.21, p > 0.05]\), whereas that performed

<table>
<thead>
<tr>
<th>Job events</th>
<th>Presence</th>
<th>Absence</th>
<th>Difference in mean SDS</th>
<th>p for difference*</th>
</tr>
</thead>
<tbody>
<tr>
<td>N of points</td>
<td>mean (s.d.)</td>
<td>N of points mean (s.d.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All subjects and periods:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On the same day</td>
<td>68 43.21 (6.69)</td>
<td>111 38.85 (5.26)</td>
<td>4.36</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Data with two-week intervals:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On the same day</td>
<td>55 43.55 (6.86)</td>
<td>88 38.57 (5.11)</td>
<td>4.98</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Two weeks later</td>
<td>52 42.52 (7.58)</td>
<td>81 39.33 (5.10)</td>
<td>3.19</td>
<td>n.s.</td>
</tr>
<tr>
<td>Data with one-week intervals:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On the same day</td>
<td>33 42.61 (6.37)</td>
<td>55 39.11 (5.64)</td>
<td>3.50</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>One week later</td>
<td>30 42.67 (5.76)</td>
<td>48 39.21 (5.71)</td>
<td>3.46</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Two weeks later</td>
<td>27 42.37 (5.77)</td>
<td>41 39.10 (5.45)</td>
<td>3.27</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

* Two-way ANOVA controlling for individual effects (see text for details).

n.s.: p > 0.05.
on the SDS of one week later showed significant event effects \([DF = 1, F = 12.04, p < 0.001]\). Individual effects were significant in both cases. \([DF = 9, F = 27.8, p < 0.001]\) and \([DF = 9, F = 47.47, p < 0.001]\), respectively.

**Individual patterns of depression**

There were four subjects, C, E, F, and J, whose SDS raw score exceeded the level 2 (48–55 in raw score) that was mentioned in methods. We will examine the individual patterns of these four subjects as follows.

Figure 1 shows the time-series of SDS raw score of subject C. His SDS raw scores fluctuated under 44 for the first five months. However, it increased to 49 on March 31, on the day that the amount of his work increased tremendously before the deadline (C1). His overwork was more than 20 hours/week in the preceding week.

Figure 2 shows the time-series of SDS raw score of subject E. At point E1, the subject was engaged in the system-design stage with a deadline of “specification of the system” in the middle of November. He was also busy at the point E2, with the deadline of a temporary system at the end of January. In the middle of March, there was a final deadline for the whole system (E3).

Figure 3 shows the time series of SDS score of subject F. At point F1, the subject was engaged in the system-design stage with a deadline of system specification in the middle of November. He was also busy in January with a deadline of a temporary system at the end of January (F2). Furthermore, on March 17, he started to respond to a problem with a temporary system which his clients began to complain about (F3). On this day, his SDS raw score increased to 48.

![Fig. 1. Time series of SDS raw score and representative events in subject C.](image-url)
Figure 4 shows the time series of SDS raw score of subject J. On January 21 (J1), a life event, a death of his nephew, happened. The subject had been living with his nephew, a 16 day old baby. The SDS raw score increased 9 points compared with the preceding observing point and reached to 48. This high score lasted for two weeks and disappeared in one month.

Fig. 2. Time series of SDS raw score and representative events in subject E.

Fig. 3. Time series of SDS raw score and representative events in subject F.

Figure 4 shows the time series of SDS raw score of subject J. On January 21 (J1), a life event, a death of his nephew, happened. The subject had been living with his nephew, a 16 day old baby. The SDS raw score increased 9 points compared with the preceding observing point and reached to 48. This high score lasted for two weeks and disappeared in one month.
As noted initially, the goal of the present study was to examine the time series of job/life events and health changes over time prospectively in an occupational setting. It was found that the events had a significant effect on the SDS raw score. It also showed that the effective time period of the events on depression is within two weeks. Figures 1, 2, 3, 4 showed the change through time of SDS raw data whose the peaks of which corresponded to the occurrence of job/life events. The present study is unique in that it gives longitudinal data, using a well-validated assessment of depression, in a group of individuals who continued an occupational rule throughout the observation.

The results of this study showed that SDS raw data increased at the time of occurrence of job events or life events. This kind of high rating of depressive symptoms is reported to enhance the risk of clinical depression\(^ {23}\). Moreover, the presence of increased depressive symptoms has been showed to result in disability in every day life as clinical depression\(^ {24}\). Therefore, our results relate to mental health problems with clinical relevance.

The results showed that the week-based effects of job events or life events on health problems in a short time scale. There are two differences between the job events or life events considered in this study and those in the previous studies. One is the difference in characteristics of the events. The previous studies of life events relate to life changes that rarely happen in every day life, whereas our study scores more daily job events that occasionally happen. The other difference is
the time interval between the occurrence of the events and their effects. Previous studies of life events relate to the onset of depression six to twelve months after the occurrence of the events, whereas our study showed the immediate effect of the everyday life events. The temporal interval is the week, not the month/year, in our study.

With the week-based analysis, the present study showed that the effective time period of the events on depression is within two weeks. This result is not shown in the previous studies, since these studies analyzed the depressive state only one point in time, or in a long time interval (month or years), failing to assess the dynamical change in the depression state. The present study observed the time series of the depressive state, therefore, the sensitivity of the change in the depressive state or the effective time period is considered higher than other studies.

In interpretation of these results, the characteristics of the job of this study should be considered. Whether the results of these week-based analyses are affected by the specific features of the occupation or the results can be generalized to overall occupation, should be examined in a further analysis. It also must be considered that there would be a measurement-bias that depressive symptoms may lead to overreporting of the events. Moreover, the study would be modified by considering the other factors which affect depressive symptoms, such as event-sensitivity or moderators in each individual, or other environmental factors which moderate the event-impact.

Although this study used a very limited sample of specific occupation in Japanese industry, with the week-based analysis in a prospective approach, the present study showed the week-based effects and effective time period of job events or life events on depressive symptoms. The cause-effect relationship showed more clearly between the life events including job events and the depressive symptoms. Furthermore, we can discuss the effective time periods of the events based on this study. Such information is useful in the intervention of negative job events or life events to prevent the mental health problems in the general population.

REFERENCES