

# Conjoint Community Resiliency Assessment Measure-28/10 Items (CCRAM28 and CCRAM10): A Self-report Tool for Assessing Community Resilience

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**Abstract** Community resilience is used to describe a community's ability to deal with crises or disruptions. The Conjoint Community Resiliency Assessment Measure (CCRAM) was developed in order to attain an integrated, multidimensional instrument for the measurement of community resiliency. The tool was developed using an inductive, exploratory, sequential mixed methods design. The objective of the present study was to portray and evaluate the CCRAM's psychometric features. A large community sample ( $N = 1,052$ ) were assessed by the CCRAM tool, and the data was subjected to exploratory and confirmatory factor analysis. A Five factor model (21 items) was obtained, explaining 67.67 % of the variance. This scale was later reduced to 10-item brief instrument.

Both scales showed good internal consistency coefficients ( $\alpha = .92$  and  $\alpha = .85$  respectively), and acceptable fit indices to the data. Seven additional items correspond to information requested by leaders, forming the CCRAM28. The CCRAM has been shown to be an acceptable practical tool for assessing community resilience. Both internal and external validity have been demonstrated, as all factors obtained in the factor analytical process, were tightly linked to previous literature on community resilience. The CCRAM facilitates the estimation of an overall community resiliency score but furthermore, it detects the strength of five important constructs of community function following disaster: Leadership, Collective Efficacy, Preparedness, Place Attachment and Social Trust. Consequently, the CCRAM can serve as an aid for community leaders to assess, monitor, and focus actions to enhance and restore community resilience for crisis situations.

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## Introduction

The term 'Community Resilience' yields more than 28.5 million results in popular search engines, reflecting its' relevance in various aspects of human social life. Being a subject for study in areas such as disaster risk reduction (Joerin et al. 2012; Sherrieb et al. 2012), environmental change (Cutter et al. 2008), developmental psychology and mental health (Ungar 2011), public health (Castleden et al. 2011; Poortinga 2011) and community psychology (Kimhi and Shamai 2004)—Community resilience was defined by many researchers over the last two decades (Castleden et al. 2011; Norris et al. 2008) generating various definitions. In

the present study we refer to Community resilience as the community's ability to withstand crises or disruptions. This view corresponds to it's being a multi-dimensional concept, used by many fields at many phases, as it commonly transpires in the conceptual intersection between economic, social and environmental capital of societies under crises. The complex nature of evaluating and defining community resilience is evident in current literature (Castleden et al. 2011). Over the years, different research teams put effort in the identification of positive resources within the community that will predict resilient response in the face of adversity. These include theoretical models (e.g. Chandra et al. 2010; Cutter et al. 2008; Norris et al. 2008) on the one hand, measurable indicators of these models on the other (Cutter et al. 2010; Sherrieb et al. 2010) and field-tested questionnaires for assessing community resilience such as the CART and others (Pfefferbaum et al. 2013; Sherrieb et al. 2012). Cutter et al. (2008) presented a place-based model for understanding community resilience to natural disasters. The model includes several types of resilience that may be attributed to the community and include ecological, social, economic, institutional, infrastructure and community competence dimensions. Elements of community resilience are both physical and perceptual (Ungar 2011). The physical components include infrastructure, economic resources, availability and access to services. Other elements are associated with the individual's perception of his or her community. For instance, social trust, leadership and previous experience of the community member with crisis. The elements that are highly tied to community's ability to overcome emergency situation include social capital (Putnam 1995; Adger 2003), social cohesion (Forrest and Kearns 2001; Rolfe 2006), collective efficacy (Chandra et al. 2010), social support (Norris et al. 2008), sense of trust (Stewart et al. 2009) and attachment to place (Mishra et al. 2010). These community elements are interconnected and together form unique community structure. Nevertheless, Cutter et al. (2008) state that even though there are various approaches for describing and evaluating resilience, "none of these metaphorical and theoretical models have progressed to the operational stages where they effectively measure or monitor resilience at the local level" (p. 604). Cutter et al. (2010) attempted to measure the model using baseline resilience indicators for communities derived from publically available data sources. Despite these attempts, the task of measuring and monitoring community resilience remained challenging. This is in part due to the diversity of both the interpretation of the components of resilience and the methods for its' assessment, stemming from the complexity and the multidisciplinary nature of the issues at hand. Sherrieb et al. (2012) noted the lack of a metric that provides a general assessment of a community's anticipated resilience capacity.

The Conjoint Community Resiliency Assessment Measure (CCRAM) therefore took a novel and fresh stand. Its' basic assumption is that at this stage of development in the field of Community Resiliency measurement, in order to build a tool that will serve as a reliable measure of the complex multidimensional concept, one should take multiple viewpoints and perspectives. The authors therefore suggested a process whereby the leading existing measurements of community resilience in the field will be considered for inclusion in a multidisciplinary tool. Developers of existing tool were invited to present the theory that guided them along the development of their tool and the process of their formation. Based on these materials, together with end-users and other stakeholders, the aim was to develop a novel, broader, encompassing tool. This approach facilitated the creation of the CCRAM, a comprehensive tool that included aspects beyond the different measures and the uniqueness of each of the original instruments.

The tool was developed using an inductive, exploratory, sequential mixed methods design (Castro et al. 2010; Creswell and Clark 2007). These methods are based on qualitative and quantitative research methods (Johnson et al. 2007), and are suggested to provide much more information that will generate practical applications. Utilization of such mixed methods offers comprehensive investigation of the topic, and is suitable for topics that require multiple viewpoints in order to obtain the full picture. Members of the conjoint collaboration were involved in the process of tool development, which lasted over 2 years and had three main phases which included (1) Contextualization: based on a literature review, key informant interviews, semi-structured interviews with researchers, meetings with content experts and academic discussions the team investigated practical and theoretical definitions of community resilience and studied existing instruments and the theories that they emerged from, (2) Item generation: using analysis of existent measures, and subsequent structured and scientifically valid consensus reaching methods for content validity (e.g. Nominal Group Techniques and Delphi process; Jones and Hunter 1995) the team sorted the extensive question bank and narrowed the tool into a manageable number of items, while maintaining the core of each original tool and the theoretical constructs behind it. (3) Instrument validation: the final questionnaire was examined and received feedback from original instrument owners. Subsequently a pilot study was conducted to verify the internal and external validity of the tool. The present study presents data from this pilot investigation. The CCRAM tool assesses the attitudes and perceptions of community members about various aspects in their community whereas theoretical models provide the framework. Cohen et al. (2013) suggest that CCRAM is a

potential provider of information for authorities and decision makers. Recently, it was also shown to be associated with some demographic variables as well as with national resilience (Kimhi et al. 2013). The objective of the present study was to portray and evaluate the CCRAM's psychometric features. The psychometric characteristics presented support the factor structure and enhances the CCRAM's credibility as an acceptable instrument for the assessment of community resilience.

## Method

### Participants

Participants in the study included 1,052 adults aged 18–86 years ( $M = 44.65$ ,  $SD = 15.05$  years) who volunteered to take part in the study. Participants were drawn from 15 small to medium size (up to 20,000 inhabitants) communities throughout Israel during 2011–2012. Two methods of data collection were used to gather data from three types of communities. These included face to face in door to door surveys at randomly selected addresses, an electronic questionnaires distributed with a complete electronic mailing list using web-based survey ([www.qualtrics.com](http://www.qualtrics.com)). Types of community included three small urban communities and local authorities ( $n = 490$ ) (including local or regional councils), eight villages and community settlements ( $n = 362$ ) and four collective communities ( $n = 200$ ) (also called Kibbutz, which is a small self-governed commune). These settlements are different from each other by type of governance, size of community and form of organization (e.g. co-operative, communal organization) and other characteristics (see further, Rosen and Razin 2008). Response rates varied between settlement types with the minimum of 40 % in the small urban communities and up to 95 % (in one of collective communities). Sampling ratio was 13 % of households in small urban communities and local authorities, 20 % of households in villages and community settlements and 40 % of households in collective communities.

### Measures

**Background information.** A background questionnaire containing demographic (e.g. age, gender, family status, income, religiosity) and emergency related information (e.g. physical preparedness, belonging to local community emergency response team (CERT), history of exposure to emergency events) was administered to participants.

**The Conjoint Community Resiliency Assessment Measure (CCRAM) tool** was developed in an iterative process described above (Aharonson-Daniel et al., under review).

Thirty-three items from the original process had remained in the questionnaire after the initial factor analysis and were thus included in the current examination. These items represented perceptions regarding several aspects of the community (e.g. “My town is organized for emergency situations” or “The residents of my town are greatly involved in what is happening in the community.”), which participants were asked to rate on a 5-point Likert scale (1-Disagree, 5-Very Strongly Agree). No reverse items exist in the CCRAM, and it takes approximately 10 min to complete. The CCRAM version which was used in the present study was the original Hebrew version of the scale. The English items presented in this paper are the English version of the CCRAM, which was back-translated to ensure content preservation.

**Perceived individual and community resilience.** In order to establish preliminary evidence for divergent and concurrent validity for the CCRAM, two single-item questions were constructed, each intended to assess the perceived ability to quickly return to routine after an emergency event—either as an individual or as a community. Participants were presented with the sentence “Resilience is defined as the ability to quickly return to routine after an emergency event. To what extent to you agree with the following sentences.” Next, they were asked to rate the item “My personal level of resilience is high” and the item “My town's level of resilience is high” on a 5-point scale with the same labels used above. Recently, Leykin (2013) showed that the single item assessing individual resilience was highly and significantly correlated ( $r = .61$ ) with the 10-item Connor-Davidson Resilience Scale (Campbell-Sills and Stein 2007), a valid tool which measures the ability to cope with adversity.

### Procedure

#### Statistical Analysis

Statistical Package for Social Sciences (SPSS; version 19) was used to perform all data analysis. AMOS 18.0 was used to perform confirmatory factor analysis (CFA). The total sample ( $N = 1,052$ ) was randomly split into two halves, yielding equivalent samples ( $n = 526$  each), that were not statistically different from each other in terms of gender, age, family status, type of community in which they live and other key background demographic data. For the first half of the sample, Exploratory Factor Analysis (EFA) was performed, and on the other, CFA was applied to test the resulted factor structure obtained in the EFA. Such split-sample strategy was previously recommended by Wegener and Fabrigar (2000) and was utilized in community studies (e.g. Proescholdbell et al. 2006).

### Exploratory Factor Analysis

Principal components analysis was used as the method of extraction, with Varimax rotation. All factors with eigenvalues greater than 1.0 were retained and the Scree Test was used to verify the total number of factors to retain (Costello and Osborne 2005). Items that had double loading (defined as difference smaller than .15 in the loadings) were deleted, and items that had similar meaning (prototypic items and were correlated with each other above  $r = .70$ ) were removed in order to shorten the questionnaire. After each item omission, the analysis was rerun and the rotated structure examined. Iterations were stopped after no double loadings were evident. As stated above, to verify the factor structure obtained, CFA was conducted on the second half of the sample.

### Confirmatory Factor Analysis and Construction of a Brief Version

Maximum-Likelihood CFA was used to test the fit of several models of community resilience. Models' goodness-of-fit was assessed using several indices and based on generally accepted thresholds. Model Chi Square ( $\chi^2$ ) statistic along with its degrees of freedom are reported as previously recommended (Kline 2005; Hayduk et al. 2007), due to its' sensitivity to sample size, additional fit indices are presented. The Comparative Fit Index (CFI; Bentler 1990) evaluates the fit of a hypothetical model in relation to a more restricted (i.e. nested) baseline model, root mean square error of approximation (RMSEA; (Browne and Cudeck 1993) is another popular measure of goodness-of-fit, and Akaike Information Criterion (AIC; 1974) is a comparative measure of fit, with the model with lowest AIC having best fitting model. According to Hu and Bentler (1999), threshold values indicating model fit are  $>.95$  for CFI,  $<.05$  (or  $.06$ ) for RMSEA. Initially, a one-dimensional model was examined, suggesting that Community Resiliency is a unified construct, representing a general perceived competence of the community. Next, the model obtained in the Exploratory Factor Analysis was examined on the second half of the sample. After correction with five error covariance, the final model was obtained. In order to construct a shorter, brief assessment tool of community resilience, for practical purposes, an attempt was made to reduce the number of items while maintaining the validity of the tool. Items for the brief assessment tool were chosen according to factor loadings (at least one item loaded in the top two factor loadings) and content representation (items with similar content description were avoided) (Smith et al. 2012). The shorter assessment measure was subjected to the same examination described above, initially with a single factor model and

subsequently with similar factor structure obtained in the extended version.

### Results

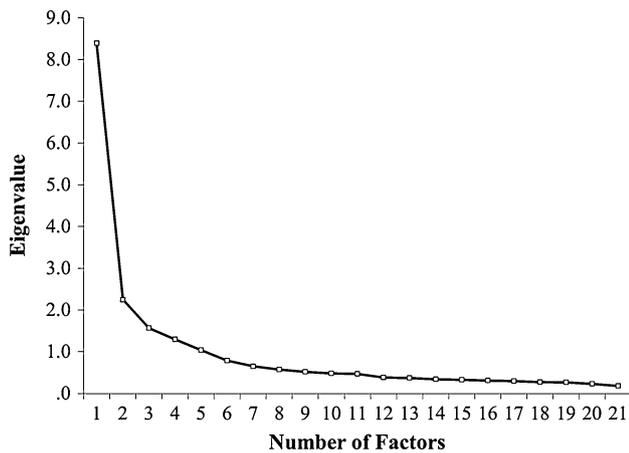
Participants in this study included 1,052 adults aged 18–86 ( $M = 44.65$ ,  $SD = 15.05$ ) years. Table 1 presents descriptive statistics of the study population characteristics.

The type of community was not found to have a significant relationship with gender and community

**Table 1** Descriptive statistics of the study's sample (N = 1,052)

|                                    | n   | %     |
|------------------------------------|-----|-------|
| Type of community                  |     |       |
| Midsize town and local authorities | 490 | 46.6  |
| Villages and community settlements | 362 | 34.4  |
| Collective communities             | 200 | 19.00 |
| Gender                             |     |       |
| Female                             | 580 | 55.3  |
| Male                               | 468 | 44.7  |
| Family status                      |     |       |
| Live alone                         | 257 | 24.7  |
| Live in permanent relationship     | 783 | 75.3  |
| Education                          |     |       |
| Elementary/high school education   | 333 | 32.1  |
| Professional education             | 230 | 21.9  |
| Academic education                 | 474 | 45.7  |
| Employment                         |     |       |
| Unemployed                         | 170 | 16.2  |
| Employed                           | 882 | 83.8  |
| Income                             |     |       |
| Below average                      | 329 | 31.7  |
| Average                            | 360 | 34.7  |
| Above average                      | 348 | 33.6  |
| Age                                |     |       |
| 18–25                              | 98  | 9.4   |
| 26–35                              | 245 | 23.5  |
| 36–45                              | 241 | 23.1  |
| 46–55                              | 193 | 18.5  |
| 56–65                              | 176 | 16.9  |
| 66+                                | 91  | 8.7   |
| Community volunteering             |     |       |
| No                                 | 741 | 71.6  |
| Yes                                | 134 | 27.9  |
| CERT <sup>a</sup> volunteering     |     |       |
| No                                 | 905 | 87.4  |
| Yes                                | 131 | 12.6  |

n Varies and do not end up to N = 1,052 due to missing data  
CERT community emergency response team



**Fig. 1** Scree test plot for exploratory factor analysis (EFA) of the conjoint community

volunteering,  $\chi^2$  (df = 2) = 1.28, n.s, but it had a significant relationship with age (collective communities had significantly older members than the two other community types),  $\chi^2$  (df = 10) = 52.77,  $p < .001$ , family status (more permanent relationships among villages and community settlements members),  $\chi^2$  (df = 2) = 39.59,  $p < .001$ , education (greater portion of non-academic degree in small urban communities),  $\chi^2$  (df = 4) = 116.12,  $p < .001$ , employment status (more reported employment status among members in villages and community settlements),  $\chi^2$  (df = 2) = 15.44,  $p < .001$ , income (participants from villages and community settlements had higher income),  $\chi^2$  (df = 4) = 134.69,  $p < .001$  and CERT volunteering (less volunteering among members of small urban communities),  $\chi^2$  (df = 2) = 11.52,  $p < .01$ .

**Table 2** Summary of exploratory factor analysis results for community resilience assessment measure using Varimax rotation (n = 526)

| Item content  | Factor loadings |            |            |            |            |
|---|-----------------|------------|------------|------------|------------|
|   | 1               | 2          | 3          | 4          | 5          |
| 6. I have faith in the decision makers in the municipal authority (regional council)  | <b>.87</b>      | .14        | .12        | .05        | .11        |
| 1. The municipal authority (regional council) of my town functions well   | <b>.80</b>      | .16        | .12        | .08        | .10        |
| 19. The municipal authority (regional council) provides its services in fairness  | <b>.81</b>      | .24        | .21        | .08        | .01        |
| 15. I have faith in the ability of the elected/nominated head of my town to lead the transit from routine to emergency management of the town | <b>.77</b>      | .21        | .25        | .07        | .15        |
| 21. The residents of my town will continue to receive municipal services during an emergency situation  | <b>.74</b>      | .15        | .28        | .18        | .04        |
| 11. In my town, appropriate attention is given to the needs of children   | <b>.65</b>      | .18        | .07        | .20        | .31        |
| 7. I can depend on people in my town to come to my assistance in a crisis   | .16             | <b>.75</b> | -.03       | .13        | .20        |
| 2. There is mutual assistance and concern for others in my town   | .27             | <b>.65</b> | .30        | .27        | .03        |
| 16. I believe in the ability of my community to overcome an emergency situation   | .42             | <b>.64</b> | .28        | .14        | .03        |
| 12. There are people in my town who can assist in coping with an emergency  | .18             | <b>.71</b> | .01        | .19        | .31        |
| 20. The residents of my town are greatly involved in what is happening in the community   | .37             | <b>.46</b> | .17        | .16        | .36        |
| 17. My family and I are acquainted with the emergency system of my town (to be activated in times of emergency)                               | .14             | .22        | <b>.82</b> | .10        | -.01       |
| 8. The residents of my town are acquainted with their role is in an emergency situation   | .16             | .24        | <b>.82</b> | .09        | .10        |
| 3. My town is organized for emergency situations  | .41             | .07        | <b>.70</b> | .13        | .08        |
| 13. In my town, there are sufficient public protection facilities (such as shelters)  | .21             | -.19       | <b>.57</b> | .07        | .19        |
| 18. I would be sorry to leave the town where I live   | .17             | .03        | -.06       | <b>.82</b> | -.01       |
| 9. I feel a sense of belonging to my town   | .14             | .27        | .22        | <b>.70</b> | .22        |
| 4. I am proud to tell others where I live   | -.01            | .11        | .33        | <b>.67</b> | .10        |
| 14. I remain in this town for ideological reasons   | .19             | .35        | .03        | <b>.65</b> | .18        |
| 5. The relations between the various groups in my town are good   | .16             | .16        | .15        | .11        | <b>.87</b> |
| 10. There is trust among the residents of my town   | .15             | .28        | .09        | .17        | <b>.83</b> |
| Eigenvalues   | 8.21            | 2.11       | 1.70       | 1.30       | 1.08       |
| % of variance   | 39.09           | 10.06      | 8.08       | 6.17       | 5.14       |

KMO = .909,  $\chi^2$  = 6,097.537, df = 210,  $p < .001$ ; 1—leadership; 2—collective efficacy; 3—preparedness; 4—place attachment; 5—social trust; CCRAM-10 is composed of items 1–10. Bold values indicate high loading to the factor

### Exploratory Factor Analysis (EFA)

The process began with 33 items. After several runs and deletion of items with similar meaning and high correlation between them, the analysis resulted in 21 items remaining in the questionnaire yielding five factors, explaining 68.54 % of the variance. Scree test (Fig. 1) shows five points remaining above the flattened line of the eigenvalues.

### Community Resiliency Assessment Measure

The CCRAM factor structure is composed of: (1) *Leadership* factor ( $\alpha = .91$ ), composed of six items representing general faith in decision makers, specific faith in local leaders, perception of fairness in the way local authority provides services, and functioning of the community. (2) *Collective Efficacy* factor ( $\alpha = .83$ ), composed of five items representing collective efficacy, support, involvement in the community and mutual assistance. (3) *Preparedness* factor ( $\alpha = .80$ ) is composed of four items, representing family and community acquaintance with emergency situations, and view of the town's preparedness for emergency situations. (4) *Place attachment* factor ( $\alpha = .75$ ) is composed of four items, representing emotional attachment to the community, sense of belonging, pride in community and ideological identification with the community. The last factor is *Social trust* ( $\alpha = .85$ ), composed of two items representing trust and quality of relationship between members in the community. Table 2 summarizes the final EFA using 21 items. Seven items that were excluded from the factor analysis and are not used for calculation are still included in the questionnaire and available for interpretation. These items refer to perception of service continuity (health and transportation), quality of information received during emergency (i.e. communication), intentions to leave community during crisis—information that leaders found useful for running their community during crises. The 21 items resulting from the factor analysis joined with these seven items, form the CCRAM28.

### Confirmatory Factor Analysis

Confirmatory factor analysis (See Table 3) indicated that the 5 factor model with corrected error covariance showed a marginal, but acceptable fit to the data ( $\chi^2 = 593.6$ ,  $df = 174$ ;  $RMSEA = .068$ ;  $CFI = .935$ ;  $AIC = 707.6$ ). However, the five factor model using the short, 10-item questionnaire, yielded excellent fit to the data ( $\chi^2 = 59.85$ ,  $df = 25$ ;  $RMSEA = .051$ ;  $CFI = .985$ ;  $AIC = 119.81$ ).

### Correlational Analysis

A zero-order correlational analysis, using Pearson product moment was conducted in order to examine the correlations between factors of the CCRAM. These are presented in Table 4. The correlational analysis resulted in low to moderate significant correlations among all factors, with correlations low as  $r = .34$  for social trust and preparedness, and  $r = .58$  for collective efficacy and leadership. Factors' correlation to total CCRAM score ranged from  $r = .61$  for social trust and  $r = .84$  for leadership.

### Impact of Background Variables

The examination of possible significant associations between background variables and composite CCRAM score yielded in the following results: (1) belonging to local CERT,  $r(1,036) = .15$ ,  $p < .001$ , age,  $r(1,044) = .13$ ,  $p < .001$ , number of years living in the community,  $r(1,034) = .16$ ,  $p < .001$ , community volunteering,  $r(1,036) = .15$ ,  $p < .001$ , level of religiosity,  $r(1,026) = .09$ ,  $p < .01$ , and having permanent relationship,  $r(1,026) = .09$ ,  $p < .01$ , had all significant but weak associations with perceived community resilience. (2) Gender, home emergency preparedness, family total income, employment status, being affected in past

**Table 3** Goodness-of-fit indicators of model for CCRAM factors (n = 526)

| Model                 | $\chi^2$ | df  | $\chi^2/df$ | CFI  | RMSEA | AIC    |
|-----------------------|----------|-----|-------------|------|-------|--------|
| 21 Items five factors | 593.646  | 174 | 3.41        | .935 | .068  | 707.60 |
| 10 Items five factors | 71.70    | 25  | 2.39        | .985 | .051  | 119.81 |

In both models  $\chi^2$  reached significance level of  $p < .001$

Descriptive statistics

CFI comparative fit index, RMSEA root mean square error of approximation, AIC Akaike information criterion

**Table 4** CCRAM factors: zero order correlations and descriptive statistics (N = 1,052)

| Variables           | 1   | 2   | 3   | 4   | 5   |
|---------------------|-----|-----|-----|-----|-----|
| Leadership          | –   |     |     |     |     |
| Collective efficacy | .58 | –   |     |     |     |
| Preparedness        | .54 | .43 | –   |     |     |
| Place attachment    | .37 | .53 | .35 | –   |     |
| Social trust        | .38 | .53 | .34 | .40 | –   |
| CCRAM               | .84 | .82 | .73 | .69 | .61 |

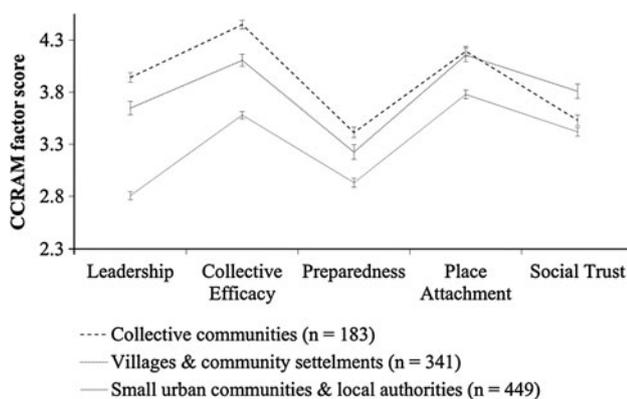
Factors are presented according to the exploratory factor analysis (21 items); All correlations are at  $p < .001$  level of significance

CCRAM conjoint community resiliency assessment measure

emergency situation, education level, military service, and being an immigrant had no statistically significant impact on community resilience.

### Type of Community Impact

After controlling for belonging to local CERT, age, number of years living in the community, community volunteering, level of religiosity, and having a permanent relationship, a multivariate analysis of covariance showed that type of settlement had a significant effect on overall community resilience and its' factors,  $F(10, 1,914) = 36.03, p < .001$ , Pillai's Trace = .32,  $\eta_p^2 = .16$ . Collective communities did not have statistically higher average resilience ( $M = 3.88, SD = .51$ ) than villages and community settlements ( $M = 3.68, SD = .62$ ), while both had higher average resilience than small urban communities and local authorities ( $M = 3.25, SD = .70$ ). The analysis conducted using the CCRAM-10 revealed similar results,  $F(2, 981) = 93.56, p < .001, \eta_p^2 = .16$ . As it can be seen from Fig. 2, for leadership and collective efficacy factors the differences were found between the three types of communities, while for preparedness and place attachment factors, collective communities and villages and community settlements (which were not different from each other in average scores) had statistically significantly higher level of community resilience than small urban communities and local authorities. In the social trust factor, however, villages and community settlements had a statistically significant higher average score ( $M = 3.73, SD = .83$ ) than the other two types of communities, small urban communities ( $M = 3.42, SD = .94$ ) and collective communities ( $M = 3.39, SD = .87$ ) as indicated by the significant interaction term of Type of community X Factor type, obtained in the repeated measures analysis of covariance (ANCOVA),  $F(8, 3860) = 26.77, p < .001, \eta_p^2 = .05$ .



**Fig. 2** CCRAM factors according to type of community. Note: Error bars denote standard errors

### Association with Single-Item Measures of Resilience

The total CCRAM score positively and significantly correlated with the single item perceived community resilience,  $r_p(1,039) = .59, p < .001$ , after controlling for perceived individual resilience, which significantly correlated with the single-item of perceived community resilience,  $r(1,042) = .48, p < .001$ . In addition, when controlling for perceived community resilience (measured by the single item), total CCRAM score has no statistically significant correlation with individual resilience,  $r_p(1,039) = .03, n.s$ . The CCRAM-10 demonstrated a similar pattern of association with the single item perceived community resilience,  $r_p(1,039) = .56, p < .001$ .

### Discussion

The present study is the first to describe the psychometric properties of the CCRAM, including its' factor structure. Due to the lack of tools that are empirically grounded and intended to measure significant resources of community resilience, it was difficult to find a parallel for comparison. The most similar tool to which the current factor analysis will be compared is the 21-item CART<sup>®</sup> (Communities Advancing Resilience Toolkit) survey (Sherrieb et al. 2012; Pfefferbaum et al. 2013). Although there was no communication between the two development groups, it is noteworthy that the CCRAM has some overlap with the CART<sup>®</sup>. First, several items, e.g. CCRAM item “I have faith in the decision makers in my municipal authority” and CART<sup>®</sup> item “People trust public officials”, or CCRAM item “I feel a sense of belonging to my town” and CART<sup>®</sup> item “People feel they belong to community”. Second, the ratio of items related to emergency/crisis and other capacities (in CCRAM 9:12, and in CART<sup>®</sup> 7:14)—differences are evident regarding factor structure despite an identical length of 21 items.

Taking into account that a comprehensive and real-world practice oriented, mixed research methods approach was used in order to develop the CCRAM (Creswell 2003), and that the vast accumulation of experience of developers was prioritized over theory in the construction of the items—it is of interest to examine the resulted factor structure in light of other existing models of community resilience.

Leadership, the CCRAM factor that explained the most significant portion of the variance (39 %) deals with the relationships with local leadership (including trust and perception of leadership competence and service continuity during times of crisis). Existing literature emphasizes the role of local authority or governance as core elements of

community resilience (Longstaff and Yang 2008; Wilson 2012) The role of good governance is considered to be important during every phase of the crisis cycle (Baker and Refsgaard 2007) and has been suggested to have a key role across different disciplines in dealing with resiliency (Castleden et al. 2011). The collective efficacy factor is made up of terms referred to in the literature as community mastery (Hobfoll et al. 2002), perceived social support (Norris et al. 2008), cohesion and willingness to intervene on behalf of the common good (Sampson et al. 1997). Together they all have significant association with community resilience (Norris et al. 2011). Uscher-Pines et al. (2012) suggested that prepared, self-reliant citizens are the foundation of a resilient community. While some researchers (e.g. Cutter et al. 2008) take into consideration preparedness as a manifestation of social learning in the feedback process of resiliency building, Uscher-Pines et al. (2012) claim that usually, emergency preparedness is not incorporated in models of community resilience. The CCRAM tool, however takes into account the domain of emergency preparedness and shows that it has significant associations with the other factors of community resilience.

Mishra et al. (2010) refer in place attachment to aspects of bonding between people and places and involves the interplay of affect and emotions, knowledge and beliefs, behaviors and actions in reference to a place. According to Ross et al. (2010) strengthening people–place connections (i.e. place attachment) is equivalent to community resilience strengthening. Norris et al. (2008) add that place attachment can promote resilience and recovery at the community level.

Social trust refers to the belief that other members of the community can be relied upon and to the readiness to act on the assumption of the other's benevolence (Cohen et al. 2013). Enhanced social trust has been associated with different elements of community resilience (Cacioppo et al. 2011; Olsen and Shindler 2010; Zautra et al. 2010).

As described above, all factors identified in this study are tightly linked to previous literature on community resilience. In addition, the current factor structure is the result of data gathered from a large community sample. This contributes to the external validity of the CCRAM to examine the perceptions of community members. Some elements of community resilience that were recognized by other teams, such as information and communication (Norris et al. 2008) were present in the initial instrument's draft but were eliminated during the validation process of the tool. We found that items related to information and communication (e.g. item 24: "the information I receive from the municipal authority during emergency meets my needs") were excluded due to double loading during the EFA. Other elements such as economic development (Norris et al. 2008) are not assessed directly in CCRAM as

they are considered to be better estimated using publically accessible indicators (Sherrieb et al. 2010), however, keeping in mind that the number of communities assessed by the CCRAM is continuously growing, further estimation of correlation between indicators of economic development is left for future analysis. Other economic elements like resource equity (Norris et al. 2008) are assessed in CCRAM (item 19: "The municipal authority provides its services in fairness") but in our model it was found to be highly interrelated with the leadership factor and does not load on a single factor. CCRAM factors are inter-correlated and thus not totally orthogonal, but possibly some elements in the community, resource equity (although economic in nature) are more tied to aspects related to leadership.

The CCRAM serves as an asset to local decision makers in the community in the way that it represents baseline evaluation based on community sampling. Repeated assessments in the same community during different times will enable local leaders to observe changes in several resilience domains in their contingent. Policy change implementation, community capacity building (Chaskin et al. 2001), and emergency events all may have influence on the community and on the perceptions of its' members. For instance, Aharonson-Daniel et al. (2013) found that compared to a baseline measurement, during the 2012 Operation Pillar of Defense (Operation Pillar of Defense 2012), reported community resilience factors significantly increased by 9 % (collective efficacy domain) to 27 % (in the emergency preparedness domain), eventually demonstrating an average of 13.5 % increase. Therefore, the brief version of the CCRAM (CCRAM-10) which showed excellent construct validity in the present study has the applicability to be incorporated by local government in community diagnosis during times of emergency, in order to reflect the capability of the community to withstand crises and recover from them. Cohen et al. (2013) showed the sensitivity of the CCRAM while using advanced statistical analysis such as hierarchical logistic regression and receiver operating characteristic analysis. Beyond background variables, the CCRAM indicator was found to be a very strong predictor of perceived community resilience.

The short version of the CCRAM, the CCRAM-10 was found to have the best fit to the data. In addition, when compared to the 21 item scale, similar magnitude in association to the single item assessing perceived community resilience was observed, suggesting that the CCRAM-10 is reliably capable of assessing the original five factors and differentiating between types of communities. Nevertheless, the full item questionnaire (21 items) and the seven additional items that are not calculated to form the CCRAM score, give more comprehensive information for decision makers and leaders regarding different community capacities and the level of their interactions

with the people in routine and during emergency. This can assist decision makers in designing more detailed, specific and focused policy for the community. Furthermore, once interventions take place to improve certain aspects that influence community resilience, the variety of items will facilitate a more detailed and sensitive assessment of change achieved.

Limitations of the present study include issues of generalizability due to relative low representation of different communities across Israel. However, as preliminary investigation aimed to establish the factor structure, we can conclude that the factor structure has shown acceptable fit for the present sample. We are continuously expanding the database with the aim to establish a national databank which will encompass hundreds of settlements, enabling a macro outlook and analysis at the community level, combined with publicly accessible indicators of physical and economic resources in the community. Currently there are ongoing investigations using CCRAM across various types of communities in over twenty local authorities in Israel. So far we have obtained over 5,000 responses and the questionnaire has been translated from Hebrew to Arabic, English, Spanish, Russian, and German. All translations, including the English version of the CCRAM (presented in this paper) were back-translated and some are currently being implemented in community studies abroad.

In order to further enhance the external validity of the CCRAM, future research is warranted. Comparison of the CCRAM to other community indicators, either based on members' perceptions (via self-reports) or on publicly accessible indicators, would enable to explore associations between socio-economic popular indicators. Association of the CCRAM with valid indicators of personal resilience, various psychological indicators, sociological measures and more, can provide a broader multidisciplinary understanding of the inter-relations between people and their community as well as the individual's effect on their personal and community resilience. We also suggest that the CCRAM and the CART<sup>®</sup> be further examined and assessed together, in order to establish concurrent validity (Collins et al. 2006) indices on the one hand, but also further investigate the external validity of each of these measures. The incorporation of this measurement tool in community-based interventions may contribute to the establishment of clearer, more understandable and manageable frameworks for monitoring and observing communities.

Once the measure is broadly and commonly used, the community resiliency profiles may serve higher levels of leadership such as the homeland security, homefront command, as well as governmental agencies responsible for health, education, social welfare and more. Currently, equal weight was given to each factor in the calculation of the overall CCRAM score. As the scope of use of this tool

increases and the database of community resilience grows larger, it is our intention to explore in depth the precise "weight" of each factor in the overall score. Preliminary analysis using quintile regression analysis suggests that the weight of factors in different types of communities and even between various groups within the same community may vary. It is possible and reasonable that the factors will remain valid in all communities but their weight in the overall resiliency score will vary.

In order to capture the community as a complete system, citizens' perspectives of their community's capacities as captured by the validated CCRAM tool, should be considered in future studies and surveys in regions that currently use only objective public information in order to estimate community resilience. The CCRAM tool is available for use and can be obtained by writing to the authors.

## Conclusion

The CCRAM has been shown to be a valid and a practical tool for the assessment of community resilience. Both internal and external validity have been demonstrated, as all factors obtained in the factor analytical process, based on data gathered from a large community sample, were tightly linked to previous literature on community resilience.

The CCRAM facilitates the estimation of an overall community resiliency score but more importantly, it detects the current strength of five key elements in community function following disaster: Leadership, Collective Efficacy, Preparedness, Place Attachment and Social Trust. Consequently, the CCRAM can serve as a tool for community leaders (including town's mayor, or the head of the community or regional/local council), broader governance and the scientific community to assess, monitor, and focus actions to enhance and restore community resilience for crisis situations.

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