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ORIGINAL PAPER

Commentary on "Predictors of Seclusion or Restraint Use Within Residential Treatment Centers for Children and Adolescents" by Green-Hennessy and Hennessy

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Abstract
In their 2015 study, Sharon Green-Hennessy and Kevin D. Hennessy addressed an important gap in the literature on seclusion and restraint use in child and adolescent residential treatment centers (RTCs). Their analysis revealed that several facility-level characteristics—such as facility size and ownership—predicted the use of seclusion/restraint in child/adolescent RTCs. The authors also examined patient demographic variables that were significant predictors of seclusion/restraint in prior research on individual patients within facilities. However, Green-Hennessy and Hennessy did not find any relationship between these demographic variables and seclusion/restraint. In this commentary I argue that the null relationship between patient demographics and seclusion/restraint was a result of an ecological fallacy. Rather than attempting to use aggregate patient data to infer individual-level processes, this patient data should be used to study aggregate effects. I demonstrate that by re-conceptualizing these patient demographics as indicative of *facility characteristics*, rather than *patient characteristics*, new information can be gleaned about the types of facilities that use seclusion/restraint. The arguments presented here have broader implications for future research in this field that relies on aggregate patient data.

Keywords Residential treatment centers · Seclusion · Restraint · Ecological fallacy · Cross-level bias

Introduction

In their 2015 study "Predictors of Seclusion or Restraint Use Within Residential Treatment Centers for Children and Adolescents" Sharon Green-Hennessy and Kevin D. Hennessy [1] examine predictors of seclusion and restraint among American licensed or accredited residential treatment centers (RTCs) for children and adolescents. The paper addresses an important

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gap in the literature on the use of seclusion/restraint in child/adolescent RTCs, by examining both patient demographics and facility level variables as predictors of seclusion/restraint [1, 2].

Green-Hennessy and Hennessy use the 2010 National Mental Health Services Survey (N-HMSS), a nationally representative survey of all facilities in the Substance Abuse and Mental Health Services Administration's database [3] and find that a number of facility-level variables such as size, private ownership, and public funding predict the use of restraint while patient demographics such as percent male, percent minority and percent involuntarily admitted do not. The latter finding appears to contradict prior literature on the use of seclusion/restraint on children/adolescents, which suggests that male patients, patients from marginalized ethnic/racial groups, and involuntarily admitted patients are all much *more* likely to experience seclusion/restraint [1, 4–8]. In this commentary I argue though that these findings do not actually contradict prior evidence. Rather, histograms of the patient demographics suggest that conceptualizing patient demographics as indicative of *patient characteristics* leads to an ecological fallacy. By changing the conceptual model to focus on *facility characteristics* we can both avoid an ecological fallacy, and uncover important new information about the types of facilities that employ seclusion and restraint.

Re-conceptualizing 'Patient Characteristics' to Predict Facility Level Outcomes

There are two broad ways to conceptualize the relationship between patient demographics—that is statistics on the patients in a facility—and the use of seclusion/restraint at the facility level. These are summarized in Fig. 1. Green-Hennessy and Hennessy used the first conceptualization, which theorizes that effects of patient demographics represent cumulative effects of individual *patient characteristics*. At first glance, this conceptualization seems to make sufficient analytical sense. If the odds of a male patient being secluded/restrained are 20% higher than for a female patient, then the more male patients in a facility the higher the chance

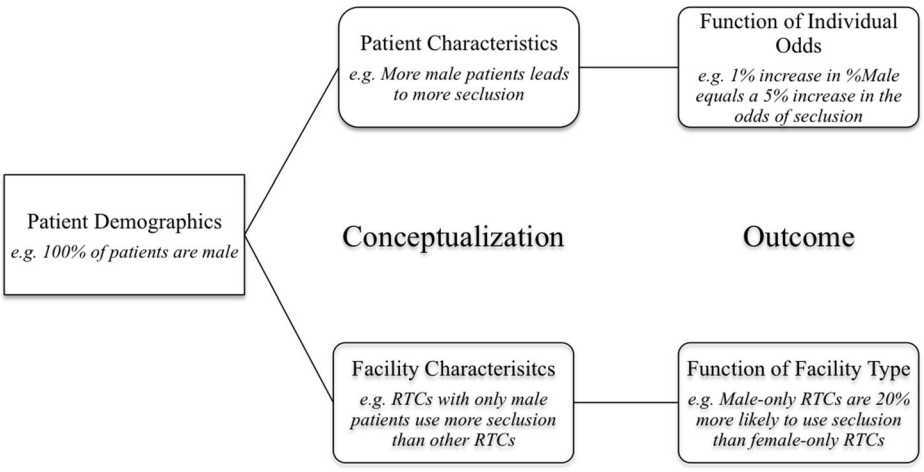

Fig. 1 Diagram of the two different conceptualizations of patient demographics and the outcomes associated with each

that facility uses seclusion/restraint in a given time period. However, in order for this conceptual model to be valid, certain conditions must be met.

Using aggregate level data to make inferences about individual-level phenomenon assumes that the relationship between the individual-level phenomenon and the outcome holds at the aggregate level [9, 10]. This assumption is visualized in Eq. 1—adapted from Firebaugh's $\overline{X}$-*rule* [9]—where Y is the dependent variable, X is the individual level independent variable, and $\overline{X}$ represents the aggregate-level independent variable. The relationship between the dependent variable and the independent variable is only bias-free when X does not have an aggregate effect on Y—in other words, when $\beta_2 = 0$. If this assumption is violated it results in cross-level bias [9, 10], otherwise known as the ecological fallacy.

$$Y = \propto + \beta_1 X + \beta_2 \overline{X} + \epsilon \tag{1}$$

Applied to this case, the $\overline{X}$-rule suggests that aggregate level effects may explain the dissonance between Green-Hennessy and Hennessy's results and prior research on individual predictors of restraint/seclusion. Figures 2, 3, and 4 display histograms for the three continuous, demographic variables. The histograms suggest that rather than being normally distributed, patients are grouped into certain types of facilities. For example, Fig. 2 reveals that almost 30% of RTCs in the analytic sample had only male patients, roughly 12% had only female patients, and the rest primarily fell between 20-80% male. This means there are essentially two distinct types of RTCs: mixed-sex and non-mixed facilities.

It is easy to imagine how these types of facilities may have an effect on the odds of seclusion/restraint. In fact, even if the outcome was changed to frequency of seclusion/restraint, the type of facility could still have an aggregate effect on the odds of seclusion/restraint. Prior studies comparing the odds of seclusion/restraint between male and female patients were conducted in mixed facilities [6, 8], but all-male or all-female facilities may implement different policies or procedures than mixed facilities.

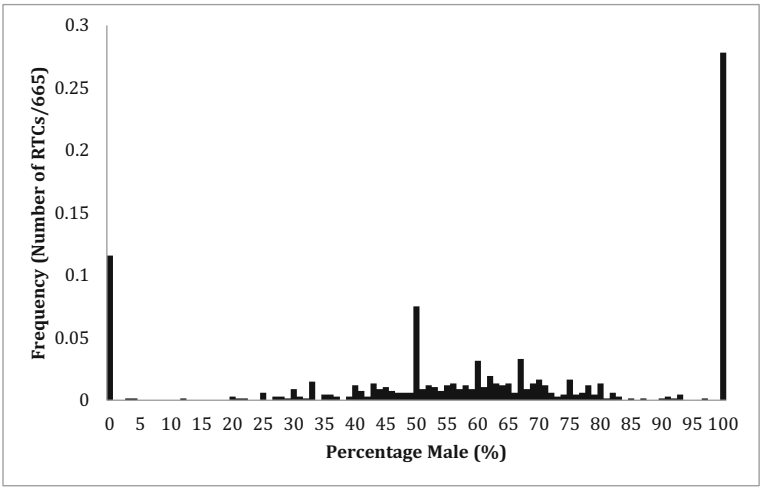

Fig. 2 Histogram of percentage male (N=665)

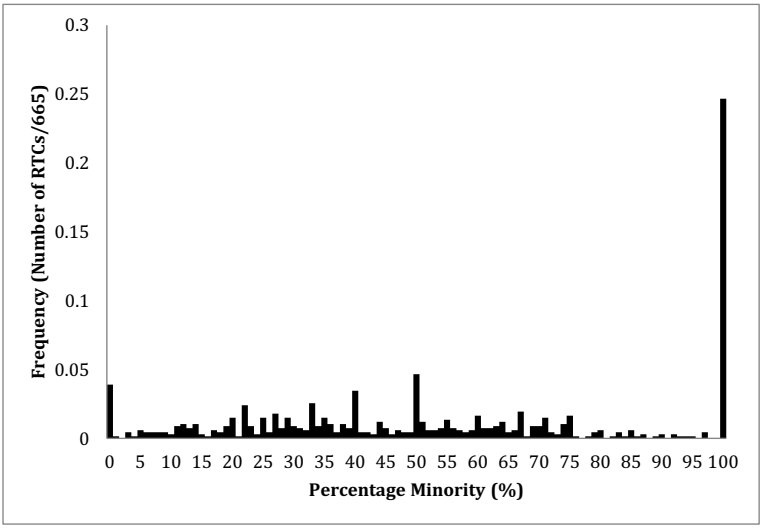

Fig. 3 Histogram of percentage minority (N=665)

In order to address this ecological inference problem, I propose adopting the second conceptual model illustrated in Fig. 1. In this model, patient demographics represent facility characteristics rather than patient characteristics. In other words, these demographics tell us information about facilities, same as the primary source of funding does, and not about individual patients. By operationalizing the patient demographics into categorical variables we can compare the odds of using seclusion/restraint between different types of facilities—essentially investigating the aggregate effects of patient demographics instead of making ecological inferences.

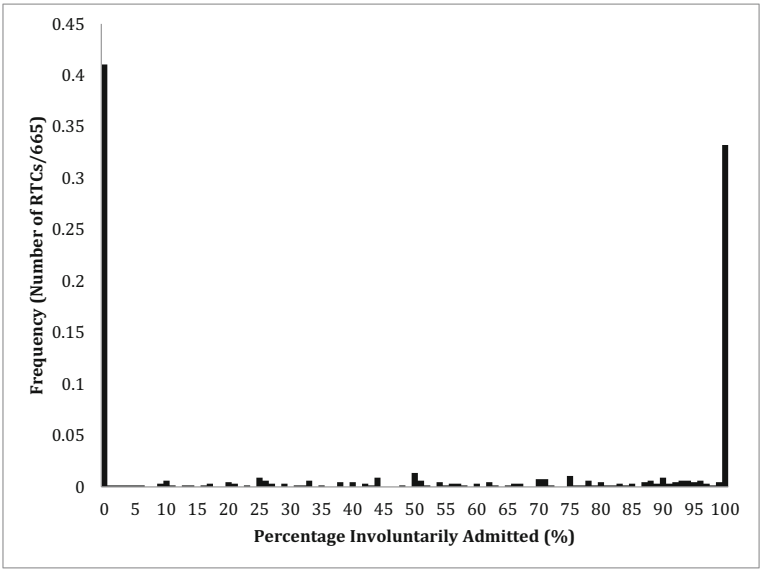

Fig. 4 Histogram of percentage involuntarily admitted (N=665)

Operationalizing Patient Demographics as 'Facility Characteristics'

In the following analysis, I have divided each of the demographic variables into three categories based on the histograms in Figs. 2, 3 and 4. Given the large portion of RTCs with either all or no male clients, the percent male variable was recoded into exclusively male, exclusively female, and mixed facilities. Similarly, percent involuntarily admitted was recoded into all involuntary, no involuntary, and mixed. Finally, percent minority was recoded into all minority, majority minority, and majority White. I performed the same logistic regression as Green-Hennessy and Hennessy—with the same analytic sample (N=665) and variables—except using categorical demographic variables. Descriptive statistics for the variables included in this analysis are displayed in Table 1. Table 2 displays a side-by-side comparison of the results from the revised model and Green-Hennessy and Hennessy's results. The odds ratios for the patient demographic variables in the revised model are also visualized separately in Fig. 5.

The most striking result from the revised model is that RTCs with all or no involuntarily admitted patients were significantly less likely to report using seclusion/restraint within the last

Table 1 Descriptive statistics for the analytic sample (N=665)

Variable	Number of RTCs	Percentage of sample (Out of 665 Total)
Used seclusion or restraint in past 12 months		
Yes (Outcome)	545	81.95
No	120	18.05
Number of male/female patients		
Exclusively male	185	27.82
Exclusively female	77	11.58
Mixed facility (Reference)	403	60.60
Number of minority patients		
All minority	164	24.66
Majority minority	210	31.58
Majority white (Reference)	291	43.76
Number of involuntary patients		
No involuntary	273	41.05
All involuntary	221	33.23
Mixed facility (Reference)	171	25.71
Offers psychotropic medication		
Yes	581	87.37
No (Reference)	84	12.63
Offers SED program		
Yes	587	88.27
No (Reference)	78	11.73
Ownership		
Private for-profit	105	15.79
Private non-profit	542	81.50
Public/other (Reference)	18	2.71
Size of facility		
More than 36 Beds	272	40.90
13 to 36 Beds	229	34.44
12 or less beds (Reference)	164	24.66
Single source providing majority of funding		
Private	33	4.96
State	268	40.30
Federal	229	34.44
None (Reference)	135	20.30

Table 2 Comparison of Green-Hennessy and Hennessy's logistic regression results to results obtained after recoding the continuous variables into categorical variables to reflect facility characteristics (revised model) [1]

	Odds Ratio of RTC using seclusion/restraint in past twelve months	
Variables	Green-Hennessy & Hennessy [1]	Revised model
Proportion Male/Female		
% Male Clients	1.00 (0.99-1.00)	
All Female Facility (Reference=Mixed Facility)		0.89 (0.44-1.80)
All Male Facility (Reference=Mixed Facility)		0.67 (0.39-1.14)
Proportion White/Minority Clients		
% Minority	1.00 (0.99-1.00)	
All Minority Residents (Reference=All White Residents)		1.25 (0.69-2.25)
Majority Minority Residents (Reference=All White Residents)		0.84 (0.49-1.44)
Proportion Involuntarily Committed		
% Involuntary Committed	1.00 (0.99-1.00)	
No Involuntarily Admitted Clients (Reference=Mixed Facility)		0.46 (0.24-0.89)
All Involuntarily Admitted Clients (Reference=Mixed Facility)		0.38 (0.19-0.75)
Provides Psychotropic (Reference=Does Not Provide)	2.65 (1.51-4.88)	2.73 (1.54-4.83)
Provides SED Program (Reference=Does Not Provide)	2.52 (1.38-4.60)	2.42 (1.32-4.45)
Ownership		
Private For-Profit (Reference=state owned)	4.68 (1.24-17.60)	4.87 (1.25-18.9)
Private Non-Profit (Reference=state owned)	4.33 (1.37-13.67)	4.59 (1.42-14.82)
Size of Facility		
13-36 Beds (Reference=12 or less)	3.96 (2.31-6.80)	3.69 (2.11-6.44)
More than 36 Beds (Reference=12 or less)	8.24 (4.42-15.39)	7.29 (3.76-14.14)
Primary Funding Source		
Federal (Reference=No Primary Funding Source)	2.28 (1.20-4.33)	2.55 (1.32-4.94)
State (Reference=No Major Funding Source)	2.40 (1.32-4.38)	2.90 (1.56-5.42)
Private (Reference=No Major Funding Source)	0.21 (0.08-0.58)	0.21 (0.08-0.58)

twelve months. This differs from Green-Hennessy and Hennessy's analysis, in which involuntary admittance was not significantly associated with seclusion/restraint [1]. These contrasting results illustrate the importance of choosing a conceptual and analytic model that properly reflects the nature of both the outcome and predictors. Conceptualizing percent involuntary as indicative of patient characteristics lead to cross-level bias. The results from the revised analysis demonstrate a clear aggregate level effect of involuntary admittance on the use of

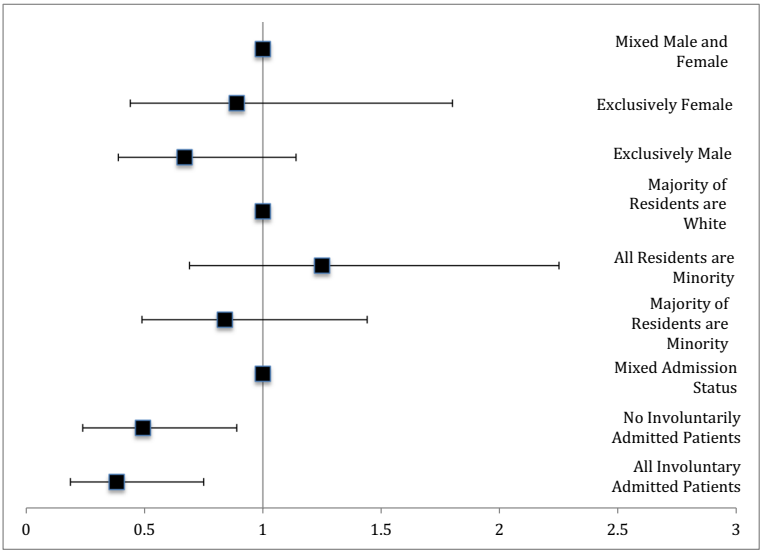

Fig. 5 Odds ratios for patient demographic variables

seclusion/restraint, different from the individual level effect reported in the literature [4, 5]. Facilities with all or no involuntarily admitted patients seem to possess an attribute(s), which—when controlling for other facility level factors such as funding and ownership—is associated with lower odds of seclusion/restraint. The next step should be to try to uncover the characteristic(s) of these facilities that make them less likely to use seclusion/restraint. In other words, seeking out more covariates that could help identify what is special about these types of facilities.

Even after changing the operationalization of percent male and percent minority, these two variables do not show significant associations with seclusion and restraint. However, it is important to re-emphasize that this result should not be understood as contradicting the literature. Similarly, the results on involuntary admittance should not be seen as contradicting previous studies examining patient level predictors of seclusion/restraint that found involuntary admit status was positively associated with seclusion/restraint. In this situation, the patient demographic variables were acting as facility level predictors of seclusion/restraint, not patient level, so rather than contradicting previous literature they instead extend our knowledge about seclusion/restraint in new directions.

For example, we now know that facilities that have primarily White patients are not more likely to use restraint than facilities where a majority of patients represent a marginalized racial/ethnic group. This does not mean that patient race/ethnicity is not associated with the frequency of use of seclusion/restraint—in fact the literature would suggest that within facilities that *do* use restraint, race and ethnicity are important predictors of the frequency of seclusion [4–6]. However, this result does mean that there is not something inherent in facilities with a majority of White patients that make them more likely to eschew any use of seclusion/restraint than other facilities—which is new and positive information. Further research could certainly break down this analysis by racial/ethnic group, or examine other covariates that may mediate the relationship between race/ethnicity and the use of seclusion/restraint—such as the state or region a facility is located in.

Conclusion

Overall, the evidence from the revised model supports the *facility characteristics* conceptual framework. Not only did this framework allow for new findings through a revised analytic model, but it also avoided cross-level bias. Rather than viewing the results for the patient demographics as contradicting prior literature, this framework allows for the extraction of new information about different types of facilities. We now know that facilities with only male or only female patients do not have significantly different odds of using seclusion/restraint than mixed-sex facilities. Similarly, facilities with a majority of White patients do not have different odds of using seclusion/restraint than facilities with a majority of patients from a marginalized racial or ethnic group. Meanwhile, facilities with all or no involuntarily admitted patients are less likely to report using seclusion/restraint, suggesting these types of facilities may have unique characteristics that could be researched further.

The challenges discussed in this paper relate to much broader methodological issues. Researchers studying health at the institutional-level are frequently confronted with the challenge of drawing inferences between the aggregate and individual levels [11, 12]. Data permitting, these issues can sometimes be surmounted with multilevel modeling [13]. However, in this case—as in many others—individuals were not identifiable in the dataset. In these circumstances, the solution lies in choosing the proper conceptual model. As I have demonstrated in this commentary, even when aggregate data cannot provide information on individual-level processes, it can still provide important information on aggregate-level effects.

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Compliance With Ethical Standards

Conflict of Interest The authors declare no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

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