How to integrate proxy data from two informants in life event assessment in psychological autopsy

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Abstract

Background: Life event assessment is an important part in psychological autopsy, and how to integrate its proxy data from two informants is a major methodological issue which needs solving.

Methods: Totally 416 living subjects and their two informants were interviewed by psychological autopsy, and life events were assessed with Paykel’s Interview for Recent Life Events. Validities of integrated proxy data using six psychological autopsy information reconstruction methods were evaluated, with living subjects’ self-reports used as gold-standard criteria.

Results: For all the life events, average value of Youden Indexes for proxy data by type C information reconstruction method (choosing positive value from two informants) was larger than other five methods’. For family life related events, proxy data by type 1st information reconstruction method were not significantly different from living subjects’ self-reports (P = 0.828). For all other life events, proxy data by type C information reconstruction method were not significantly different from the gold-standard.

Conclusions: Choosing positive value is a relatively better method for integrating dichotomous (positive vs. negative) proxy data from two informants in life event assessment in psychological autopsy, except for family life related events. In that case, using information provided by 1st informants (mainly family member) is recommended.

Keywords: Suicide, Life event, Psychological autopsy, Proxy data, Informant, Methodology

Background

Suicide is an important global public health issue: more than 800,000 people die by suicide each year worldwide. World Health Organization (WHO) has declared that reducing suicide-related mortality is a global imperative [1, 2]. For effective suicide prevention, it is critical to know more about what drives them to take their lives by suicide. Psychological Autopsy (PA) offers a way to address this, which was originally developed by Shneidman as an approach to determine the cause of a suspicious death (i.e. to differentiate suicides from killings) in forensic examinations [3]. PA is a tool by which information for deceased persons is reconstructed by interviewing those closest to them – known as the informants – and examining corroborating evidence from sources such as health records. Informants are usually the main information sources for PA, and the information offered by informants is known as proxy data for the target subject [4–8].

To reconstruct the information of suicide case, a single informant might not be sufficient. So two or more informants are suggested for information collection in PA. However, there is no specific criteria for determining how many informants should be included in a psychological autopsy. In previous suicide research, the informants ranged from one to ten, and it was common that different informants may provide inconsistent information [9, 10]. How to integrate proxy data from different informants? This is an important methodological issue confronted by suicide researchers in psychological autopsy [6, 11–14]. Whether proxy data can be representative of that of the target depends on the method of information reconstruction.
Kraemer pointed out that using different methods of synthesizing the data from different informants might result in different validities [15]. In our previous study, we found that using a second informant did not significantly enhance information validity for the target on hopelessness, impulsivity, anxiety, and coping, in the form of numeric variables [14]. Life events which are usually measured as categorical variables are important content in psychological autopsy [4]. Conner and his colleagues used one informant for psychological autopsy and found that the validity of proxy data on stressful life events was mixed: specificity was higher than sensitivity across life event categories, and agreement on stressful life events was mixed: specificity was higher than sensitivity across life event categories, and agreement was substantial for public and observable events but lower than sensitivity across life event categories, and agreement.

Methods
Subjects
This study is a part of case-control psychological autopsy undertaken in residents of rural China. Samples were selected from sixteen rural counties in three provinces in China (6 from Liaoning, 5 from Hunan, and 5 from Shandong). In each county, all the suicide cases in residents aged 15–34 years were sampled consecutively from October 2005 to June 2008. Similar numbers of living subjects aged 15–34 years were randomly recruited as controls from the same counties in the same time period. This study only included 416 living subjects, excluding the suicide cases. The living subjects were at mean (SD) age of 25.7 (6.2) years, with 51.4% female.

For each target subject, two informants were interviewed, as well as target subject self. The informants were people recommended by the targets themselves but selected by the research team, based on familiarity with the target’s life and circumstances and availability for (and willingness to) consent to in-person interview. 1st informant was usually a parent, spouse or other important family member, and 2nd informant was usually a friend, co-worker or neighbor. Interviews with the target subjects were used as the gold standard for evaluating the validities of different information reconstruction methods.

Measure
Paykel's Interview for Recent Life Events (IRLE) was used to measure life events. Twenty life events were added to the original 44 life events in the instrument, so that a total of 64 events were covered in the interview [17, 18]. It was validated in our previous study (12). The life events can be classified into five categories: (1) Cat1: marriage related, including 14 items, (2) Cat2: family life related (18 items), (3) Cat3: work and study related (10 items), (4) Cat4: health related (13 items), (5) Cat5: law issue related and others (9 items).

Principles of six different psychological autopsy information reconstruction methods
Six different psychological autopsy information reconstruction methods were included in this study, and their corresponding principles were outlined as followings.

Type 1st: only use information offered by 1st informant as the target’s proxy data, without using any data provided from 2nd informant. In other words, although there were two informants, we only use 1st informant’s data.

Type 2nd: only take the information provided by 2nd informant as the target’s proxy data, without using any data offered by 1st informant. That is to say, type 2nd equals to 2nd informant.

Type A: (I) choose information provided by 1st Informant when both informants provide information, (II) if 1st informant does not provide information, information offered by 2nd informant will be selected as proxy data for the target, and (III) treated as a missing value when neither informant provides information. This method indicates that 1st Informant is the main information source for the target while 2nd informant acts as supplement.

Type B: (I) choose information provided by 2nd informant when both informants provide information, (II) if 2nd informant does not provide information, information offered by 1st informant will be selected as proxy data for the target, and (III) treated as a missing value when neither informant provides information. This method indicates that 1st Informant is the main information source for the target while 2nd informant acts as supplement.

Type C: (I) use the only information when only one informant provides related data, (II) choose the positive data for the item when two informants offer different information (one positive, the other negative), (III) treat as positive value when both informants offer positive value, (IV) treat as negative value when both informants offer negative value, (V) treat as a missing value when neither informant provides information. We simplify type C’s principles as choosing positive value from two informants.

Type D: (I) use the only information when only one informant provides related data, (II) choose the negative data for the item when two informants offer different information (one positive, the other negative), (III) treat as positive value when both informants offer positive value, (IV) treat as negative value when both informants offer negative value, (V) treat as a missing value when neither informant provides information. We simplify type D’s principles as choosing negative value from two informants.
Statistical analyses
Concordance of proxy data by the six different information reconstruction methods on life events and subjects’ self-reports was evaluated using McNemar test. Validities of these proxy data were further evaluated by following indexes: Sensitivity, Specificity, Youden Index and Kappa Value. Youden Index is an index combined sensitivity and specificity into a single measure (Sensitivity + Specificity - 1) and has a value between 0 and 1. The Kappa value is a metric that rates how good the agreement is whilst eliminating the chance of luck. For comparisons among these six techniques, two-way analysis of variance was employed. A $P$-value of $< 0.05$ was considered to be statistically significant. All the statistical analyses were conducted by SPSS 18.0.

Results
Characteristics of informants of the target subjects
As Table 1 showed, 55.8% of the 2nd informants of the target subjects were male, higher than its proportion (38.2%) among 1st informants. 2nd informants were younger, more single, and more educated than 1st informants. However, there were no significance differences between 1st and 2nd informants on religion, annual family income and Center for Epidemiological Survey Depression Scale (CES-D) depression score. Table 1 showed that 1st informants were more familiar with the targets than 2nd informants, with higher proportions of ‘very familiar’ (33.4% vs 12.2%) and ‘familiar’ (38.2% vs 37.3%). As Table 2 indicated, informants of suicide groups were elder, less educated and poorer.

Type A and B gained the same results with type 1st and 2nd respectively in each category of life event. Proxy data by type C psychological autopsy information reconstruction method (choosing positive value from two informants) on Cat 1 and Cat 3–5 life events (‘marriage’, ‘work and study’, ‘health’, ‘law issue and others’ related life events) were not statistically significantly different from information provided by the target subjects themselves, and their $P$ values were 0.810, 0.363, 0.534 and 0.477, respectively. For Cat 2 life event (family life related event), proxy data

| Table 1: Comparison of characteristics of 1st and 2nd informants of the target |
|---------------------------------------------------------------|
| 1st informant n (%) | 2nd informant n (%) | $\chi^2$ or $t$ | df | $P$ |
|---------------------|---------------------|----------------|----|-----|
| Gender              |                     |                |    |     |
| Male                | 159 (38.2)          | 232 (55.8)     | 25.71 | 1  | < 0.001 |
| Female              | 257 (61.8)          | 184 (44.2)     |      |    |        |
| Age (yr)            | 36 (29, 46) $^a$    | 31 (21, 41) $^a$ | 6.36$^{b}$ | 827 | < 0.001 |
| Marital status      |                     |                |    |     |
| Single              | 35 (8.4)            | 112 (26.9)     | 51.43 | 3  | < 0.001$^{c}$ |
| Married             | 371 (89.2)          | 298 (71.7)     |      |    |        |
| Widowed             | 9 (2.2)             | 5 (1.2)        |      |    |        |
| Others              | 1 (0.2)             | 1 (0.2)        |      |    |        |
| Education (yr)      | 9 (6, 9) $^a$       | 9 (7, 9) $^a$  | $-3.65^{b}$ | 830 | < 0.001 |
| Religion            |                     |                |    |     |
| Atheism             | 378 (90.9)          | 386 (92.8)     | 4.36 | 4  | 0.317$^{c}$ |
| Catholicism         | 10 (2.4)            | 8 (1.9)        |      |    |        |
| Buddhism            | 26 (6.2)            | 20 (4.8)       |      |    |        |
| Other religion      | 0 (0)               | 2 (0.5)        |      |    |        |
| Data missing        | 2 (0.5)             | 0 (0)          |      |    |        |
| Annual family income (1000 RMB) | 14.3 (10.0, 25.0) $^a$ | 15.0 (10.0, 25.0) $^a$ | $-0.68^{b}$ | 728 | 0.498 |
| CES-D score         | 4 (1, 9) $^a$       | 4 (1, 9) $^a$  | $0.29^{b}$ | 826 | 0.771 |
| Familiarity to the target |             |                |    |     |
| Very unfamiliar     | 0(0)                | 1(0.2)         |      |    |        |
| Unfamiliar          | 7(1.7)              | 9(2.2)         |      |    |        |
| Middle              | 67(16.1)            | 154(37.0)      |      |    |        |
| Familiar            | 159(38.2)           | 155(37.3)      |      |    |        |
| Very familiar       | 139(33.4)           | 51(12.2)       |      |    |        |
| Data missing        | 44(10.6)            | 46(11.1)       |      |    |        |

$^a$Because of non-normal distributions, median (1st, 3rd quartiles) was used. $^b$t test was used for those numerical variables
$^c$Fisher’s exact test was employed
by type C information reconstruction method had higher positive rate than target subjects’ self-reports, while proxy data by type 1st and type A information reconstruction methods demonstrated no statistical difference ($P = 0.828$). All other proxy data by other information reconstruction methods had lower positive rates than information offered by targets themselves ($P < 0.05$). See Table 3 and Table 4.

There was no statistical difference among the Kappa values of six different psychological autopsy information reconstruction methods ($P = 0.139$). For the sensitivity, specificity and Youden index, there were significant differences among six different psychological autopsy information reconstruction methods, as well as among five different categories of live events. See Table 5. Further analyses showed that sensitivity and Youden index of proxy data by type C were highest while sensitivity and Youden index of proxy data by type D were lowest. However, for the specificity, proxy data by type C were lowest while type D were highest. There were no significant differences among other four types (type 1st, 2nd, A, B) psychological autopsy information reconstruction methods on sensitivity, specificity and Youden index.

**Discussions**

How to integrate proxy data from two or more informants in psychological autopsy is an important methodology issue confronting suicide research. Different informants may have different familiarities to different aspects of the target. If we use inappropriate methods to integrate different proxy data from different informants, we may not make full use of the information, even take inexact information and eventually conclude wrong conclusion. What’s more, one information reconstruction method may not be enough when integrating proxy data for one target. So we explored information reconstruction methods by using life event data.

In this study, 1st informant was usually a parent, spouse or other important family member while 2nd informant was usually a friend, co-worker or neighbor. This was why 2nd informants were less familiar with the target subjects, younger, more single, and more educated than 1st informants. However, there were no significance differences between 1st and 2nd informants on religion, annual family income and CES-D depression score. So the potential bias of data collection between 1st and 2nd informants, which might be influenced by religion belief, money incentive and depression could be avoided [8].

For the six information reconstruction methods in this study, type A and B gained the same results with type 1st and 2nd respectively in each category of life event. Mainly because there were few missing data in the proxy data by 1st and 2nd informants, and the data supplement from another informant with the information reconstruction type A or B seemed to be unnecessary in this study. It indicated that there were no differences between type 1st and A, type 2nd and B, when there were few missing data among data provided by informants. This result was similar with our previous research on validities of proxy data of hopelessness, impulsivity, anxiety and coping, in the form of numeric variables [14]. This study found that proxy data of family life related events by type 1st information reconstruction method were not significantly different from living subjects’ self-reports, but for other life events, proxy data by type C (choosing positive value from two informants) information reconstruction method were not significantly different from living subjects’ self-reports. What’s more, average value of Youden Indexes for proxy data of life events by type C information reconstruction method was larger than other five methods. These

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**Table 2** Comparison of characteristics of 1st and 2nd informants between suicides and controls

| groups          | variables       | Suicides (n = 392) | Controls (n = 416) | t    | df | $P$   |
|-----------------|-----------------|-------------------|-------------------|------|----|-------|
| 1st informant   | Gender          |                   |                   |      |    |       |
|                 | Male            | 224 (57.1) $^a$   | 159 (38.2) $^a$   | 28.92$^a$ | 1   | < 0.001 |
|                 | Female          | 168 (42.9) $^a$   | 257 (61.8) $^a$   |      |    |       |
|                 | Age (yr)        | 49 (38, 57) $^b$  | 36 (29, 46) $^b$  | 10.77 | 800 | < 0.001 |
|                 | Education (yr)  | 6 (4, 9) $^a$     | 9 (6, 9) $^a$     | −6.42$^b$ | 806 | < 0.001 |
|                 | Familiarity to the target | 2.90(0.99) $^c$ | 3.16(0.78) $^c$ | −3.93 | 731 | < 0.001 |
| 2nd informant   | Gender          |                   |                   |      |    |       |
|                 | Male            | 217 (55.4)        | 232 (55.8)        | 0.01 | 1   | 0.906 |
|                 | Female          | 175 (44.6)        | 184 (44.2)        |      |    |       |
|                 | Age (yr)        | 43 (33, 52) $^b$  | 31 (21, 41) $^b$  | 6.36 | 806 | < 0.001 |
|                 | Education (yr)  | 9 (6, 9) $^a$     | 9 (7, 9) $^a$     | −3.65 | 801 | < 0.001 |
|                 | Familiarity to the target | 2.34(0.82) $^c$ | 2.66(0.75) $^c$ | −5.54 | 728 | < 0.001 |

$^a$It indicates n (proportion, %). $^b$Median (1st, 3rd quartiles) was used

$^c$It represents mean (SD). $^d$χ$^2$ test was employed
results indicated choosing positive value from two informant was the best way to integrate proxy data from two informants on the life events except family life related events. But for family life related events, 1st informants who were usually family members were optimal for collecting this kind of life event information. Family life related life events always had the highest positive value in comparison to other life events.

Table 3: Comparisons between data of life events from target subjects’ self-reports and proxy data by six different psychological autopsy information reconstruction methods

| Life events | Typea | Target | Posb | Negc | Total | Typea | Target | Pos | Neg | Total | P |
|-------------|-------|--------|------|------|-------|-------|--------|-----|-----|-------|---|
| Cat1        | PD 1st | Pos    | 48   | 20   | 68    | Cat2  | PD 1st | Pos  | 74  | 41   | 115 | 0.018 |
|             | Neg    | 39     | 309  | 348  | 416   |       | Neg    | 44  | 257 | 301  |     | 0.828 |
|             | Total  | 87     | 329  | 416  |       | Total  | 118 | 298 | 416  |     |       |
| 2nd         | Pos    | 40     | 20   | 60   | 0.001 | 2nd   | Pos   | 64  | 22  | 86   | 0.000 |
|             | Neg    | 47     | 309  | 356  |       | Neg    | 54  | 276 | 330  |     |       |
|             | Total  | 87     | 329  | 416  |       | Total  | 118 | 298 | 416  |     |       |
| C           | Pos    | 54     | 36   | 90   | 0.810 | C      | Pos   | 86  | 59  | 145  | 0.006 |
|             | Neg    | 33     | 293  | 326  |       | Neg    | 32  | 239 | 271  |     |       |
|             | Total  | 87     | 329  | 416  |       | Total  | 118 | 298 | 416  |     |       |
| D           | Pos    | 34     | 2    | 36   | 0.000 | D      | Pos   | 47  | 2   | 49   | 0.000 |
|             | Neg    | 53     | 327  | 380  |       | Neg    | 71  | 296 | 367  |     |       |
|             | Total  | 87     | 329  | 416  |       | Total  | 118 | 298 | 416  |     |       |
| Cat3        | PD 1st | Pos    | 26   | 27   | 53    | Cat4  | PD 1st | Pos  | 55  | 36  | 91   | 0.030 |
|             | Neg    | 73     | 290  | 363  |       | Neg    | 58  | 267 | 325  |     |       |
|             | Total  | 99     | 317  | 416  |       | Total  | 113 | 303 | 416  |     |       |
|             | 2nd    | Pos    | 30   | 20   | 50    | 0.000 | 2nd   | Pos  | 50  | 19  | 69   | 0.000 |
|             | Neg    | 69     | 297  | 366  |       | Neg    | 63  | 284 | 347  |     |       |
|             | Total  | 99     | 317  | 416  |       | Total  | 113 | 303 | 416  |     |       |
|             | C      | Pos    | 45   | 44   | 89    | C      | Pos   | 70  | 50  | 120  | 0.534 |
|             | Neg    | 54     | 273  | 327  |       | Neg    | 43  | 253 | 296  |     |       |
|             | Total  | 99     | 317  | 416  |       | Total  | 113 | 303 | 416  |     |       |
|             | D      | Pos    | 11   | 2    | 13    | D      | Pos   | 31  | 4   | 35   | 0.000 |
|             | Neg    | 88     | 315  | 403  |       | Neg    | 82  | 299 | 381  |     |       |
|             | Total  | 99     | 317  | 416  |       | Total  | 113 | 303 | 416  |     |       |
| Cat5        | PD 1st | Pos    | 7    | 12   | 19    |       |       |       |     |     |      |     |
|             | Neg    | 43     | 354  | 397  |       |       |       |     |     |     |     |
|             | Total  | 50     | 366  | 416  |       |       |       |     |     |     |     |
|             | 2nd    | Pos    | 8    | 21   | 29    | 0.011 |       |       |     |     |      |     |
|             | Neg    | 42     | 345  | 387  |       |       |       |     |     |     |     |
|             | Total  | 50     | 366  | 416  |       |       |       |     |     |     |     |
|             | C      | Pos    | 11   | 32   | 43    | 0.477 |       |       |     |     |      |     |
|             | Neg    | 39     | 334  | 373  |       |       |       |     |     |     |     |
|             | Total  | 50     | 366  | 416  |       |       |       |     |     |     |     |
|             | D      | Pos    | 4    | 0    | 4     | 0.000 |       |       |     |     |      |     |
|             | Neg    | 46     | 366  | 412  |       |       |       |     |     |     |     |
|             | Total  | 50     | 366  | 416  |       |       |       |     |     |     |     |

1. Type refers to six different psychological autopsy information reconstruction methods, including type 1st, 2nd, A, B, C and D. Type A and B gained the same results with type 1st and 2nd respectively in each category of life event, and their results were not repeatedly demonstrated.
2. Pos refers to no. of positive cases, and ‘Neg’ refers to no. of negative cases.
3. PD refers to proxy data gathered from informants.
4. Cat1–5 refers to ‘marriage,’ ‘family life,’ ‘work and study,’ ‘health,’ ‘law issue and others’ related life events respectively.
related events are usually quite private and the family members know them better, so 1st informants are recom-
mended for information collection in psychological
autopsy. For most other life events, one informant usually
is not enough to reconstruct the target subject’s
information in psychological autopsy. Two informants can offer
additional information for each other. Generally speaking,
information provided by informants for the target subjects
shows high specificity and low sensitivity. In other words,
informants may underreport a life event, but seldom lie to
report some life events which have never happened to the
target before. So it is much more important to enhance
sensitivity to avoid false positive in the data gathering of
life events.

There were two limitations in this study. Firstly,
the living subjects were different from people with suicidal
behavior and informants of suicide cases were most likely
to be in grief or with other different characteristics, so
whether the conclusions of this study can be applied to
suicidal people needs further research. Second, living sub-
jects’ self-reports were used as golden-standard criteria,
and it might be improper if the living subjects lied on the
life event reporting. Third, there was recall bias when
informants of the target (suicide or community control)
were interviewed. However, this study contributed to the
methodology of proxy data integration from two informants in psychological autopsy.

**Conclusion**

How to integrate proxy data from two informants for life event assessment in psychological autopsy is an important methodology issue. Different informants may have different familiarities to different aspects of the target. What’s more, inappropriate methods to integrate proxy data from two informants may lead to wrong conclusion. Two methods of information reconstruction can be employed in psychological autopsy: choosing positive value is a relatively better method for integrating dichotomous (positive vs. negative) proxy data from two informants in life event assessment, while using information provided by 1st informants (mainly family member) is recommended for family life related events.

**Abbreviations**

CES-D: Center for Epidemiological Survey Depression Scale; IRLE: Interview for Recent Life Events; PA: Psychological Autopsy; WHO: World Health Organization

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**Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Authors’ contributions**

JZ and LF designed this research and wrote the main manuscript. YW and LF analyzed the data and interpreted the results. All authors read and approved the final manuscript. JZ and YW contributed this paper equally as co-first authors.

**Ethics approval and consent to participate**

The research protocol was approved by Research Ethical Committees of State University of New York Buffalo State in United States, Shandong University in Shandong province, China, Central South University in Hunan province, China, and Liaoning Provincial Center for Disease Prevention and Control in Liaoning province, China. The research nature of the interview and the background of the research project were explained to all interviewees, and informed consent forms detailing the rights of interviewees were read and signed by both parties prior to each interview. For those participants who were younger than 18 years old, a consent of their parent or legal guardian were obtained.

**Competing interests**

All the authors declare that they have no conflicts of interest.

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