The Open Nursing Journal

Content list available at: https://opennursingjournal.com

RESEARCH ARTICLE

Perceptions of Stages of Family Violence and their Perceived Solutions in Persons with Schizophrenia

Masako Kageyama[1,*], Keiko Yokoyama[2] and Yuichiro Horiai[3]

[1]*Department of Health Promotion Science, Osaka University Graduate School of Medicine, Suita, Japan*
[2]*Department of Nursing, Faculty of Health Sciences, Saitama Prefectural University, Saitama, Japan*
[3]*Department of Shalom no i.e, Not-for-profit agency, Sazanami, Japan*

Abstract:

Background:

Family violence committed by persons with schizophrenia is a serious problem in the context of the accelerated deinstitutionalization in Japan. Community nurses could play an important role in resolving family violence by persons with schizophrenia.

Objective:

This study aimed to clarify the reasons for family violence as perceived by adult children with schizophrenia and ways to resolve this problem.

Methods:

A qualitative descriptive design was employed. Group interviews with 10 participants—five individuals with schizophrenia and five parents of adult children with schizophrenia-were conducted. Transcriptions were segmented according to the following three research questions: "How do parents recognize and cope with violence committed by persons with schizophrenia?," "How do persons with schizophrenia perceive committing violence toward their parents and how do they change themselves after doing so?" and "How do persons with schizophrenia perceive ways to resolve the issue of violence toward parents?" The data were categorized and subcategorized based on the similarity of codes and organized in chronological order. Categories concerning reasons for violence and the subsequent changes in persons with schizophrenia made up the stages of their experiences.

Results:

Parents could not understand the reasons for violence committed by persons with schizophrenia. Experiences of committing violence and changes after violence as perceived by persons with schizophrenia involved the following five stages: complicated causes of occurrence, environment conducive to violence, onset of violence, gaining power, and regret and growth. Persons with schizophrenia wanted to be observed from a distance and were desirous of establishing relationships beyond the home.

Conclusion:

It is necessary for nurses to bridge the gap between patients and their parents by serving as a communication channel between them. In this way, there is hope to promote recovery even if the patient with schizophrenia commits violent acts toward the parent.

Keywords: Family violence, Schizophrenia, Mental disorder, Caregiver, Communication, Parent-child relationship.

Article History	Received: June 26, 2019	Revised: September 16, 2019	Accepted: September 16, 2019

1. INTRODUCTION

In Japan, accelerated deinstitutionalization in conjunction with a rate as high as 75% of persons with mental disorders living with their families demonstrates increasing importance of community nursing care [1]. Schizophrenia significantly impacts not only the patient but family members as well. Apart from the emotional, psychological, physical, and economic impact of the caregiving burden [2, 3], family members living with persons with schizophrenia are sometimes also at the receiving end of violence by them. Rates of physical violence against family members by persons with mental disorders since

* Address correspondence to this author at Department of Health Promotion Science, Osaka University Graduate School of Medicine, Suita, Osaka 565-0871, Japan; Tel: +81-6-6789-2553; E-mail: kageyama-tky@umin.ac.jp

the onset of mental illness have been reported as 47% in the U.S [4], 40% in Australia [5], 52.9% in the U.K [6], and 60.9% (only schizophrenia) in Japan [7]. Based on these studies, it is estimated that at least 40% of family members experience violence by persons with mental disorders regardless of the country [4]. In Japan, half or more of inpatients of psychiatric hospitals are diagnosed with schizophrenia [8]. The rates of family violence by persons with schizophrenia over their lifetime in Japan were 51.0% toward mothers, 47.0% toward fathers, and 60.9% toward any family member, including parents [7].

It has been reported that one of the risk factors for violence toward parents in Japan is the high hostility and criticism involved in family interactions [9]. In a survey in Australia, higher rates of physical and psychological violence toward parents from adult children with severe mental illness were associated with poor relationships between them [5]. In another survey of family members in the U.S., families with violent members reported significantly lower adjustment scores than did families with nonviolent members [10]. Therefore, family violence may increase with ineffective family interactions and be reduced by educating both parents and children on effective communication strategies. Such intervention programs to manage child-to-parent violence are scarce. In Taiwan, a nurse-led clinical intervention program resulted in significantly reduced violence [11]. In Japan, although the Comprehensive Violence Prevention and Protection Programme has been implemented to prevent medical staff from suffering harm by inpatients [12], there are no intervention programs for family members caring for persons with mental disorders living in the community. Reports state that psychiatric home visiting nurses are provided training to promote communication between persons with mental disorders and family members and advocate and coordinate between them [13, 14]. Therefore, nurses working in the community could play an important role in resolving family violence by persons with schizophrenia.

There is a lack of research on family violence among persons with mental disorders and investigations of family violence and mental disorders have generally been restricted to inpatient settings at admission, with little examination in community settings [15]. Qualitative studies of family violence are an important starting point, for in this situation of very little research, qualitative studies can provide insight into family violence and its resolution [15] and serve as building blocks for larger, more extensive investigations. In Taiwan, a qualitative study of 14 dyads of parents and their hospitalized adult children revealed the repetitive nature of violence and recognition of parents and adult children with schizophrenia [16]. This study focused on inpatients who may experience more severe medical conditions than persons living in the community; therefore, its results are not widely generalizable. In Japan, a qualitative study on parents of persons with schizophrenia living in the community clarified parents' coping processes after experiencing violence. The subjects of the study also reported that the violence took 10 to 20 years to solve because of the unclear causes [17]. In order to develop an effective intervention program for the resolution of family violence, clarification of the reasons for family violence as perceived by adult children with schizophrenia and ways to resolve the problem may be important. Taking into account the views of persons with schizophrenia, this study aimed to clarify the reasons for their violence toward parents, how they change themselves after committing violence, and how the violence can be resolved.

2. MATERIALS AND METHODS

2.1. Design

As this is an unexamined research area, a qualitative descriptive design was employed.

2.2. Definition of Family Violence

In this study, "family violence" was defined as any incident or a pattern of incidents of controlling, coercive or threatening behavior, violence or abuse between family members. This definition encompasses physical, psychological, sexual, and financial violence, as well as threatening, controlling, and coercive behaviors. This definition is based on one issued by the Home Office of the UK government [18].

2.3. Interview Participants

Persons with schizophrenia who have committed violence toward their parents, and parents who have experienced violence by their adult children with schizophrenia, participated in this study. Previous qualitative research has revealed that including real parent-children pairs is problematic because parents can be afraid of speaking out about their children's behavior for fear of being subjected to more violence [17, 19]. Therefore, the parents and patients with schizophrenia included in this study were not related to one another.

We recruited participants with schizophrenia in Yokohama, a large urban city in Japan. Firstly, we recruited individuals from a large self-help group for persons with mental disorders by sending invitations to a mailing list with approximately 200 registered members to which the third author belonged. To recruit a larger sample, we then contacted community mental health support agencies in Yokohama by phone and recruited parent participants through two self-help groups for family members of persons with mental disorders in Yokohama and Saitama City, near Tokyo. Interviews were conducted in conference rooms in a business center near Yokohama. The participants were provided a meal but received no other reward.

2.4. Interview Methods

The group interview, with a mix of participants with schizophrenia and parents of adult children with schizophrenia, was conducted. Firstly, the parents answered the following questions: "How did you cope with the violence committed by your son or daughter?", "What did you have the most trouble with at the time?", and "What did you most want to know when you experienced violence?" Secondly, participants with schizophrenia answered questions prompted by the parent participants. Thirdly, participants with schizophrenia answered the following questions: "How do you feel when you commit violence?", "What do you want to tell your parents?", "What

are your feelings after committing violence?", and "How do you try to change yourself after committing violence?" The interviews were conducted by the first and second authors, who have experience with conducting group interviews for qualitative studies. The group interviews were conducted on a group of two participants with schizophrenia and three parents, and the other group of three participants and two parents. The interviews included a 15-minute intermission to help the group members maintain concentration. The total time of the interviews was two hours per group.

2.5. Data Analysis

The recorded interview data were transcribed, and the transcriptions were segmented by meaning. Each segment was coded and labeled according to the following three research questions: "How do parents recognize and cope with violence by persons with schizophrenia?," "How do persons with schizophrenia perceive committing violence toward their parents and how do they attempt to change themselves after doing so?" and "How do persons with schizophrenia perceive resolving the issue of violence toward parents?" Data were categorized and subcategorized based on the similarity of codes and organized in chronological order. Reasons for violence and the subsequent changes in patients with schizophrenia made up the stages of their experiences. To ensure the trustworthiness and rigor of the findings [20], the first author collected all the data to ensure consistency of data collection (dependability) and analyzed the data, and the second author confirmed the first author's interpretation through discussion (confirmability). We requested that the interview participants endorse the results, and all participants agreed with the results (credibility). The generalizability of the findings was confirmed by 10 persons with mental disorders and 9 parents of persons with mental disorders who were not participants (transferability).

2.6. Ethical Consideration

The objectives of the study, voluntary basis of participation, confidentiality, and autonomy were explained to participants orally and in writing, using the participant information sheet. Written informed consent was obtained before each interview. This study was approved by the Research Ethics Committee, Faculty of Medicine, Osaka University (17218).

3. RESULTS

3.1. Demographic Characteristics of Participants

Five patients with schizophrenia and five parents were divided into two groups. All the participants with schizophrenia belonged to a large self-help group and were male; two were in their 30s, one in his 40s, and two in their 50s. Violence toward parents included (A) making holes in the walls and playing loud music, (B) repeated punching and kicking and playing loud music, (C) shouting abuses, (D) kicking lightly and trying to punch, and (E) breaking things and playing loud music. All patients with schizophrenia were employed at welfare agencies or companies part- or full-time at the time of the interview. All five of the parents belonged to one of two self-help groups and were mothers, three of whom were in their 60s and two in their 70s. Four of the mothers had experienced punching and kicking by their adult children (F, G, I, J), and one had been shouted at, by her daughter (H).

3.2. Parents' Recognition of and Coping with Violence by Persons with Schizophrenia

When parents suffered violence by their son or daughter, they were unable to understand why. They thus inferred reasons for the violence to cope with it. However, after violence occurred, parents were not prepared for future potential violence As shown in Table **1**,. Aspects of parents' recognition of and coping with violence by persons with schizophrenia comprised four categories: *unable to understand reasons for committing violence toward parents*, *inferring reasons for committing violence*, *ways to cope with violence*, and *no preparation for future potential violence*.

Table 1. Parents' recognition and coping to violence by persons with schizophrenia.

Category	Subcategory
Unable to understand reasons of committing violence toward parents	Suddenly happen Unable to ask the reason
Inferring reasons of committing violence	As resentment against parents As worsen symptoms As release stress in daily life As uncontrolable impulsiveness
Ways to cope against violence	Avoide stimulation Unresinting the adult child Runing away Assist hospitalization
No preparation to next potential violence	Feeling of fear potential violence Want to keep stable

3.2.1. Unable to Understand Reasons for Committing Violence Toward Parents

Parents felt that the violence against themselves happened suddenly. Parents could not ask their adult children with schizophrenia why they committed violence against them.

"I cannot understand why my son committed violence against me. I felt the violence happened suddenly. I was confused. I want to know why he did it." (F)

"My son punched me and broke things. After he did so, I could not ask him why. I want him to be calm." (G)

3.2.2. Inferring Reasons for Committing Violence

When parents suffered violence by their adult children, they inferred the reasons for the violence *as resentment against parents, as worsening symptoms, to release stress in daily life*, and *as uncontrollable impulsiveness.*

Parents inferred that their adult children committed violence against them out of resentment for the parents' child-rearing, or against hospitalization with the parents' consent.

"My son was gentle and had no confidence from childhood. He had to obey his parents' orders and did not go through a rebellious period. When he committed violence toward me, I felt he was taking revenge against me for his childhood." (G)

"I took my son to a psychiatric hospital under compulsion. After that, my son committed violence against me out of hatred of me." (I)

Parents inferred interrupted medication and worsening symptoms as reasons for committing violence against them. However, when the adult children took medication properly, parents inferred that they committed violence against them to release stress of daily life, and that they could not control their impulses to commit violence.

"My son was likely to stop taking medication because of lack of insight into his illness. He used to relapse and was admitted to a psychiatric hospital." (G)

"My son felt stress due to relationships with others. To release the stress, he used to commit violence against me, his mother." (J)

"Whenever my son experienced something unacceptable, he committed violence against me. Even if I was careful not to do such things, I could not avoid something happening that he did not like." (G)

3.2.3. Ways to Cope with Violence

When the persons with schizophrenia committed violence against their parents, parents took ways to cope as follows: *avoiding provocation, not resisting the adult child, running away*, and *assisting hospitalization*.

"When my daughter abused me verbally, I did not say anything because it could provoke her." (H)

"I did not resist my son. For example, when he requested that I buy him something to eat, I used to go shopping as soon as possible. I wanted to calm his violence in any way." (G)

"I used to run away from my son." (I)

"My son asked me why I ran away while he was struggling with the illness." (J)

"When my son's symptoms worsened, other family members and I could not live with him at home. We took my son to a psychiatric hospital." (G)

3.2.4. No Preparation for Future Potential Violence

Parents felt fear that their adult children would commit violence again. However, in many situations, they did not communicate with their adult children about the violence, nor did they consult with psychiatric doctors, nurses, or other staff. Parents wanted to keep calm.

"I feared that my son would start to get angry. What I wanted was only for my son to be calm." (G)

"Once my son got calm, I wanted him to stay calm. Therefore, I did not take any action so as to avoid provoking him." (F)

3.3. Stages of Violence and Changes After Violence

Patients' experiences of committing violence and their perceptions of the subsequent changes within themselves comprised the following five stages: complicated causes of occurrence, environment conducive to violence, onset of violence, gaining power, and regret and growth (Table **2**).

Table 2. Stages of violence and subsequent changes.

Stages	Category	Subcategory
1. Complicated causes of occurrence		
	Acute positive symptoms	World of delusion Insufficient medication Medical condition requiring hospitalization
	Social withdrawal and cognitive issues	Social withdrawal Cognitive issues
	Pain of illness	Unable to accept own illness Painful medical condition
	Lack of recognition between parents and child	Incommunicable in words Desire parents to understand Resentment due to involuntary hospitalization
2. Environment conducive to violence		
	Emotional dependence on parents and addictive violence	Parents as vent Mother's acceptance Acting repulsively father Repetitive dependence Calculated violence
	Home as the whole world	Cohesive relationships in nuclear family No world except home Safe yet dangerous home
	Protective world toward persons with disorders	Overprotective society Undeveloped sociality
3. Onset of violence		
	Confused and sudden violence	Feeling of brain coming undone Vague memories Unintentional behavior
4. Gaining power		
	Changing the dynamic of the relationship with parents	Winning parents who suppressed me Change hierarchical relationship
	Being in control	Confirmation of fighting instinct through physical feelings. Solution to anxiety and fear Confirmation of having the power to make a change
5. Regret and growth		
	Regret	Shame Unable to permit oneself
	Growth caused by violence	Growth by living apart from parents Devotion to parents resulting from regret Being kind to parents Gratitude toward parents

3.3.1. Complicated Causes of Occurrence (First Stage)

Persons with schizophrenia committed violence against their parents because of a combination of complicated reasons such as *acute positive symptoms*, *social withdrawal and cognitive issues*, *pain of illness*, and *gap between parents and child*.

"There is no singular cause of violence; it is a complicated process." (A)

3.3.1.1. Acute Positive Symptoms

Persons with schizophrenia stated that they had been suffering from acute positive symptoms, which found expression in a "world of delusions." They also felt that their medication was insufficient and that their medical condition needed hospitalization.

"When I got off the bike, my neighbor shut the window. Therefore, I thought the neighbor was harassing me. Such situations fuel my delusions." (E)

"Taking medication stopped my delusions, which had the potential to make me aggressive. Therefore, violence and taking medication may be related." (A)

"I tried to punch my mother, who I thought was an alien trying to abduct me. I think I was in a state of confusion at that time. After the event, I was admitted to a psychiatric hospital." (D)

3.3.1.2. Social Withdrawal and Cognitive Issues

The patients had been experiencing social withdrawal and believed they had cognitive issues.

"When I was in withdrawal, I had contact only with my family members. The situation was not good. I did not enjoy conversation. Therefore, I did not know what I was saying to family members." (D)

(Parent) "After committing violence against me, my son calmed down and apologized to me. I felt he was also hurting; his expression was so gentle. I find it difficult to understand these shifts between aggression and calmness." (F)

(Person with schizophrenia) "I think we are unaware of the switch between different kinds of situations and cannot control it. I looked back to interpret why I committed violence. During the process, I gradually came to understand the connection between two situations and can now identify the shift from acute change to mild change." (A)

3.3.1.3. Pain of Illness

Persons with schizophrenia had been so overwhelmed by the pain associated with the situation that they did not want to accept that they were ill. They recognized committing violence against their parents due to such pain of illness.

(Parent) "My son was not conscious of being ill. Therefore, he did not understand why he was hospitalized." (I)

(Person with schizophrenia) "I think the reason why I committed violence against my mother was that I was pained by the illness. I wanted my mother to rescue me, but I knew she could not rescue me. I had such complex pain. I was conscious of being ill and understood that I needed to take medication. However, I did not want to accept the situation." (D)

(Parent) "He accused me of taking him compulsorily to a psychiatric hospital and committed violence against me. However, I think my son committed violence against me when he could not get what he wanted. I think he only justified himself." (I)

(Person with schizophrenia) "I think he did not justify himself. We as persons with mental disorders feel pains of the illness that we cannot resolve by ourselves." (E)

3.3.1.4. Lack of Recognition Between Parents and Child

This category means that persons with schizophrenia felt a lack of recognition by their parents, and it comprises three subcategories: *incommunicable in words, desire parents to understand,* and *resentment due to involuntary hospitalization*.

Persons with schizophrenia felt their situation was *incommunicable in words*, which might make it difficult for their parents to understand. Persons with schizophrenia felt that their parents did not feel their pain of illness or their painful situation, and they felt a *desire for their parents to understand* them. In particular, persons with schizophrenia harbored resentment against their parents for having them hospitalized against their will. They were hurt by the involuntary hospitalization and felt that their parents did not understand their painful experiences.

(Parent) "My son dropped out of high school and was at home. He was repeatedly violent toward family members." (I)

(Interviewer) "How did your son feel at that time?"

(Person with schizophrenia) "From listening to her story, what I understand is that her son could have been worried about something or suppressing something that happened in school. I had long-term non-attendance at school, too. I guess that he may not have communicated verbally with his mother and committed violence instead." (D)

(Person with schizophrenia) "I was bullied in high school and directed that anger toward my parents. I guess her son may have gone through something similar." (E)

(Person with schizophrenia) "I wanted my parents to understand my pain. However, I could not talk to them and damaged the walls at home instead." (A)

(Parent) "When my son comes back home after involuntary hospitalization, he resumes committing violence against me." (I)

(Person with schizophrenia) "Fighting back." (D)

3.3.2. Environment Conducive to Violence (Second Stage)

Persons with schizophrenia perceived the first stage, complicated causes of occurrence, as creating an environment conducive to violence. In such environments, the categories of *emotional dependence on parents and addictive violence, the home as the entire world,* and *urge to protect(ive) persons with mental disorders* emerged.

3.3.2.1. Emotional Dependence on Parents and Addictive Violence

According to persons with schizophrenia, the reasons for committing violence against parents included *parents as vent, acceptance from the mother, acting repulsively father, repetitive dependence, and calculated violence.*

Persons with schizophrenia felt that committing violence against their parents helped them vent stress. They felt

accepted by their mothers, but repelled by their fathers. Such excessive acceptance by the mother could lead to repetitive violence as a form of dependence. They recognized that they committed violence against parents only at home because committing violence outside the home would be treated as a crime. Such violence was expressed as calculated violence by persons with schizophrenia.

(Person with schizophrenia) "Parents are very protective of their children. Dependence causes a repetitive chain of violence." (B)

(Person with schizophrenia) "I agree. The parent is no one and, therefore, only likely to be targeted because the home is the patient's entire world. If we commit violence outside the home, we know it is a crime. No vent without parents." (C)

(Parent) "A closed-off parent-child relationship is not good. Making a breakthrough like making air hole is better. If we use various support, I think the severe situation will not change." (J)

"A mother is the only person who will accept me for what I am. A father stands to represent society. Therefore, I am defensive toward my father." (E)

3.3.2.2. The Home as the Whole World

The home held certain characteristics of isolation. These were the cohesive relationships of nuclear families, an all-encompassing entity, and a safe but dangerous place.

"Violence cannot be permitted in society. However, the home is a closed space, where violence can be committed without being punished for it." (C)

3.3.2.3. Protective World Toward Persons with Disorders

Persons with disorders believed society is overprotective of them, causing them to be socially undeveloped. There are support service systems for mental disorders in Japan that are only open to persons with disorders. Therefore, persons with disorders are not likely to communicate and work with persons without disorders. Persons with schizophrenia think that such protective supportive world could not help them develop socially. Persons with schizophrenia think that if persons with schizophrenia committed violence outside the home, they would learn social rules and stop committing violence.

"It is known that committing violence outside the home is a crime. Therefore, it is better to encourage persons with mental disorders to commit violence outside the home, where they will face repercussions for it. In this manner, their social development can be encouraged. Family members as well as the social systems are generally overprotective of persons with mental disorders, which is detrimental to their social development." (B)

3.3.3. Onset of Violence (Third Stage)

Persons with schizophrenia described the onset of violence to be the third stage.

3.3.3.1. Confused and Sudden Violence

In the exact moment when they committed violence, they had the feeling of their *brain coming undone,* had *vague memories*, and *engaged in unintentional behavior*.

"My mother misunderstood and believed I had done something wrong. Therefore, I felt repulsed by my mother, which was expressed as violence. When I commit violence, I feel my brain coming undone. Usually, I can think more, understand more, and manage difficult situations without committing violence. I want my parents to understand my situation and me. Other persons with schizophrenia may think the same way as me." (A)

"Violence is momentary; our emotions reach a sudden peak and drop just as quickly. Therefore, we cannot control such changes." (B)

3.3.4. Gaining Power (Fourth Stage)

To persons with schizophrenia, violence does not have only negative connotations; it is also associated with power and being in control of their lives. This, together with bringing about a change in their relationship with their parents, is especially important for those who experience withdrawal and cannot find meaning in their lives.

3.3.4.1. Changing the Dynamic of the Relationship with Parents

After committing violence against their parents, who had so far suppressed them, they witnessed a change in the dynamic of the parent-child relationship.

"When I use coercive words, my mother shrinks back. Such behavior makes me think about changing the hierarchical parent-child relationship. Actually, I have changed the nature of the relationship." (E)

"I spent my childhood like a dog being tamed by my parents. Committing violence against my parents, therefore, was like the dog biting the owner." (A)

3.3.4.2. Being in Control

The experience of committing violence put persons with schizophrenia in control of their being. Their physical responses served as confirmation of their fighting instinct and the power to make a change, as well as a solution to anxiety and fear.

"The physical feelings assured me that I still had the fighting instinct. I still had power." (A)

3.3.5. Regret and Growth (Fifth Stage)

After committing violence, persons with schizophrenia regretted their behavior. However, this regret could also lead to personal growth. Therefore, a violent episode can lead to one of two situations: "regret" and "growth fueled by violence."

3.3.5.1. Regret

They regretted having committed violence, feeling ashamed and unable to permit themselves.

"I was suppressed by my father since childhood. After his death, I flew into a temper and broke the Buddhist altar that

held his remains. When my mother entered my room, she said nothing; instead, she just collected the broken pieces and placed them in a plastic bag. I instantly regretted my actions and cannot forgive myself." (E)

3.3.5.2. Growth Caused by Violence

The regret that follows violence can also fuel personal growth, such as by living apart from parents, becoming devoted to parents, being kind to parents, and feeling gratitude toward parents.

"I had wanted to move away from my parents as soon as possible. If I had continued to live with them, I was afraid I would not amount to anything." (C)

"When I was in a bad condition, I resented my parents for giving birth to me. Therefore, I wanted my parents to feel as sad as I did and deliberately sought to use words that would hurt them. However, I am grateful for my parents now and am devoted to caring for my elderly mother." (E)

"My parents let me live apart from them because I was violent toward my mother. I thought my parents were worried about whether I could live by myself. However, since then, I have lived by myself. The fact that I am employed and living by myself gives my mother much relief. I visit my mother once a month. This current situation arose from regret over committing violence." (B)

3.4. Potential Solutions to Violence as Perceived by Persons with Schizophrenia

According to persons with schizophrenia, the following could serve as solutions to violence: establishing what parents can and cannot do, maintaining a moderate distance, parental care, a combination of acceptance and severity, routine stress release, maintaining community connections outside of family, not being forced to do things they dislike, and having trust in medical care (Table **3**).

3.4.1. Establishing what Parents can and Cannot do

Persons with schizophrenia believed that parents have an important role to play. However, they also understood that parents are unlikely to be objective when it comes to their children. Therefore, they sought to distinguish between what parents can and cannot do.

"I think there are some things only family members can do, while there are others that they cannot. If service providers fill the gap created by what is beyond the family's capacity, family relationships may improve. I think family members are likely to be subjective and emotional, unable to stop themselves from saying things they should not necessarily say. If people outside the family support persons with mental disorders, I expect that family issues may be resolved." (C)

3.4.2. Maintaining a Moderate Distance

Persons with schizophrenia perceived that maintaining a moderate distance from parents is important regarding solving family violence. This has two subcategories: distance within the same home and living separately and meeting sometimes.

"When I used to get irritated with my parents when we were living together, I used to leave the living room and stay in my room. Staying alone makes me calm. Now I live alone and meet my parents occasionally. This distance is comfortable for me." (C)

Table 3. Solutions to violence as perceived by persons with schizophrenia.

Category	Subcategory
Establishing between what parents can and cannot do	
	Parental roles Importance of parents Lack of objectivity
Maintaining a moderate distance	
	Distance within the same home Living separately and meeting sometimes
Parental care	
	Be worried about me Listen to my complaints Be by my side
Treating with acceptance and severity	
	Not to be overly accepting but treat with severity Accept once and make me introspect
Routine stress release	
	Having some ways of stress release Places to escape
Maintaining community connections outside of family	
	Be connected with outsiders and see oneself objectively Be way from the support system without being isolated from the community
Not forcing patients to do things they dislike	
	Do not take me outside when I am in withdrawal Call police in dangerous but preventing crisis
Having trust in medical care	
	Meeting compatible psychiatrist Taking medicine

3.4.3. Parental Care

Persons with schizophrenia need care from their parents to solve violence. This care could be expressed as being worried about the patient, listening to their complaints, and being by their side.

"I want my parents to listen to my troubles and the painful situations I go through. Listening to my troubles may depress them, but as is the case with most persons with mental disorders, my parents are the only ones who can listen to me." (A)

"I know shouting abusive language is not a good thing. However, it was the only thing I could do at that time. I wanted my parents beside me." (C)

3.4.4. Treating with Acceptance and Severity

Persons with schizophrenia perceived too much acceptance to be detrimental to solving the problem of violence. They believed that parents must act with a certain degree of severity; accepting a violent episode once is fine, but patients must be made to introspect about their actions.

"I think parents should accept their children; however, they

must be made to think about problematic issues by themselves. Most parents are overly accepting of their children. Such treatment is only likely to foster more violence. Do not accept too much." (B)

3.4.5. Routine Stress Release

Persons with schizophrenia considered it important to have an outlet to release stress and have a place to escape by themselves occasionally.

"To release stress, it is important to have a place where we can escape or hide." (B)

3.4.6. Maintaining Community Connections Outside of Family

Persons with schizophrenia considered it important to connect with outsiders and see oneself objectively and be away from the support system without being isolated from the community.

"I think persons who have been affected by the violence they themselves have committed are unlikely to connect with others. I want to tell such isolated persons to hold hands and form a circle to make connections with others. Persons who spend all their time at home know only their parents. If they connect with others, they can have new perspectives on things." (C)

(Parent) "My son had few friends in childhood." (J)

(Person with schizophrenia) "I have listened to your story and think your son needed someone to talk to him and listen to what he had to say." (A)

(Parent) "I think you may be right." (J)

3.4.7. Not Forcing Patients to do Things they Dislike

Parents sometimes did what they believed was best for their son or daughter, even though this was sometimes not what the adult offspring wanted. Persons with schizophrenia believed they should not be forced to go outside when they are in withdrawal.

"Persons in withdrawal need time to be withdrawn at home. Parents had better to wait until persons in withdrawal go outside voluntarily." (A)

Parents sometimes call the police in dangerous situations. Persons with schizophrenia believed that calling the police is important in a crisis situation but does not prevent a crisis.

"I think calling the police is not good to prevent crisis but good to avoid crisis at serious situation." (D)

3.4.8. Having Trust in Medical Care

Persons with schizophrenia considered meeting a compatible psychiatrist and taking the necessary medication important with regard to solving the problem of violence.

"I think finding a compatible psychiatrist is very important; it is much like finding a lover. It is synchronization. A psychiatrist who is compatible with the patient may be able to coax him/her into revealing more information and treat the person in ways others cannot. So, I think synchronization is important." (C)

4. DISCUSSION

This study determined parents' recognition of and coping with violence by persons with schizophrenia, the stages in the experience of committing violence, changes after violence, and solutions to violence as perceived by persons with schizophrenia.

4.1. Parents' Recognition of and Coping with Violence by Persons with Schizophrenia

When parents suffered violence by their son or daughter, they were unable to understand why. They inferred reasons for committing violence and sought ways to cope with violence. However, they were not prepared for future potential violence. Therefore, parents needed a long time to solve violence by their adult children with schizophrenia.

The findings are supported by past research on parents suffering violence by persons with schizophrenia in Japan that found that one of the main characteristics of parents' coping process is the long time it took them to understand the violence [17]. In the current study, parents cope with violence by their adult children by *avoiding provocation, not resisting the adult child, running away*, and *assisting with hospitalization*. They could not consult professional staff including nurses, rely on professional support in the crisis period, or use home visiting services. This may be due to Japan still having poor outreach services [21].

4.2. Stages in the Experiences of Committing Violence and Subsequent Changes

The following were the five stages: complicated causes of occurrence, environment conducive to violence, onset of violence, gaining power, and regret and growth.

The first stage, "complicated causes of occurrence," includes acute positive symptoms, social withdrawal and cognitive issues, pain of illness, and gap between parents and child. In previous studies, violence was shown to be related to hallucinations and delusions [22] and cognitive impairment [23], which are very similar to the acute positive symptoms and social withdrawal and cognitive issues described by the participants of the current study. Previous studies have also reported that violence may be related to ineffective communication between parents and adult children [9, 16]. The current study delved into the concept of "ineffective communication," identifying categories such as pain of illness and gap between parents and child. Persons with schizophrenia were desirous of making their parents understand their pain of illness because they were unable to accept their own illness and struggled with a painful medical condition. However, they perceived their troubles as being incommunicable in words. Therefore, their cognitive impairment, responsible for the inability to verbally express their feelings, may be a cause of violence. If parents are aware of their children's pain, communication may be more effective. The current study demonstrated that patients with schizophrenia seek understanding from their parents, and this knowledge may contribute to reduced violence.

The theme of resentment stemming from involuntary hospitalization has not been reported in past research in Taiwan [16]; therefore, it might be unique to Japan. One type of involuntary psychiatric hospitalization in Japan involves evaluation by a qualified psychiatrist and the agreement of a family member. The involvement of family members often strains the relationship with patients [24]. In such involuntary hospitalization, patients are likely to be in seclusion and/or to be physically restrained due to severe symptoms. Past research has reported that the median length of seclusion and physical restraint in Japan is much longer than in other countries [25]. Due to painful experience in psychiatric hospitals in Japan, persons hospitalized involuntarily with the assistance of their parents sometimes hate their parents [26]. Painful and dangerous experiences in seclusion and/or under restraint may negatively affect family relationships and cause further family violence.

In the second stage, which is an environment conducive to violence, the categories that emerged were emotional dependence on parents and addictive violence, the feeling that the home is the entire world, and the protective urge toward persons with disorders. A previous study identified the repetitive nature of family violence [16]. However, in the current study, only one participant with schizophrenia (B) displayed repeated violence against his mother. Regarding repetitive violence in past research, most violent episodes were verbal, followed by damage to property, violent threats of harm, and physical violence towards objects and families [16]. In Japan, the rates of the different types of repetitive violence committed more than 100 times in a lifetime that were most reported were verbal violence of shouting (8.7%) and swearing/insulting (8.3%), followed by destruction of property (4.7%) and punching and kicking (3.3%) [27]. However, as repetitive violence was not frequent but occurred at a rate less than 10%, repetitive violence may be not typical in patients living in the community. One of the reasons for the differences may be the severity of illness. The patients of the current study were all employed at the time of their interview. However, in a past survey, all patients were hospitalized at the time of the interview and only 29% were employed [16], which may indicate a more severe illness than that of the current study patients. Therefore, the present study differs from past research on inpatients with severe symptoms with regard to the stronger emphasis on emotional dependence on parents than addictive or repetitive violence [16].

Emotional dependence and addictive violence are likely to occur when patients perceive the home as their entire world and when those around them are too overprotective. Living together was reported as a risk factor for family violence [22]. The high rate of living together and slow deinstitutionalization in Japan might have led to insufficient outreach support services in the community [28].

The protective support system for only persons with the disorder as a risk factor was not found in past research. Japanese culture has a higher degree of mental-health-related public stigma than other countries [29], and in particular, schizophrenia is more stigmatized than depression [30]. Therefore, persons with schizophrenia are likely to be concealed from the public, leading to family isolation, which is a risk factor for family violence.

The most important finding in the current study was the positive aspect of violence. After committing violence, persons with schizophrenia felt ashamed and unable to permit themselves. Then, in the fifth stage, regret was accompanied by growth. The reason why violence fueled such growth was that for persons with schizophrenia, violence does not have only negative connotations; it is also associated with gaining power and control over their lives, which was recognized in the fourth stage. Family violence is a taboo [19], such that parents suffering violence by their adult children found it difficult to admit even in self-help groups made up of family members of persons with mental disorders [17] because they felt shamed by the family violence [19]. This taboo may lead to delays in seeking help and needing a long time until the solution. The findings of the current study are encouraging for family members and persons with schizophrenia in that even if they commit violence, they can reflect on their actions and continue to grow. This positive aspect is a new finding that has not been reported in past research.

4.3. Potential Solutions to Violence as Perceived by Persons with Schizophrenia

Persons with schizophrenia perceived having trust in medical care to be a solution to family violence, as reported in past research [16]. However, they also recognized many other important aspects. While a national survey reported that family members provide daily care like medicine management [31], the present study demonstrated that persons with schizophrenia do not desire this. They want to be observed from a moderate distance to be able to distinguish between what parents can and cannot do and wish to be treated with a combination of acceptance and severity. They also wish to establish relationships beyond the home, with members of the community and require an inclusive society where they can interact with their neighbors. Psychological independence from parents was perceived as a solution to violence. Indeed, the "8050 problem," which refers to people in their 50s who have shut themselves up at home without working or interacting with others outside of their family over an extended period (*hikikomori*), living alone with parents who are in their 80s, is a major issue in Japan [32]. Such family isolation is a precursor to violence. Parents are expected to be independent of their adult children.

4.4. Implications for Practice

In the current study, persons with schizophrenia were desirous of making their parents understand their pain of illness. If parents can be aware of and sensitive to their feelings of pain, it may facilitate more effective communication. In the mental health system in Japan, outpatients regularly visit mental clinics by themselves without family members. Therefore, intervention between patients and family members can be provided at home. The services provided at home are mainly home-visiting services by nurses. The home-visiting nurses working in the community can make home visits and ask patients why they committed violence towards their parents, because most parents cannot ask the reasons by

themselves. Nurses can also advise parents what they can and cannot do, encourage them to maintain a moderate distance from their adult children, and encourage them to release stress. After listening to persons with schizophrenia and their parents independently they can bridge the gap between them by communicating the latter's feelings. Moreover, an intervention program that promotes the understanding of the feelings of both parties would be useful in solving family violence and can be provided as family psychoeducation or family education regarding family violence by persons with schizophrenia even in psychiatric hospitals where their adult children are hospitalized.

Persons with schizophrenia felt pained by their experiences of seclusion and/or restraint. Nurses working in hospitals are encouraged not to use seclusion and/or restraint; this will go a long way in preventing painful experiences among persons with schizophrenia and the escalation of family violence. However, involuntary hospitalization and insufficient outreach services in the community are basic issues that must be resolved first.

The fact that the environment is conducive to violence may be owing to the pressures of living together and the fact that care is provided only by family members, with no assistance from outreach services. It may also be related to public and self-stigma. Reducing stigma is necessary so as to end the isolation and concealment of violence in nuclear families. Opportunities to speak openly are important. Family self-help groups may, therefore, play an important role.

The current study revealed that there is hope to promote recovery even among persons with schizophrenia who commit violence. However, parents who experience violence are likely to be distressed [33] and at a high risk of posttraumatic stress disorder [34]. Counseling and support for persons with schizophrenia and their parents are needed for the establishment of positive long-term relationships. Such support may be easier to provide when the persons are hospitalized because of violence. Before hospitalization, family respite services will be effective not only to afford parents distance from persons with mental disorders but also to provide counseling or support for family members during respite. Family respite services are currently quite insufficient in Japan and are greatly needed in the future.

4.5. Study Limitations and Further Research

There are some limitations to this study. Firstly, the number of participants was small. Although we attempted to recruit a larger sample, it was not possible because of the stigma associated with schizophrenia. However, in qualitative studies, the saturation of themes is more important than large sample sizes. Participants belonged to three self-help groups and all of them were acquainted with some of the other participants. Therefore, participants seemed to be relaxed and speak their feelings honestly, which was conducive to yielding rich interview data. The generalizability of the findings was confirmed by 10 persons with mental disorders and 9 parents of persons with mental disorders who were not participants. We judged data saturation to have been almost achieved. In the future, longer interview times may be considered to ensure adequate data saturation. However, persons with schizophrenia may not find it easy to concentrate on interviews lasting for a long time.

In a future study, although real parent-children pairs are problematic, patient participants and their parents can enter alternative groups. For example, if 10 patients and parents are recruited, the interview can be conducted in the following manner: Patients and their parents enter alternative groups: group One: patients: A, B, C, D, E and parents of patients F, G, H, I, J, K; Group two: patients: F, G, H, I, J, K and parents of patients A, B, C, D, E. We did not conduct separate or independent coding by a second author. Instead, the coding of the first author was discussed with the second author.

Next, the participants with schizophrenia were all male and the parents were all female. This inadequate representation may be owing to stigma and gender bias in family self-help groups, where females are likely to be made to feel ashamed of their behavior and conceal their violence. Most family group members are mothers, who are also the main caregivers. Further research is needed to investigate the experiences of female participants with schizophrenia and fathers of persons with schizophrenia.

In a future study, in order to identify possible solutions, studies with video recording at home may be conducted. For example, after violence occurs, nurses, social workers and/or doctors can review the video together with the patient and the parent involved, in separate rooms to find out causes, barriers and solutions together; prevention strategies can be developed and tested within the same study settings (home video recording).

CONCLUSION

Considering that parents require a long period-10 to 20 years-to resolve violence because of its unclear causes [17], the perceptions of persons with schizophrenia who have committed violence against their parents may provide valuable insight. In particular, even if persons with schizophrenia commit violence against a parent, they regret it, feel gratitude toward their parents, and undergo positive growth. Persons with schizophrenia can thereby gain power and control over their lives.

AUTHORS' CONTRIBUTIONS

MK carried out data collection and participated in study design, analysis, and manuscript preparation. KY and YH carried out the data collection and participated in study design. All authors read and approved the final manuscript.

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Research Ethics Committee, Faculty of Medicine, Osaka University (17218).

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants.

AVAILABILITY OF DATA AND MATERIALS

The data sets analyzed during the current study are available from the corresponding author upon request.

FUNDING

This work was supported by a research grant from the Mitsubishi Foundation, 2017-18(Program Grant Number 29311).

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

We would like to thank the research participants and the Mitsubishi Foundation.

REFERENCES

[1] Japan Ministry of Health Labour & Welfare. Heisei 28 nen seikatsuno shidurasanado nikansuru chosa [2016 National survey for children and adults with disabilities living in the community]. 2018.

[2] Awad AG, Voruganti LN. The burden of schizophrenia on caregivers: A review. Pharmacoeconomics 2008; 26(2): 149-62. [http://dx.doi.org/10.2165/00019053-200826020-00005] [PMID: 18198934]

[3] Caqueo-Urízar A, Miranda-Castillo C, Lemos Giráldez S, Lee Maturana S-L, Ramírez Pérez M, Mascayano Tapia F. An updated review on burden on caregivers of schizophrenia patients. Psicothema 2014; 26(2): 235-43.http://www.ncbi.nlm.nih.gov/pubmed/24755026 [Internet]. [PMID: 24755026]

[4] Labrum T, Solomon PL. Rates of victimization of violence committed by relatives with psychiatric disorders. J Interpers Violence 2015. Advance online publication [PMID: 26231334]

[5] Vaddadi KS, Gilleard C, Fryer H. Abuse of carers by relatives with severe mental illness. Int J Soc Psychiatry 2002; 48(2): 149-55. [http://dx.doi.org/10.1177/002076402128783208] [PMID: 12182510]

[6] Onwumere J, Grice S, Garety P, *et al.* Caregiver reports of patient-initiated violence in psychosis. Can J Psychiatry 2014; 59(7): 376-84. [http://dx.doi.org/10.1177/070674371405900705] [PMID: 25007421]

[7] Kageyama M, Yokoyama K, Nagata S, *et al.* Rate of family violence among patients with schizophrenia in Japan. Asia Pac J Public Health 2015; 27(6): 652-60. [http://dx.doi.org/10.1177/1010539515595069] [PMID: 26182940]

[8] Ministry of Health Labour and Welfare. Kanja chosa 2014 [Patients survey 2014] [Internet] 2014.http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001141596

[9] Kageyama M, Solomon P, Kita S, Nagata S, Yokoyama K, Nakamura Y, *et al.* Factors Related to Physical Violence Experienced by Parents of Persons with Schizophrenia in Japan 2016.http://linkinghub.elsevier.com/retrieve/pii/S0165178115305953 [http://dx.doi.org/10.1016/j.psychres.2016.06.036]

[10] Swan RW, Lavitt M. Patterns of adjustment to violence in families of the mentally ill. J Interpers Violence 1988; 3(1): 42-54. [http://dx.doi.org/10.1177/088626088003001004]

[11] Sun GC, Hsu MC. Effects of nurse-led child- and parent-focused violence intervention on mentally ill adult patients and victimized parents: A randomized controlled trial. Int J Nurs Stud 2016; 60(1): 79-90. [Internet]. [http://dx.doi.org/10.1016/j.ijnurstu.2016.03.002] [PMID: 27297370]

[12] Commitee CVP and PPA. Iryosyoku notameno hokatsuteki boryoku boshi puroguramu [Comprehensive Violence Prevention and Protection Programme for medical staff]. Tokyo: Igakushoin 2005.

[13] Setoya N, Kayama M, Miyamoto Y, Ambo H, Hayashi A, Sawada A. Seishinka homon kangode teikyosareru kea naiyo. J Japan Acad Nurs Sci 2008; 28(1): 41-51. [Nursing interventions provided by psychiatric home visit nurses in Japan]. [http://dx.doi.org/10.5630/jans.28.1_41]

[14] Toyoshima Y, Otsubo M, Washio M. Seishin syogaiwo kaigosuru kazokuni taisuru homon kangoshi niyoru shien naiyono kento. Japan Acad Psychiatr Ment Heal Nurs 2013; 22(1): 78-84. [Examination of care by the visiting nurse to the family who cares for mental disorders].

[15] Solomon PL, Cavanaugh MM, Gelles RJ. Family violence among adults with severe mental illness: A neglected area of research. Trauma Violence Abuse 2005; 6(1): 40-54. [http://dx.doi.org/10.1177/1524838004272464] [PMID: 15574672]

[16] Hsu MC, Tu CH. Adult patients with schizophrenia using violence towards their parents: A phenomenological study of views and experiences of violence in parent-child dyads. J Adv Nurs 2014; 70(2): 336-49. [http://dx.doi.org/10.1111/jan.12194] [PMID: 23855926]

[17] Kageyama M, Yokoyama K, Nakamura Y, Kobayashi S, Fujii C. The coping process of Japanese parents who experience violence from adult children with schizophrenia. Arch Psychiatr Nurs 2018; 32(4): 549-54. [http://dx.doi.org/10.1016/j.apnu.2018.03.004] [PMID: 30029746]

[18] Home Office. Information for Local Areas on the change to the Definition of Domestic Violence and Abuse Produced in partnership with 2 Information for Local Areas on the change to the Definition of Domestic Violence and Abuse 2013.https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/142701/guide-on-definition-of-dv.pdf

[19] Kageyama M. 2016.http://ci.nii.ac.jp/ncid/BB22498992.bib

[20] Lincoln YS, Guba EG. Naturalistic inquiry Naturalistic inquiry. 1985. [http://dx.doi.org/10.1016/0147-1767(85)90062-8]

[21] Kayama M, Kido Y, Setoya N, *et al.* Community outreach for patients who have difficulties in maintaining contact with mental health services: Longitudinal retrospective study of the Japanese outreach model project. BMC Psychiatry 2014; 14: 311. [http://dx.doi.org/10.1186/s12888-014-0311-y] [PMID: 25403680]

[22] Reid WH. Killing family members: mental illness, victim risk, and culpability. J Psychiatr Pract 2004; 10(1): 68-71. [http://dx.doi.org/10.1097/00131746-200401000-00008] [PMID: 15334989]

[23] Reinharth J, Reynolds G, Dill C, Serper M. Cognitive predictors of violence in schizophrenia: A meta-analytic review. Schizophr Res Cogn 2014; 1(2): 101-11.http://linkinghub.elsevier.com/retrieve/pii/S2215001314000134 [Internet]. [http://dx.doi.org/10.1016/j.scog.2014.06.001]

[24] Kageyama M, Shirota Y, Toga M, Kawabata K, Taguchi A. [Professional mental health support provided by local government to families of people with schizophrenia in need of treatment]. [Nihon kōshū eisei zasshi] Japanese J public Heal [Internet] 2012; 59(4): 259-68.http://www.ncbi.nlm.nih.gov/pubmed/22816184

[25] Noda T, Sugiyama N, Sato M, *et al.* Influence of patient characteristics on duration of seclusion/restrain in acute psychiatric settings in Japan. Psychiatry Clin Neurosci 2013; 67(6): 405-11. [http://dx.doi.org/10.1111/pcn.12078] [PMID: 23941159]

[26] Kageyama M, Shirota Y, Toga M, Kawabata K, Taguchi A. [Professional mental health support provided by local government to families of people with schizophrenia in need of treatment]. Nippon Koshu Eisei Zasshi 2012; 59(4): 259-68. [Professional mental health support provided by local government to families of people with schizophrenia in need of treatment]. [PMID: 22816184]

[27] Kageyama M, Solomon P, Yokoyama K, Nakamura Y, Kobayashi S, Fujii C. Violence towards family caregivers by their relative with schizophrenia in Japan. Psychiatr Q 2018; 89(2): 329-40. [http://dx.doi.org/10.1007/s11126-017-9537-4] [PMID: 28971267]

[28] Oshima I, Mino Y, Inomata Y. How many long-stay schizophrenia patients can be discharged in Japan? Psychiatry Clin Neurosci 2007; 61(1): 71-7. [http://dx.doi.org/10.1111/j.1440-1819.2007.01613.x] [PMID: 17239042]

[29] Ando S, Yamaguchi S, Aoki Y, Thornicroft G. Review of mental-health-related stigma in Japan. Psychiatry Clin Neurosci 2013; 67(7): 471-82. [http://dx.doi.org/10.1111/pcn.12086] [PMID: 24118217]

[30] Griffiths KM, Nakane Y, Christensen H, Yoshioka K, Jorm AF, Nakane H. Stigma in response to mental disorders: A comparison of Australia and Japan. BMC Psychiatry 2006; 6: 21.

[http://dx.doi.org/10.1186/1471-244X-6-21] [PMID: 16716231]

[31] Zenkaren Daiyonkai zenkoku kazoku niizu chosa hokokusyo. Tokyo: Zenkaren 2006. Forth national survey for families

[32] Japantimes. Measures needed to address social recluse problem [Internet] 2019.https://www.japantimes.co.jp/opinion/2019/04/05/editorials/measures-needed-address-social-recluse-problem/#.XUEjGej7RaQ

[33] Kageyama M, Solomon P, Yokoyama K. Psychological Distress and Violence Towards Parents of Patients with Schizophrenia. Arch Psychiatr Nurs 2016; 30(5): 614-9. [Internet]. [http://dx.doi.org/10.1016/j.apnu.2016.02.003] [PMID: 27654247]

[34] Kageyama M, Solomon P. Post-traumatic stress disorder in parents of patients with schizophrenia following familial violence. PLoS One 2018; 13(6)e0198164 [http://dx.doi.org/10.1371/journal.pone.0198164] [PMID: 29856788]