Highlights

- Secondary analysis of an RCT of ACT for parents of children with asthma.
- Cross-lagged panel model analyses were conducted.
- Parental psychological flexibility (PF) mediated effect of ACT on parental distress
- Parental PF mediated effect of ACT on childhood asthma symptoms.
- ACT improves the health outcomes of parent-child dyads at 6 months follow-up.

Abstract

Objective: This is a secondary analysis of a previously reported randomized controlled trial, aimed at examining the mediating role of parental psychological flexibility (PF) in an Acceptance and Commitment Therapy (ACT)-based childhood asthma management program for parents.

Methods: The participants were 168 parents (mean age (SD)=38.40 (5.90) years; 88.1% mothers) and their children who had been diagnosed with asthma (mean age (SD)=6.81 (2.50) years; 62% boys). They were randomly allocated to either the program composed of a four-session, group-based ACT plus asthma education (ACT Group) or to a group-based asthma education talk plus three telephone follow-ups (Control Group). The parents underwent assessments at baseline, and immediately, 3-months, and 6-months after the intervention for the following outcomes: PF (Acceptance and Action Questionnaire-II), psychological distress of the parents (Depression Anxiety Stress Scale-21); and the asthma symptoms and use of inhaled bronchodilators of their children.

Results: Cross-lagged panel models showed that the improvement in parental PF at post-intervention mediated the effect of ACT on reducing parental psychological distress (all beta coefficients (βs) ranged from -2.20 to - 2.30, all *P*s<.01) and childhood asthma symptoms in terms of daytime symptoms (β= -.22, 95% CI [-.52, -.02], *P*=.04), nighttime symptoms (β= -.17, 95% CI [-.33, -.02], *P*=.04), and the use of bronchodilators (β= -.22, 95% CI [-.48, -.02], *P*=.03) at 6-months post-intervention.

Conclusion: ACT makes a unique contribution to improving the health outcomes of parents and their children diagnosed with asthma through fostering parental PF.

Keywords: Parents; children; psychological flexibility; cross-lagged panel model; acceptance and commitment therapy

The role of parental psychological flexibility in childhood asthma management: An analysis of cross-lagged panel models

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1. Introduction

Psychological flexibility (PF), which refers to the ability to be open to difficult experiences as they unfold in the present moment while engaging in behaviors consistent with self-chosen values [1], has been postulated as a fundamental aspect of psychological health [2, 3]. It is a key therapeutic process in the Acceptance and Commitment Therapy (ACT) model that can be strengthened by six inter-correlated skills, namely acceptance, defusion, contact with the present moment, self-as-context, values, and committed action [1]. Through fostering PF via ACT, individuals could become more able to engage in activities consistent with their values while being willing to experience whatever psychological experiences might arise [1]. Psychological well-being and psychological distress may be unable to capture the dynamic psychological process that a person experiences and that unfolds over time, such as how the person adapts to fluctuating situational demands, takes different perspectives flexibly as needed, and persists in or changes his/her behavior to pursue central values [2].

In literature, the positive effects of ACT on the psychological health outcomes of individuals diagnosed with depression, anxiety, psychosis and chronic pain have been empirically supported by meta-analyses of randomized controlled trials (RCTs) [4-6]. Furthermore, a recent systematic review of 12 studies using mediation analysis has revealed the mediating role of PF in ACT leading to reductions of depressive and anxiety symptoms, improvements in patient functioning even with pain interference and other health outcomes (e.g., smoking cessation and re-hospitalization due to psychosis) [7]. Within the context of the family, studies have shown that ACT has positive effects on the PF of parents of children with congenital heart disease and cancer [8], chronic pain [9], autism spectrum disorders, and developmental difficulties [10-13], positive association between parental PF and familial adjustment toward a child's diagnosis of cancer has been recently found [14].

Apart from exploring the direct health benefits of ACT in parents, recent studies have examined the role of parental PF on child health outcomes and the effects of ACT among the parent-child dyads. A number of cross-sectional studies have found that poor parental PF accounts for a further variance in a variety of adverse health outcomes in children. These include anxiety and related psychopathologies [15]; pain-related anxiety symptoms, depressive symptoms, and functional disability in children with chronic pain problems [16-18]; the internalizing and externalizing of problems in youth as a result of maladaptive parenting practices [19]; and childhood asthma morbidity [20]. When compared to a parenting intervention alone, two RCTs have shown that an ACT-based parenting program is more effective at reducing the emotional and behavioral problems of children who had been diagnosed with acquired brain injuries [21] and cerebral palsy [22]. Secondary analyses of these RCTs have also found that those parents who receive training in ACT report better PF that mediate the interventional effects on dysfunctional parenting style and parental psychological adjustment [23, 24]. However, the specific link between the change in parental PF and their child's health outcomes was not clear.

Because there have been few interventions that have successfully addressed the psychological needs of parents of children with asthma [25], and in view of the promising effects of ACT, an RCT of an ACT-based asthma management program compared with only asthma education (the usual care) for parents of children with asthma was recently conducted [26]. In this RCT, parents who received additional ACT training reported better PF starting from post-intervention to 6-months post-intervention, less psychological distress (i.e. less anxiety and stress) at 6-months post-intervention, while their children exhibited less severe asthma symptoms during daytime and nighttime starting from 3- to 6-months post-intervention [26]. The improvements in parental PF, parental psychological distress, and childhood asthma symptoms mentioned above in *sequence*, imply that fostering parental PF

via ACT may play a significant role in improving the health outcomes of parent-child dyads. Nevertheless, the literature indicates that poor childhood asthma conditions can negatively affect the psychological well-being of parents [27, 28]. In other words, the reverse direction of impact could be possible, for example, seeing their children attain better asthma outcomes in the trial at 3-months post-intervention might have affected the PF and/or psychological distress of the parents at 6-months post-intervention.

The present study is a secondary analysis of the findings of an RCT [26]. The aim is to explore whether a change in parental PF mediated changes in parental psychological distress and childhood asthma symptoms in terms of daytime symptoms, nighttime symptoms, and the use of inhaled bronchodilators in a sample of parent-child dyads where the parents had undergone an ACT-based childhood asthma management program. To overcome the challenge of clarifying the causal status of parental PF, parental psychological distress, and childhood asthma symptoms in the aforementioned trial [26], especially the potential reciprocal influences between parent and child variables, a cross-lagged panel model was used in the present study to analyze this trial data. This allowed for a simultaneous estimation to be made of all of the indirect effects of multiple mediator variables [29], and accounted for other sources of variance (e.g., autocorrelations between variables across time). It helped to more precisely determine which variable(s) of interest actually influence(s) each other over time [30]. Using cross-lagged models may further elucidate the relationships between parental psychological health and childhood asthma outcomes, which can be complex and dynamic [31].

2. Methods

2.1. Participants and procedures

This is a secondary analysis of a previously reported RCT (ClinicalTrials.gov registration: NCT02405962), the methodology of which has previously been reported [26].

Briefly, between the 6th January and the 26th May 2016, a total of 168 parent-child dyads from two pediatric respiratory outpatient clinics of an acute hospital in Hong Kong were consecutively sampled. This hospital is under the regulation of the Hong Kong Hospital Authority and serves two out of 18 districts in Hong Kong. In 2016, these two districts had a total population of 132,000 children (15.7% of the total population aged under 14 years in Hong Kong) [32]. Both clinics offer medical consultation services and asthma education to families of children with asthma.

Parents were eligible for inclusion in the RCT if they were either a father or a mother (aged 18-65 years); a primary caregiver of their child with asthma; living together with the index child; able to communicate in Cantonese; and a Hong Kong permanent resident. The children (aged 3-12 years) should have received a physician's diagnosis of asthma (International Classification Diseases–10 codes J45, J46) as documented in their electronic medical records. Children aged two years or below were excluded, because transient asthma symptoms that occur in children at this age range can be due to Respiratory Syncytial Virus bronchiolitis or to virus-induced wheeze, a viral infection, rather than to asthma [33, 34]. In addition, parents were excluded if their child had received a diagnosis of asthma and also had a congenital problem, an oxygen-dependent condition, autism spectrum disorder, epilepsy, attention deficit hyperactivity disorder, Down syndrome, or cerebral palsy, as documented by physicians in the child's medical records. Those parents who agreed to participate in the RCT provided their written informed consent, completed questionnaires, and were randomly allocated to one of the two treatment groups. They then underwent four weekly sessions of the intervention and completed follow-up questionnaires. The endpoint of the trial was at 6-months post-intervention.

2.2. Treatment conditions

The Control Group. The parents in the Control group received a 2-hour, group-based, face-to-face asthma education talk (group size of 15-20), which was the usual care conducted by a registered nurse of the study hospital. Following the Global Initiative for Asthma guidelines [35], the talk focused on teaching parents about the prevention and management of childhood asthma attacks. After the talk, they additionally received one telephone follow-up call per week for the next three weeks (15 minutes per call) from nurses to evaluate their child's asthma condition.

The ACT Group. The parents in the ACT group received four sessions of group-based, face-to-face ACT (1.5 hours per session, group size of 6-8) integrated with asthma education (0.5 hours per session) in the activity rooms of the study hospital conducted by the first author (a registered nurse and a trained ACT interventionist). The content of the asthma education was identical to that delivered to the Control group. The parents also received ACT training aimed at fostering their PF in managing childhood asthma. The ACT training included the following components: creative hopelessness exercises to help parents to get a better understanding on the consequences of their avoidance behaviors; mindfulness exercises to help them embrace their thoughts and feelings (e.g., fears and worries about their child's asthma attacks) that arise when managing their child's asthma symptoms; cognitive defusion exercises to create psychological space between themselves and their thoughts; mindfulness exercises to foster the non-judgmental acceptance of emotions, as well as in-class and take home exercises for creating action plans that are in line with their values for better asthma care.

2.3. *Measures*

For this secondary analysis report, the focus was on parental PF, distress and childhood asthma symptoms, which were based from the main RCT [26].

Parents' psychological flexibility. The 7-item Acceptance and Action Questionnaire-II (AAQ-II, Chinese version) was used to assess the PF of parents at baseline, post-intervention, and 6-months post-intervention. The parents rated each item on a 7-point Likert scale (sample item: "Emotions cause problems in my life.") [36], with a higher total score indicating poorer PF. The possible range of scores was 7-49. The AAQ-II demonstrated adequate internal consistency (α = .84) and test-retest reliabilities over a 3-month interval (*r* = .81) and adequate test-retest reliabilities over a 12-month interval (*r* = .79) [36]. The alpha of the AAQ-II in this study was .87.

Parents' psychological distress. The 21-item Depression Anxiety Stress Scale-21 (DASS-21, Chinese version) was used to assess the psychological distress of the parents, in terms of depression (α = .82), anxiety (α = .88), and stress (α = .90) [37], at baseline, post-intervention, and 6-months post-intervention. The parents rated each item on a 4-point Likert scale (sample item for depression: "I felt that I had nothing to look forward to.") [37]. In order to yield scores that were equivalent to the full DASS-42 scale, the subscale scores for the DASS-21 depression, anxiety, and stress subscale were multiplied by two, with a possible range of scores of 0-42 [38]. In this study, the alphas of the DASS-21 depression, anxiety, and stress subscales were .84, .85, and .89, respectively.

Childhood asthma symptoms. To account for seasonal influences as suggested by international experts [39], the childhood asthma symptoms were monitored at 3-month intervals. The parents reported their child's asthma symptoms over the past four weeks at baseline, 3-months, and 6-months post-intervention. Following the guidelines suggested by the Global Initiative for Asthma [35], three validated question items were used, namely: (1) day(s) with asthma symptoms per week, (2) night(s) awakening due to asthma symptoms per week, and (3) day(s) requiring inhaled bronchodilators to relieve asthma symptoms per week. These items demonstrated acceptable internal consistency (α = .83).

Prior to randomization, the demographic and asthma-related clinical characteristics of the children, as well as data on the parents' socio-demographic characteristics and personal and family history of asthma were collected from the parents' reports in the questionnaires.

2.4. Data analyses

Fig. 1 shows the hypothesized cross-lagged panel model that was used to examine the relationships between parental PF (i.e., AAQ-II score), parental psychological distress (i.e., DASS-21 total score), and childhood asthma symptoms. Each observed variable was regressed on its value, measured at a preceding time point. Since the parents of the ACT group had received the ACT training, the group assignment was an antecedent of the AAQ-II score and the DASS-21 total score in the post-intervention period. The diagonal lines represent all potential cross-lagged correlations between the AAQ-II score, DASS-21 total score, and childhood asthma symptoms throughout the period of the study, including: (1) the AAQ-II score predicted the DASS-21 total score and vice versa; (2) the DASS-21 total score predicted childhood asthma symptoms and vice versa; and (3) the AAQ-II score predicted childhood asthma symptoms and vice versa. To determine the stability of the model in analyzing hypothetical relationships, all possible autocorrelations (curved arrows) and synchronous correlations (horizontal arrows) over time were taken into account. The model was proposed to determine whether parental PF (that was the AAQ-II score) at post-intervention might mediate the effects of treatment conditions (i.e., the ACT group compared with the Control group) on the DASS-21 total score at 6-months post-intervention, as well as on childhood asthma symptoms at 3- and 6-months post-intervention.

Data analyses were performed using SPSS software (Version 23.0; IBM Corp., 2014) for descriptive statistics and correlational analyses, as well as SPSS Analysis of Moments Structure software (Version 23.0; IBM Corp., 2014) for the cross-lagged panel models. Descriptive statistics and Pearson's correlation coefficients (r) were obtained to explore the

zero-order correlations among all the observed variables to be included in the model. Effects sizes for absolute *r* were interpreted as follows: > .10, small; > .30, medium; > .50, large [40]. Three cross-lagged panel model analyses were conducted using maximum likelihood estimation for each of a child's outcomes, namely: (1) day(s) with asthma symptoms, (2) night(s) awakening due to asthma symptoms, and (3) day(s) requiring inhaled bronchodilators to relieve asthma symptoms. An acceptable model fit was determined by examining the following model fit indices: Comparative Fit Index (CFI) ≥ .90; Tucker-Lewis Index (TLI) ≥ .90; standardized root means square residual (SRMR) ≤ .10; and root mean square error approximation (RMSEA) ≤ .08 [41]. An excellent model fit was determined by a CFI and TLI greater than .95, an SRMR smaller than .08, and an RMSEA smaller than .05 [41].

When screening missing data and non-normality, out of 168 parent-child dyads who provided completed data, a total of six dyads (3.6%) were lost to follow-up at the end of the study because they did not appear for their follow-up appointment in the clinic and were non-contactable (n = 5) or the family had moved away (n = 1) [26]. With case losses of less than 5%, cases with incomplete data (3.6%) were excluded from the correlational and cross-panel model analyses [42]. All of the observed variables had a moderate degree of non-normality (skewness range: 0.64 to 1.57). The joint multivariate kurtosis value was 12.54 with a critical ratio of 9.09. To address the issue of non-normality (as well as the indirect effects in the cross-lagged models), the overall fit of all three models was further assessed using the Bollen-Stine bootstrap tests with 5,000 resamples [43], followed by a comparison of whether the parameter estimates calculated using the bootstrap method differed from those obtained using the original maximum likelihood based model, as shown by the bias values [44].

2.5. Ethical considerations

This study was granted ethical approval by the Hong Kong Hospital Authority, which governs the study clinics, and by the university institution (HSEARS20150109001). All study

procedures complied with the ethical standards of the relevant institutional committees on human experimentation and the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

3. Results

3.1. Sample characteristics

A total of 168 parent-child dyads were randomly allocated to either the ACT group (n = 84) or the Control group (n = 84). The mean age of the parents was 38.4 (SD = 5.9), and 88.1% of them were mothers. The majority were married (86%), had attained a secondary school education or below (78%), and had a monthly household income ranging from $25,001 to $50,000 Hong Kong Dollars (52%; the median monthly household income for a household of average size, consisting of a Hong Kong couple with a child was approximately $25,000 Hong Kong Dollars) [32]. The mean score (SD) for the AAQ-II was 19.88 (8.64). At least one-fifth of the parents reported mild levels of depression (20.2%), anxiety (31.0%) and stress (25.0%), the rates of severe symptoms ranged from 3.6% to 6.6%. The children were mainly boys (61%) averaging 6.8 years of age, who had been diagnosed with asthma since the age of three. On average, the children experienced at least one day per week with asthma symptoms, such as chronic coughing, wheezing, shortness of breath, or chest tightness, during the daytime (M = 1.27, SD = 1.82) and the nighttime (M = 0.96, SD = 1.52), and required short-acting bronchodilators for symptom relief (M = 1.33, SD = 1.93). Around 40% (n = 65) had been brought to an emergency department at least once in the past 6 months to receive treatment for an acute asthma attack [44].

3.2. Correlational analysis

Three significant, prospective correlations between the observed variables were shown in the correlation matrix (see online, Appendix Table A.1). First, the AAQ-II score at post-intervention significantly correlated with the DASS-21 total score at 6-months post-

intervention (r = .528, P < .001). Second, the AAQ-II score at post-intervention, but not the DASS-21 total score, significantly correlated with the childhood asthma symptoms during daytime (r = .248, P = .002) and nighttime (r = .200, P = .012), as well as with the child's use of inhaled bronchodilators to control asthma symptoms (r = .224, P = .005) at 6-months post-intervention. Third, the childhood asthma symptoms during daytime (r = .249, P = .004) and nighttime (r = .228, P = .009) at 3-months post-intervention significantly correlated with the AAQ-II score measured at 6-months post-intervention.

3.3. Path analysis of the cross-lagged panel models

Path coefficients of the cross-lagged panel models (see online, Appendix Figs. B.1, B.2, and B.3) with 95% bias-corrected bootstrapped standard errors and CIs are presented in Table 1. In all three models, the Bollen-Stine bootstrap tests were all non-significant (all *Ps* = .07). No substantial discrepancies between the results of the bootstrap analysis and the original maximum likelihood analysis were found, as shown by the bias values of each parameter estimate, which ranged from .001 to .006. All three models demonstrated acceptable fit (Model 1: χ^2 = 25.63, df = 12, CFI = .961, TLI = .955, SRMR = .046, RMSEA = .071; Model 2: χ^2 = 21.62, df = 12, CFI = .934, TLI = .917, SRMR = .054, RMSEA = .058; Model 3: χ^2 = 25.29, df = 12, CFI = .961, TLI = .952, SRMR = .053, RMSEA = .070).

In these models, treatment conditions (ACT Group versus Control Group) had significant direct effects on parental PF [AAQ-II scores in which higher scores indicate higher psychological inflexibility (all *P*s < .001)] and the DASS-21 total scores (all *P*s = .02) at post-intervention. The direct effects of the AAQ-II scores at post-intervention on the DASS-21 total scores at 6-months post-intervention were significant (all *P*s = .01), but not vice versa (all *P*s = .16-.23). In addition, the direct effects of the AAQ-II scores at post-intervention on the daytime symptoms (P = .01) and nighttime symptoms (P = .02) of the children, and on their use of bronchodilators (P = .01) at 6-months post-intervention were all

significant, but not at 3-months post-intervention (all *P*s = .34-.94). The daytime symptoms (*P* = .003) and nighttime symptoms (*P* = .01) of the children at 3-months post-intervention were found to predict their AAQ-II score at 6-months post-intervention, but not their DASS-21 total scores (all *P*s = .25-.36).

As hypothesized, all three cross-lagged models showed that an improvement in parental PF (i.e., the reduction in the AAQ-II scores) at post-intervention mediated the effects of treatment conditions on reducing parental psychological distress (i.e., DASS-21 total scores) at 6-months post-intervention (indirect effects in Model 1: β = -2.30, 95% CI [-4.62, -.51], *P* = .01, proportion mediated (PM) = 0.29; Model 2: β = -2.24, 95% CI [-4.57, -.48], *P* = .01, PM = 0.29; Model 3: β = - 2.20, 95% CI [-4.54, -.42], *P* =.01, PM = 0.28). The indirect effects of ACT through improved parental PF on reducing the children's daytime symptoms (β = -.22, 95% CI [-.52, -.02], *P* = .04, PM = 0.12), nighttime symptoms (β = -.17, 95% CI [-.33, -.02], *P* = .04, PM = 0.12), and use of bronchodilators (β = -.22, 95% CI [-.48, -.02], *P* = .03, PM = 0.19) were also found at 6-months post-intervention. However, the AAQ-II scores at post-intervention did not have significant direct effects on all three asthma-related outcomes of the children at 3-months post-intervention (all *P*s = .34-.94), the AAQ-II score at post-intervention did not mediate the effects of treatment conditions on these outcomes at 3-months post-intervention.

4. Discussion

The current study examined whether a change in parental PF mediated changes in parental psychological distress and childhood asthma symptoms in a sample of parent-child dyads where the parents had received an ACT-based childhood asthma management program in an RCT [26]. The hypotheses were partially supported, as the cross-lagged panel models indicated that improved parental PF at post-intervention mediated the effects of treatment conditions (ACT versus Control) on reducing parental psychological distress and childhood

asthma symptoms, in terms of day(s) with asthma symptoms per week, night(s) awakening due to asthma symptoms per week, and day(s) requiring inhaled bronchodilators to relieve asthma symptoms per week, at 6-months post-intervention. However, no mediated effect could be found for childhood asthma symptoms at 3-months post-intervention.

The aforementioned findings are in line with the view that PF is the central mechanism of change in ACT [1], and are consistent with evidence from previous ACT trials indicating that parental PF plays a mediating role in improving dysfunctional parenting styles and parental psychological adjustment [23, 24]. More importantly, cross-lagged models showed that improvement in parental PF significantly mediated the intervention effect on reducing childhood asthma symptoms. This again coincides with current evidence indicating that better parental PF is associated with a range of positive health outcomes in children, such as better social, emotional, and developmental functioning of children diagnosed with chronic pain [17, 45], less severe symptoms of anxiety among children with anxiety disorders [15], better asthma morbidity in children diagnosed with asthma [20], and less severe internalizing behavioral problems among typically developing children [19].

It is noteworthy that parental PF was found to mediate the effect of ACT on daytime symptoms, nighttime symptoms, and the use of inhaled bronchodilators in children at 6-months only, but not at 3-months, post-intervention. These findings imply that the influential role of parental PF on a child's health outcomes might require additional time before it is revealed (i.e., more than 3-months post-intervention). To date, it has been proposed that parents who are depressed, anxious, and stressed would have impaired motivation and a poorer capacity to pay attention to their child's asthma management needs, resulting in poor asthma management such as poor medication adherence or allowing their child to be exposed to agents that trigger asthma [31, 46]. In addition, parental stress and depression mediated by negative/hostile parenting contributes to a child's stress and depression, which in turn has

been found to predict asthma disease activity [31, 46]. In the present study, it is possible that parents who became more psychologically flexible about the challenges of managing childhood asthma were more willing to put into action what they had learned about asthma management practices, such as adherence to inhaled corticosteroids, rather than avoiding the problem. Hence, the mediated effect of ACT on the child's health outcomes occurred at the later stage of the study. Further studies, which shall include more parental or child factors, may shed light on the interplay of these variables with parental PF, which can affect a child's asthma outcome.

The cross-lagged panel analyses in the present study allowed simultaneous estimations to be made of the potential mediating effects of both parental PF and parental psychological distress on child health outcomes. Given that parental psychological distress had no direct effects on childhood asthma symptoms, this implies that the former had no mediating effects on the latter. Indeed, the mediating role of parental PF as found in the analyses, but not of parental psychological distress, confirms the ability of ACT in the trial [26] to target functionally important processes of change and supports the argument that ACT is distinct from other psychotherapeutic approaches (e.g., cognitive behavioral approaches) that target the management of symptoms [47].

Apart from the influential role of parental PF on childhood asthma symptoms as shown in the model, reciprocal relationships were found in which childhood asthma symptoms at daytime and at nighttime at 3-months post-intervention could significantly predict parental PF at 6-months post intervention. This unexpected finding is consistent with the common finding that a parent's psychological health could be affected by his/her child's health status [31, 48]. As the parents realized that their child's asthma symptoms were improving after they had received the ACT training, they might have become more motivated to engage in practicing acceptance and mindfulness skills to manage childhood asthma,

resulting in better PF. In other words, the short-term effect of the ACT-based asthma management program on a child's health outcome might have played an influential role in fostering parental PF.

The limitations of this study should be noted, and the findings should be interpreted with caution. As the AAQ-II is not a context-specific measure, we could not provide a more sensitive measurement of PF in the context of childhood asthma management. In addition, the AAQ-II was originally developed from the 16-item AAQ focusing on the assessment of acceptance or experiential avoidance [49]. Hence, we were unable to consistently investigate all six processes of the PF model and capture the specific process(es) that led to changes in the health outcomes of the parent-child dyads. In literature, only a few studies have investigated specific processes of change in the PF of parents of children with chronic health problems who received ACT, with mixed results. For example, in a Canadian sample of 33 mothers of children with autism spectrum disorder who participated in a one-and-a-half day ACT workshop, Fung and colleagues reported that two ACT processes (cognitive fusion and values), but not parental PF as a whole, partially mediated changes in the symptoms of stress and depression of parents at post-intervention [50]. In a sample of 43 parents from the United States who had experienced relationship violence and participated in four group sessions of ACT, Moyer and colleagues found that two ACT processes, experiential avoidance and valued living, did not serve as mediators of positive changes in parenting behaviors at post-intervention [51]. The present findings together with the aforementioned evidence suggest the need for further studies in clarifying whether parental PF in general, its specific process(es), or parental PF situated in a particular context (e.g., PF in parenting) mediates the effect of ACT leading to desired changes.

We noted the strong correlations between the AAQ-II and the DASS-21 scores, which could be attributed to the poor discriminant validity of the AAQ-II, with regard to the

overlaps between PF and general psychological distress [52, 53]. If further studies are conducted to simultaneously assess the mediating roles of PF and parental psychological distress on child health outcomes, the PF measure should be able to sufficiently discriminate from the measure assessing distress [54]. Other measures targeting specific processes comprising PF could also be used, such as the Cognitive Fusion Questionnaire [55] and the Valuing Questionnaire [56].

Three measures, namely daytime symptoms, nighttime symptoms and the use of inhaled bronchodilators, were used to assess childhood asthma symptoms. If other important aspects, such as lung function parameters and pharmacy refill data indicating the use of oral systematic corticosteroids to control asthma, could be assessed and included in our analyses, these measures would be conceptually adequate to serve as observed variables for a latent variable representing the severity of childhood asthma control [35].

We attempted to model continuous changes in parental and child outcomes based on discrete measurements at baseline, post-intervention, 3-months, and 6-months post-intervention. It is possible that measuring these outcomes at shorter intervals (e.g., during the intervention) would reveal a more nuanced temporal pattern of change in parental PF, parental psychological distress, and childhood asthma symptoms.

It should be noted that the sample in the present study consisted predominately of mothers (88.1%) of children with well-controlled asthma (i.e., at baseline, 75% of the children had not been hospitalized due to asthma over the past 6 months; and 52.4% did not require inhaled corticosteroids as prophylactic therapy). Hence, the results may not be generalizable to parents of children with poor asthma control. The extent to which the results can be generalized to other populations of parents of children with a chronic medical condition are also somewhat limited by the homogeneous sample of generally low-to-middle class, Cantonese-speaking Hong Kong Chinese mothers of children with asthma.

This study relied on parental reports of childhood asthma, which may have been subject to recall bias and social desirability response bias. It should be noted that over one-third of the children (61/168 = 36.3%) in this study were aged five years or below, they might have had a short attention span and have been unable to follow instructions to perform an accurate measurement of lung function in the test to verify that their asthma symptoms had improved [57]. Meanwhile, the parental reports may even more closely reflect the actual status of the disease of the child at the time that the data were collected [58, 59]. Further studies may extend the follow-up period up to 12 months to examine the extended mediating effect of parental PF on childhood asthma outcomes, taking seasonal effects into account [60].

In sum, the present study is the first to apply a more sophisticated design, a cross-lagged panel model, to test the temporal precedence of parental PF, parental psychological distress, and childhood asthma symptoms in an RCT of a parental asthma management program using ACT. The findings extend the current understanding of the effect of PF in parents who received ACT on their child's health outcomes by revealing a complex interplay between changes in parental PF and the child's health outcomes starting from post-intervention to 6-months post-intervention. The cross-sectional data indicating the significant association between parental PF and childhood asthma symptoms [20], the previous RCT demonstrating the utility of ACT in improving parental management of childhood asthma [26], and the finding in the current study that parental PF plays a mediating role between the treatment conditions and a child's asthma symptoms, all provide support for the argument that ACT can improve the health outcomes of parent-child dyads through enhancing parental PF.

Author declaration

None.

Declaration of Competing Interest

None.

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Appendices Table A.1; Fig. B.1.; Fig. B.2.; Fig. B.3. Supplementary data

Supplementary data to this article can be found online.

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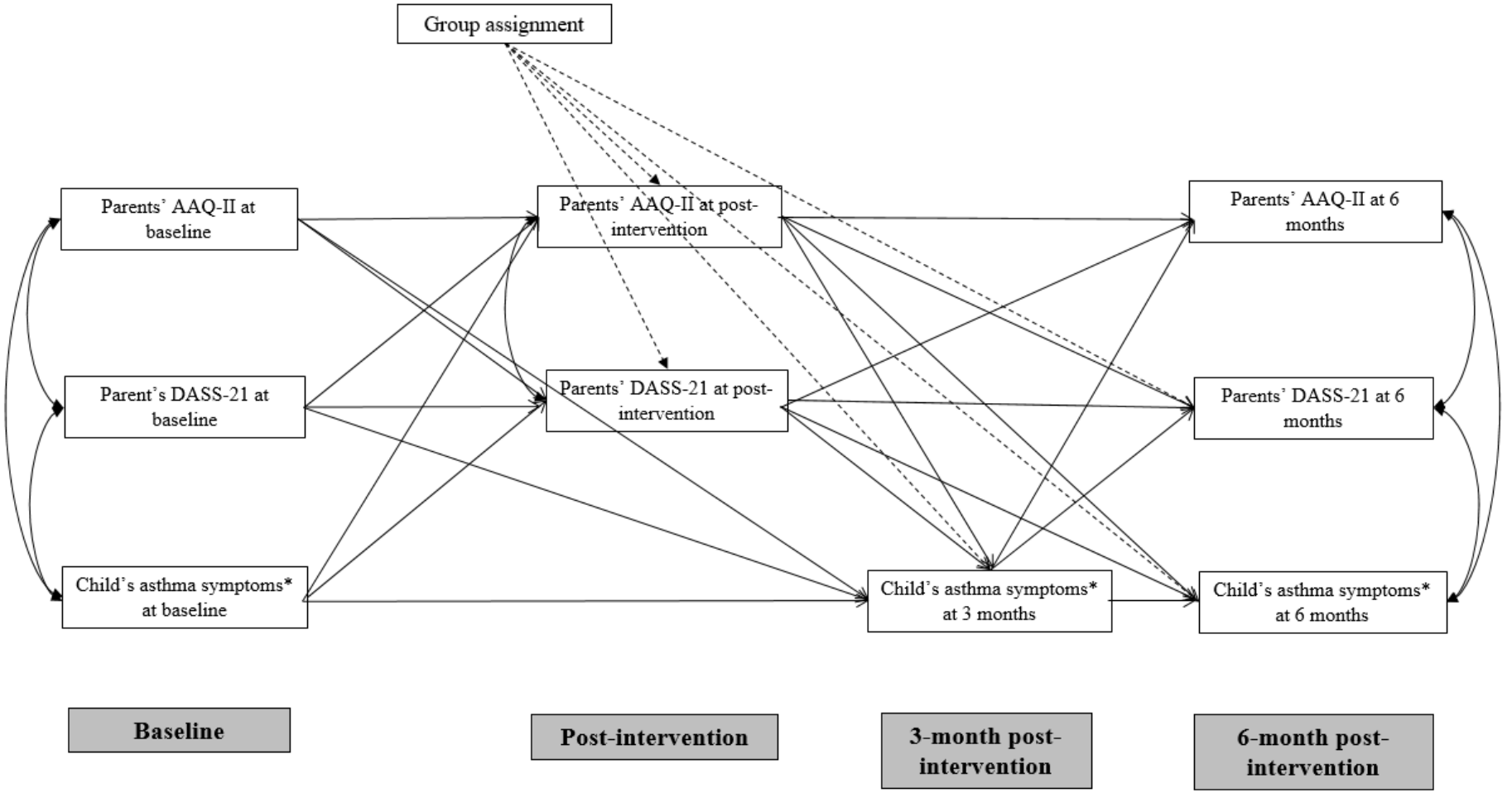

Fig. 1. A hypothesized cross-lagged panel model. Group assignment refers to the comparison between the ACT group (coded as 1) and the Control group (coded as 0) in the trial; it was an antecedent of all measures at post-intervention, and at 3- and 6-months post-intervention. Abbreviations: AAQ-II, Acceptance and Action Questionnaire-II; DASS-21, Depression Anxiety Stress Scale-21.

*This observed variable refers to (1) day(s) with asthma symptoms per week, (2) night(s) awakening due to asthma symptoms per week, and (3) day(s) requiring inhaled bronchodilators to relieve asthma symptoms per week. Each of the child's outcomes was used to test a cross-lagged model.

Table 1

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Table

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