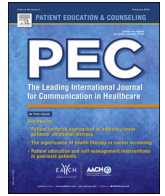




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### Intervention

# Effects of a family-assisted smoking cessation intervention based on motivational interviewing among low-motivated smokers in China

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#### ABSTRACT

**Objective:** To test the efficacy of a family-assisted smoking cessation intervention based on Motivational interviewing (MI) among low-motivated Chinese smokers.

**Methods:** A two-armed randomized controlled trial study design was utilized. 159 Smoker-supporter pairs were randomly allocated to the intervention (a family-assisted MI intervention-77) or control (an intensity-matched health education-82) group (IG & CG). Change in smoking characteristics, communication characteristics, Partner Intervention Questionnaire (PIQ), Decisional Balance Scale (DBL), and Situational Temptations Scale (STP) were measured at baseline, post-intervention, 3-month and 6-month follow-up.

**Results:** Compared to CG, IG had more significant increase over time in self-report quitting attempts of at least 24 h, biochemically verified 7-day smoking abstinence, the Positive dimension of PIQ and the Cons in DBL, whereas the daily cigarettes smoked, the Pros in DBL and STP were showed more significant decrease over time in IG ( $P < 0.05$ ). After intervention, the communication frequency and satisfactory were also improved by smokers ( $P < 0.01$ ).

**Conclusion:** The family-assisted MI intervention is more effective in changing the smoking behaviors and increasing the communication between smokers and family, than health education.

**Practical implications:** Using the family-assisted smoking cessation intervention based on MI, community health service providers can influence and empower low-motivated smokers positively for quit smoking.

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## 1. Introduction

Smoking is the primary cause of preventable diseases worldwide. The annual death toll due to tobacco is predicted to rise to more than eight million by 2030 [1]. China is one of the world's largest producers and consumers of tobacco products. In 2012, 350 million adults (27%) were current smokers in China; this ubiquitous use results in 1 million deaths directly related to smoking and 27.9 billion Yuan in productivity loss annually [2]. Thus, reducing the prevalence of smoking remains one of the country's most important public health goals.

Due to China's large population and smoking's substantial contribution to mortality, researchers have proposed that more

effectively and broadly applied smoking control strategies could prevent at least 50 million deaths [3,4]. Several intervention programs have been developed to help smokers quit in other countries. For example, a combination of counseling and pharmacotherapy has been found to achieve the highest rate of smoking cessation [5–7]. Although some programs have demonstrated moderate efficacy, unfortunately, relapse rate is also high [8], and long-term abstinence rate remains low [9]. Most smokers are “interested” in quitting, but approximately 70–80% does not plan to quit in the next 6 months [8,10]. Currently, many established smoking cessation programs focus on the remaining 20% of smokers who are ready and actively seeking assistance to quit. Primary care physicians are more likely to counsel – or refer to counseling – patients who are motivated to quit [11]. Given that those unmotivated to quit comprise a large majority of the smokers, it is necessary continue investigating proactive intervention for tobacco dependence, especially with respect to smoking motivation and process.

Motivational interviewing (MI) is a promising approach increasingly applied to smoking cessation. It has shown modest

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positive effects, particularly among those who are not currently motivated to quit, or who have low levels of motivation to quit [12,13]. MI has been defined as a collaborative, person-centered directive approach to enhance intrinsic motivation to behavioral change by helping people explore and resolve ambivalence between the desired behavior and their actual behavior [14]. MI uses several communication methods, such as open-ended questions and affirming and reflective listening, to express empathy, develop discrepancy, roll with resistance, and support self-efficacy. Although much evidence showed that MI-based intervention is more effective on smoking cessation than questioning, persuading, or advice-giving, there are significant deficiencies in the existing literature, which has not focused on the role of motivation to quit, used alternative equal intensity control groups, or considered the effect of family support [12,15].

Support from family members, such as spouses, can help the smoker to maintain long-term abstinence [16]. Non-smokers' attitudes and behaviors, especially those of friends and family, also can aid smokers to quit [17]. In particular, studies by Janice et al. showed that third-party support plays an important role in the process of smoking cessation among Chinese–Americans smokers [18]. However, an evaluation of six studies indicated mixed results [19]. Given the limited randomized controlled trials assessing family support and smoking cessation, it is worthwhile to further study the role of family support on quitting. Taken together, these findings suggest that tailoring counseling style to motivational levels and family support may be most effective.

The city of Changsha, located in southern China, has the highest smoking rate (54.54%) among six cities studied in China, but the motivation of its smokers to quit is low [20,21]. Primary health care (hospital or community) can provide a base for the initiation of effective smoking cessation interventions [22]. Community-based services were shown to reduce smoking rates by 12% yearly [23]. Unfortunately, the provision of such treatment is limited in China. The current Chinese smoking cessation programs focus on the rather ineffective method of brief health education, such as questioning, persuading, or advice-giving. To our knowledge, the use of MI-based intervention on smoking cessation in the community has not been previously reported from China. Therefore, we constructed a family-assisted smoking cessation intervention program based on MI for the low-motivated smokers in the communities of Changsha, China.

The purpose of the present study was to conduct a randomized controlled trial to examine the efficacy of MI for inducing attempts to quit among smokers with low motivation, while addressing key limitations of prior studies. We hypothesized that a family-assisted smoking cessation intervention based on MI would yield significantly less daily cigarette consumption, higher 7-day abstinence rates, and higher numbers attempting to quit for at least 24 h than intensity-matched smoking cessation education. Communication frequency and satisfaction as well as results from the Partner Intervention Questionnaire (PIQ), Decisional Balance Scale (DBL), and Situational Temptations Scale (STP), would also improve with the MI-based intervention.

## 2. Methods

A two-armed randomized controlled trial was conducted in the community setting in Changsha, China. The study was approved by the Institutional Review Board (IRB) of Central South University.

### 2.1. Participants and procedure

In China, urban geographical administrative areas go in descending order from city to district, neighborhood, community and household. We selected one of the 15 neighborhoods in Yuelu

district, located in western Changsha. Yuelu has a population of 0.8 million, and its smoking prevalence is 42.3% among the adult population [24]. To avoid the effect of contamination, two geographically separated communities in the neighborhood were randomly selected as the study sites (one intervention and one control community). The distance between the two sites was 5 km. Each had a registered population of ~40,000 with similar distribution by age and gender. In each community, smoker-supporter pairs were recruited through the word of mouth, flyers, billboards, advertising, and physician referral.

General eligibility criteria for participation were: (a) age 18 or above; (b) education level of 6th grade or higher; (c) Chinese speaking; (d) have a mailing address and telephone number. Smoker participants must have been smoking at least 5 cigarettes in the past 7 days, were not motivated or ready to quit smoking (assessed by one question [25]: “Did you try to quit smoking?”, with two possible answers “yes” or “no”). The smokers who reported “No” were designated as potential participants, and had a family member who would participate as a supporter participant. The family supporters could be smokers or non-smokers. Excluded were those who have been involved in other smoking cessation programs, and currently have psychological, alcohol, or drug problems.

Potential smokers were re-screened for their smoking status by a carbon monoxide monitor (Bedfont Scientific piCO + Smokerlyzer). Eligibility is determined by a CO level of 8 parts per million (ppm) or higher [26]. The readiness to quit smoking was re-assessed by one question asking [25], “Are you currently thinking about quitting?” with two possible responses: “No, not at all” or “Yes, in the next 6 months, but have no intention to quit in the next 30 days”. According to their answers, smokers were classified into two groups: pre-contemplators and contemplators.

Eligible smoker-supporter pairs were randomized to the intervention (the family-assisted smoking cessation intervention based on MI) or control (the intensity-matched smoking cessation education) groups (IG & CG). Randomizations were done via a computer-generated random allocation method by an independent statistician. A sample of 71 per group was necessary to detect a difference of 20% between IG and CG [18], with an estimated attrition rate of 20%. Fig. 1 provides the overview of the numbers of subjects screened, randomized, and retained.

### 2.2. The family-assisted smoking cessation intervention

#### 2.2.1. Smokers

All smokers were provided with “Pathways to Change—A Self-Help Manual for All Smokers”, a 32-page A4-size self-help manual on quitting for low-motivated smokers. Two nurses provided guidance to the smokers on how to use this booklet appropriately, lasting about 25 min.

In addition to the 25-min guidance, individualized tailored MI was delivered by the same nurses. MI consists of four weekly, approximately 20-min sessions, and each MI is conducted in-person. According to the “5 R's” (Relevance, Risks, Rewards, Roadblocks, Repetition), nurses assist smokers to explore and resolve ambivalence regarding quitting smoking, consistent with the principles and strategies described by Miller and Rollnick [14]. The “pre-contemplators” and “contemplators” received different points of emphasis in the MI. Detailed contents of the MI are shown in Table 1.

#### 2.2.2. Family supporters

All paired-supporters were provided with “Pathways to Change—A Handbook for Family supporters of All Smokers”, a 37-page A4-size manual, which is matched to the smokers' booklet. Two nurses gave 25-min long in-person guidance to

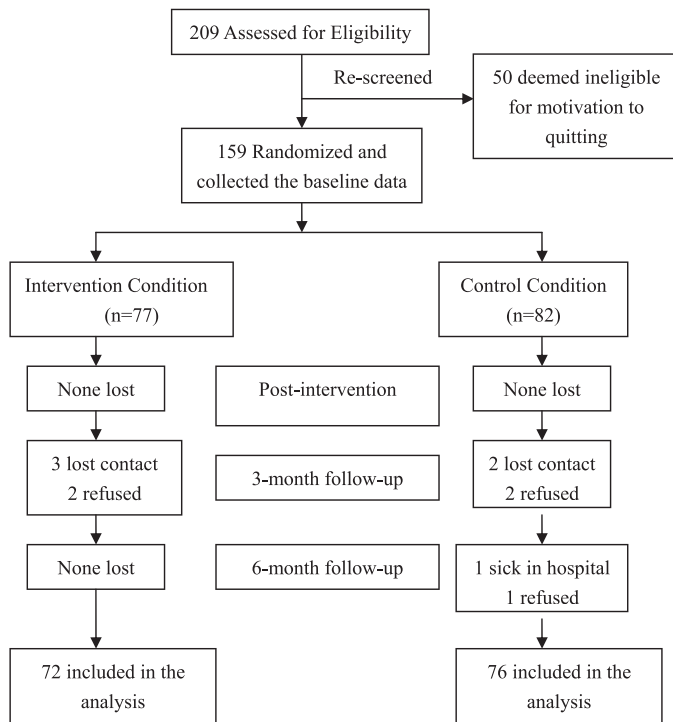


Fig. 1. Recruitment flow chart.

the supporters on how to apply the different strategies in this booklet. These two self-help booklets were both produced by Janice et al. [18].

2.3. The intensity-matched smoking cessation education

The smokers in CG received intensity-matched smoking cessation education that was equivalent in contact time and set-up to the MI group, in four weekly, 20-min sessions conducted in person. The contents of smoking cessation education was based on “5A’s”—(1) ask participants about quitting smoking at each visit, (2) advise smokers to quit, (3) assess smokers’ willingness to try to quit, (4) assist smokers’ efforts with treatment and referrals, and (5) arrange follow-up contacts to support smoking cessation efforts.

The paired-supporters in CG did not receive any intervention. At the 6-month follow-up, the smoker-supporter pairs in CG were also provided the self-help booklets used in IG.

Table 1  
 Contents of MI.

Smokers	Focused topics	Contents
Precontemplators	Discuss relevant risks of smoking	(1) Help the smokers aware that quit smoking is closely related to their own health, and discuss some smoking related issues with them, such as incidence of smoking related diseases, the family or social environment (especially when a family has children), or other important issues (e.g. ever smoking quit experience) (2) Describe the potential short- and long-term negative impacts of smoking, and the dangers of second-hand smoking (3) Emphasize that low tar/nicotine cigarettes or other forms of tobacco (such as smokeless tobacco, cigars and pipes) can not reduce the risks and hazards of smoking
Contemplators	Discuss the rewards of and roadblocks to quitting, and repeat during each visit	(1) Discuss the potential rewards of quitting, such as health promotion, increasing appetite, making good examples for their children (2) Ask the smokers about the obstacles or setbacks in their quitting process, and provide suggestions or solutions (3) Repeat the above process at the end of MI according to the difference condition of each smoker, in necessity

Table 2  
 A brief description of the intervention and control group.

Group	Participants	Contents
IG	Smokers	5 R’ s individualized MI (4 weekly, 20 min sessions, in person) Self-help booklet guidance (25 min)
	Family supporters	Self-help booklet guidance(25 min)
CG	Smokers	“5As” smoking cessation education (4 weekly, 20 min sessions, in person)
	Family supporters	No

IG: intervention group; CG: control group.

A brief description of the intervention and control group is provided in Table 2.

2.4. Fidelity assurance

Two Master’s level registered nurses with prior training and experience in using MI who were working at the community health care center delivered both the IG and CG intervention, to eliminate any potential confounding effects of difference in counselors. Prior to formal intervention, the nurses practiced the intervention protocol with 15 pilot participants. The instruments and protocol were further revised based on feedback from the pilot session. All counseling sessions in the study were digitally recorded, and two nurses were supervised by a psychology expert.

Motivational Interviewing Treatment Integrity (MITI) Code [27] was used to assess the fidelity of the intervention and its adherence to MI principles. A standardized follow-up report was designed in the format used by the University of California, San Francisco (UCSF) treatment research center [18] to summarize information about the quitting conditions, existing problems, and related countermeasures.

2.5. Data collection

All data were collected by trained research assistants who were blinded to the randomization from March to November 2013. Prior to data collection, written informed consent was obtained from each participant. Information related to baseline characteristics, PIQ, DBL, and STP were all collected at four time points: baseline (V0), immediately post-intervention (V1), 3 month (V3), and 6-month follow-up (V6), for participants in both groups. At V3 and V6, data were collected by telephone. The Standardized follow-up

report was assessed at V1, V3 and V6. In this study, the primary outcome measures were daily cigarette consumption, self-reported quitting attempts of at least 24 h, and 7-day smoking point-prevalence abstinence (biochemically verified by a carbon monoxide monitor [26]). The secondary outcomes were PIQ, DBL, and STP.

### 2.5.1. Baseline questionnaire

This questionnaire included (1) demographics characteristics: age, gender, employment, education level, marital status, monthly income (Yuan), coughing for more than 1 month; (2) smoking characteristics: age of first tobacco use, smoking condition of the paired-supporter, daily cigarette consumption, self-reported quitting attempts of at least 24 h, and biochemically verified 7-day smoking abstinence; (3) communication frequency and satisfaction between smokers and paired-supporters.

### 2.5.2. Partner Intervention Questionnaire (PIQ)

PIQ was used to evaluate the frequency of support behaviors that family or friends gave to the smokers, which was developed by Janice et al. [18]. The PIQ contains 20 items covering the negative and positive factors. In this scale, the items employed a five-point Likert-type scale (ranging from 1, "none" to 5, "always"), rating the frequency of each supportive behavior. The published Cronbach's alpha of the two factors was 0.87 and 0.90, respectively. In this study, Cronbach's alpha of the two factors was 0.88 and 0.90, and the retest reliability was 0.83 and 0.84.

### 2.5.3. Decisional Balance Scale (DBL)

The 12-item DBL [18] has a two-factor solution characterizing the pros and cons of smoking. The scale employed a 5-point rating scale ranging from 1 (not at all important) to 5 (very important). The published Cronbach's alpha of the two factors was 0.88 and 0.89, respectively. In this study, Cronbach's alpha of pros and cons factor was 0.82 and 0.87, and the retest reliability for the one-month interval was 0.82 and 0.69.

### 2.5.4. Situational Temptations Scale (STP)

The 9-item STP [18] contains three factors, negative affect situations, positive affect/social situations, and habitual/craving situations. The 5-point rating scale (1, "no temptation" to 5, "extreme temptation") predicts the trend of smoking behavior change. The published Cronbach's alpha of the STP was 0.76. In this study, Cronbach's alpha was 0.78, and the retest reliability for the one-month interval was 0.60.

## 2.6. Data analysis

The data were analyzed using SPSS for Windows (version 17.0). The homogeneity tests of the baseline characteristics of the two groups were performed using independent *t*-tests, chi-square tests, and non-parametric tests (Kruskal–Wallis *H* test). Repeated-measures analyses of variance (ANOVAs) was used to analyze the effects of intervention on smoking characteristics, PIQ, DBL, and STP. The design for each ANOVA included one between-group factor (intervention or control group), one within subject factor (time: V0, V1, and V3), and the interaction factor (group allocation × time). The independent *t*-tests and non-parametric tests were used to test group differences on outcomes at each time point. The pairwise comparisons with Bonferroni adjustment among groups were performed to analyze the outcomes of intervention group across times (V0, V1, V3, and V6). Generalized estimating equations (GEE) were used to further analyze the effect of intervention on the primary and secondary outcomes across groups over time. For all analyses, missing data were transformed by mean imputation and *P* < 0.05 was considered significant. Note

**Table 3**

Comparison of baseline characteristics between intervention and control group.

Characteristics	Intervention ( <i>n</i> = 72)	Control ( <i>n</i> = 76)	<i>P</i> -value
<b>Demographic data</b>			
Mean age (y) (SD)	47.10 ± 15.92	49.63 ± 14.08	0.306 <sup>a</sup>
Gender (%)			
Male	63 (87.5)	68 (89.5)	0.707 <sup>b</sup>
Female	9 (12.5)	8 (10.5)	
Education level (%)			
Less than high school	32 (44.4)	27 (35.5)	0.093 <sup>b</sup>
High school/Secondary	28 (38.9)	26 (34.2)	
Diploma above	12 (16.7)	23 (30.3)	
Marital status (%)			
Married or cohabiting	61 (84.72)	72 (94.74)	0.044 <sup>b</sup>
Other	11 (15.28)	4 (5.26)	
Working status (%)			
Full-time job	31 (43.06)	39 (51.32)	0.581 <sup>b</sup>
Part-time job	4 (5.56)	3 (3.95)	
Unemployment	4 (5.56)	7 (9.21)	
Retired	28 (38.89)	21 (27.63)	
Other	5 (6.94)	6 (7.89)	
Coughing for more than 1 month (%)			
Yes	17 (23.6)	29 (38.2)	0.056 <sup>b</sup>
No	55 (76.4)	47 (61.8)	
Monthly Income* (Yuan)	1500 (997–1969)	1500 (1009–2187)	0.682 <sup>c</sup>
<b>Smoking characteristics</b>			
Age of onset smoking*	18.0 (16.0–22.0)	18.0 (17.0–24.3)	0.759 <sup>c</sup>
Daily cigarette consumption*	20.0 (12.6–20.0)	20.0 (10.0–20.0)	0.584 <sup>c</sup>
Quitting attempts of at least 24 h*	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.577 <sup>c</sup>
7-day smoking abstinence*	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.784 <sup>c</sup>
The paired-supporters' smoking condition (%)			
Yes	12 (16.67)	15 (19.74)	0.675 <sup>b</sup>
No	60 (83.33)	61 (80.26)	
<b>Communication characteristics</b>			
Communication frequency (%)			
At least once per day	13 (18.1)	9 (11.8)	0.070 <sup>b</sup>
At least once or twice per week	24 (33.3)	15 (19.7)	
At least once or twice per month	18 (25.0)	19 (25.0)	
At least once or twice per year	15 (20.8)	26 (34.2)	
Less than once per year	2 (2.8)	7 (9.2)	
Communication satisfactory (%)			
Unsatisfactory	10 (13.9)	14 (18.4)	0.150 <sup>b</sup>
Neutral	28 (38.9)	38 (50.0)	
Satisfactory	34 (47.2)	24 (31.6)	

\* Median, P25–P75; SD, standard deviation.

<sup>a</sup> *P*-values for independent *t*-test.

<sup>b</sup> *P*-values for  $\chi^2$ -test.

<sup>c</sup> *P*-values for non-parametric test.

that the 6-month data was only analyzed in IG, because of too many invalid questionnaires in CG.

## 3. Results

### 3.1. Homogeneity test of subjects

There was no significant difference between the two groups in terms of demographics and smoking and communication characteristics, except for marital status (*P* = 0.044) (Table 3).

**Table 4**  
The efficacy of intervention on smoking characteristics.

Variable	Group	Time points <sup>a</sup>			Time effect <i>F</i> ( <i>P</i> )	Group effect <i>F</i> ( <i>P</i> )	Group × time <i>F</i> ( <i>P</i> )
		V0	V1	V3			
Daily cigarette consumption	IG	20.00 (12.58–20.00)	10.00 (3.00–14.00)	7.00 (2.00–10.00)	46.95 (0.000)	10.45 (0.002)	17.90 (0.000)
	CG	20.00 (10.00–20.00)	20.00 (10.00–20.00)	20.00 (10.00–20.00)			
	<i>Z</i> ( <i>P</i> )	–0.55 (0.584)	–4.42 (0.000)	–5.06 (0.000)			
Quitting attempts of at least 24 h	IG	0.00 (0.00–1.00)	2.00 (0.00–4.00)	5.00 (1.00–10.00)	38.24 (0.000)	15.18 (0.000)	52.10 (0.000)
	CG	0.00 (0.00–2.00)	0.00 (0.00–0.00)	0.00 (0.00–0.00)			
	<i>Z</i> ( <i>P</i> )	–0.56 (0.577)	–5.23 (0.000)	–6.58 (0.000)			
7-day smoking abstinence	IG	0.00 (0.00–0.00)	0.00 (0.00–1.00)	2.00 (0.00–3.00)	23.55 (0.000)	9.99 (0.002)	14.71 (0.000)
	CG	0.00 (0.00–0.00)	0.00 (0.00–0.00)	0.00 (0.00–0.00)			
	<i>Z</i> ( <i>P</i> )	–0.27 (0.784)	–0.79 (0.543)	–5.80 (0.000)			

<sup>a</sup> Median, *P*25–*P*75.

### 3.2. The efficacy of intervention on smoking characteristics (Table 4)

#### 3.2.1. Daily cigarette consumption

An interaction term (group difference × time) had a statistically significant effect on the number of cigarettes smoked per day at V1 and V3. This indicates IG had more significant decrease in daily cigarette consumption overtime than CG, *F* = 17.90, *P* < 0.001. Significant differences were also observed within IG between V6 and V0 (median difference (MD) = –14.84, 95% CI: –18.912 to –10.771), and between V6 and V1 (MD = –3.76, 95% CI: –5.299 to –2.217).

#### 3.2.2. Self-reported quitting attempts of at least 24 h

An interaction term (group difference × time) had a statistically significant effect on self-reported quitting attempts of at least 24 h at V1 and V3. This indicates IG had more significant increase in self-reported quitting attempts of at least 24 h overtime than CG, *F* = 52.10, *P* < 0.001. Significant differences were also observed within IG between V6 and V0 (MD = 5.57, 95% CI: 4.617–6.522), between V6 and V1 (MD = 3.69, 95% CI: 2.696–4.693), and between V6 and V3 (MD = 1.00, 95% CI: 0.131–1.869).

#### 3.2.3. 7-Day smoking point-prevalence abstinence

An interaction term (group difference × time) had a statistically significant effect on biochemically verified 7-day smoking abstinence at V3. This indicates IG had more significant increase in biochemically verified 7-day smoking abstinence overtime than

CG, *F* = 14.71, *P* < 0.001. But, at V1, the 7-day smoking abstinence was not significantly different between the two groups (*P* > 0.05). Within IG, there was a significant difference between V6 and V0 (MD = 2.60, 95% CI: 1.095–2.849) and between V6 and V1 (MD = 1.97, 95% CI: 1.095–2.849). The GEE consistently showed result that biochemically verified 7-day smoking abstinence was predictive of smoking cessation (data not shown).

### 3.3. The efficacy of intervention on Communication characteristics, PIQ, DBL, and STP

#### 3.3.1. Communication characteristics

Significant group differences on communication frequency (V1:  $\chi^2 = 48.34$ , *P* < 0.001; V3:  $\chi^2 = 46.98$ , *P* < 0.001) and communication satisfaction (V1:  $\chi^2 = 10.50$ , *P* < 0.01; V3:  $\chi^2 = 14.99$ , *P* < 0.001) were observed at V1 and V3.

#### 3.3.2. PIQ

An interaction term (group difference × time) had a statistically significant effect on the Positive dimension of PIQ at V1 and V3. This indicates IG had more significant increase in the Positive dimension of PIQ overtime than CG, *F* = 12.42, *P* < 0.001 (Table 5). In IG, there was no significant difference between V6 and V1, or between V6 and V3, but there was a difference between V6 and V0 (MD = –4.74, 95% CI: –8.431 to –1.041). The GEE consistently showed that the Positive dimension of PIQ had positive correlation with quitting smoking (data not shown).

**Table 5**  
The efficacy of intervention on PIQ, DBL and STP.

Variable	Group	Time points <sup>a</sup>			Time effect <i>F</i> ( <i>P</i> )	Group effect <i>F</i> ( <i>P</i> )	Group × time <i>F</i> ( <i>P</i> )
		V0	V1	V3			
PIQ-positive	IG	27 ± 7.46	31.24 ± 7.21	30.68 ± 8.70	15.15 (0.000)	6.37 (0.026)	12.42 (0.000)
	CG	27.25 ± 10.86	27.41 ± 10.59	27.51 ± 10.59			
	<i>t</i> ( <i>P</i> )	–0.16 (0.870)	2.58 (0.011)	1.99 (0.048)			
DBL-pros	IG	15.71 ± 4.84	13.50 ± 5.02	12.61 ± 4.76	30.00 (0.000)	9.15 (0.003)	15.36 (0.000)
	CG	16.38 ± 4.41	15.97 ± 4.37	15.88 ± 4.30			
	<i>t</i> ( <i>P</i> )	–0.89 (0.377)	–3.20 (0.002)	–4.39 (0.000)			
DBL-cons	IG	16.46 ± 6.16	18.60 ± 3.91	19.31 ± 4.02	13.82 (0.000)	11.35 (0.001)	5.71 (0.008)
	CG	15.21 ± 5.60	15.37 ± 5.50	15.97 ± 6.04			
	<i>t</i> ( <i>P</i> )	1.29 (0.199)	4.13 (0.000)	3.97 (0.000)			
STP	IG	31.04 ± 5.70	29.64 ± 5.07	25.79 ± 5.83	16.96 (0.000)	12.42 (0.001)	30.12 (0.000)
	CG	31.70 ± 5.68	30.22 ± 5.27	31.55 ± 5.82			
	<i>t</i> ( <i>P</i> )	–0.70 (0.485)	–0.69 (0.493)	–6.01 (0.000)			

PIQ: Partner Intervention Questionnaire.

DBL: Decisional Balance Scale.

STP: Situational Temptations Scale.

<sup>a</sup> Mean ± SD (standard deviation).

### 3.3.3. DBL

As shown in Table 5, an interaction term (group difference  $\times$  time) had a statistically significant effect on DBL at V1 and V3. This indicates IG had more significant increase in the Cons factor of DBL overtime than CG,  $F = 5.71$ ,  $P < 0.05$ , and decrease in the Pros factor ( $F = 15.36$ ,  $P < 0.001$ ). In IG, the outcomes of DBL (Cons and Pros) at V6 were significantly different than those at V0, V1, and V3 ( $P < 0.05$ ).

### 3.3.4. STP

An interaction term (group difference  $\times$  time) had a statistically significant effect on STP at V3. This indicates IG had more significant decrease in STP overtime than CG,  $F = 30.12$ ,  $P < 0.001$ . But at V1, STP was not significantly different between the two groups ( $P > 0.05$ ). In IG, the outcomes of STP at V6 were significantly different than those at V0, V1, and V3 ( $P < 0.05$ ).

## 3.4. Intervention fidelity

In this study, all summary scores and global assessment scores of MITI were evaluated against established benchmarks of MI quality [27]. The scores indicated that the nurses showed high levels of fidelity to MI. The Standardized follow-up report provided further assurance of the quality of intervention.

## 4. Discussion and conclusion

### 4.1. Discussion

This study demonstrated that the family-assisted smoking cessation intervention based on MI is more effective than intensity-matched smoking cessation education on reducing daily cigarette consumption, increasing quitting attempts of at least 24 h, and increasing 7-day abstinence among low-motivated smokers. Furthermore, communication frequency and satisfaction, PIQ, DBL, and STP were also improved by the smokers who participated in MI-based intervention.

Participants in IG reduced the number of cigarettes smoked per day from 20 to 7, while the controls continued to smoke the same amount (Table 4). In addition to daily cigarette consumption, the number of self-reported quitting attempts and biochemically verified 7-day abstinence also increased significantly more in IG ( $P < 0.05$ ). These results were consistent with previous studies [12] and indicated that MI intervention has a positive effect on smoking cessation. This study showed that family-assisted smoking cessation intervention based on MI could significantly reduce smoking in this population. The observed effect on biochemically-confirmed cessation, was inconsistent with a previous study [28]. Possibly MI-based smoking cessation intervention is more suitable to smokers with low levels of motivation to quit [12,13].

A 6-month follow-up after quitting can help smokers to avoid relapse [29,30]. In this study, there was an increase in attempts to quit for at least 24 h in IG from V0 to V6, V1 to V6, and V3 to V6 ( $P < 0.05$ ), suggesting that after family-assisted MI intervention, the readiness to quit among smokers in IG changed, the quitting autonomy of the subjects improved, leading to more smokers attempting to quit for at least 24 h. However, the differences in daily cigarette consumption and 7-day abstinence between V6 and V3 were not significant ( $P < 0.05$ ), suggesting these parameters were maintained at the intervention level. Thus, with the increase in quitting attempts, and the decrease in daily cigarette consumption, the cessation rates are more likely to improve [31].

As we hypothesized, family support plays an important role. After intervention, the communication frequency and satisfaction between the smokers and their family supporters significantly

increased. The supporters were more likely to use positive and encouraging communication (e.g., praise the smoker's non-smoking, help smokers to think about the alternatives to smoking), rather than criticism. The effect continued through the 6-month follow-up. The results suggested that after family supporters read the matched self-help booklets, they generally realized their role in the quitting process of smokers, so they communicated more actively with the smokers, and encouraged and helped them to quit. Most importantly, the finding confirmed the opinion that smokers in the stage of pre-contemplate and contemplate perceived a more positive norm of their family and friend's support regarding quitting than smokers in other stages [32]. Thus, the family-assisted MI intervention is more appropriate for smokers with low motivation to quit.

The decisional balance concept emphasizes perceiving high benefits and low barriers before behavior change can occur [32]. In this study, the smokers' cons of smoking increased faster, while the pros of smoking decreased faster over time in IG. This confirmed the opinion that the decrease of pros and increase of cons of smoking among smokers with less motivation to quit, can facilitate the smokers advance in smoking stages and change their smoking pattern [32]. Situational temptation reflects the intensity of urges of people to engage in smoking when in difficult situations [33], which was an important indicator to predict smokers' risk of relapse [34]. In this study, there was a significant decrease in STP, indicating that after intervention, the smokers were less tempted to smoke. Consequently, the risk of relapse was reduced, and the quitting confidence was enhanced.

In China, the vast majority (74%) of smokers are not ready to quit [35]. These smokers experience a great deal of ambivalence, which links to the lack of readiness to change [36]. Resolving the ambivalence and changing the motivation for quitting is crucial for progress. In this study, we attempted to construct the family-assisted smoking cessation intervention based on MI for this large majority of the smoking population. We aimed to address some key limitations of prior MI studies [12,15], such as considering the role of motivation to quit and making a comparison with the alternative equal intensity control group. This smoking cessation study was based on previous research of Janice et al. [18]. Our results implied that this MI-based smoking cessation program is acceptable, understandable, and applicable to Mainland Chinese smokers.

Several limitations must be considered when interpreting these results. The study only involved adult smokers who have low motivation to change, and the participants in this study were mainly middle-aged, so the findings cannot be generalized to other populations (e.g., adolescents). Although biochemically verified abstinence was used, pharmacological interventions can be added in order to enhance the effect of smoking cessation because drug intervention can better control the onset of addiction. We did not include smokers already having an intention to quit in the immediate future (e.g., 2 months). They would be classified as contemplators and would be difficult to characterize as smokers with low motivation to quit. The 6-month data was only analyzed in IG, because too many invalid questionnaires were received in CG. This may be due to loss of interest among CG participants. We conducted MI for only one month, which might not have allowed the nurses and smoker-supporter pairs enough time to implement the MI strategy. Additionally, intention to treat analysis was not conducted in this study, so the findings must be interpreted with caution.

### 4.2. Conclusion

In this study, the family-assisted smoking cessation intervention based on MI was provided to the smokers who have low

motivation to quit. Compared with the intensity-matched smoking cessation education, this family-assisted MI intervention was more effective in changing smoking behaviors and increasing the communication between smokers and family. Given the large numbers of smokers in China with low motivation to quit, our data suggests that a smoking cessation intervention based on MI may aid community health service providers in curbing smoking. Thus, there is a need to further explore how to integrate this intervention method into community health services.

#### 4.3. Practice implications

Our data identifies a potentially effective smoking cessation intervention based on MI for community health service providers. We hope that this family-assisted smoking cessation intervention based on MI can be integrated into community health service. Through this way, it would be more likely to offset not only the paucity of tax, but also the deficiency of the environmental, support systems that are both playing important roles in smoking cessation in China.

#### Conflict of interest statement

The authors declare that there is no conflict of interest.

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#### References

- [1] World Health Organization. Tobacco. World Health Organization; 2012 (Access date: July, 2014) Accessed at: (<http://www.who.int/mediacentre/factsheets/fs339/en/>).
- [2] The Ministry of Health in China. The report of harm to smoking in China. The Ministry of Health in China; 2012 (Access date: July, 2014) Accessed at: ([http://www.gov.cn/jrzq/2012-05/31/content\\_2149305.htm](http://www.gov.cn/jrzq/2012-05/31/content_2149305.htm)).
- [3] Peto R, Chen Z, Boreham J. Tobacco—the growing epidemic in China. *J Am Med Assoc* 1996;275:1683–4.
- [4] Yang G, Ma J, Chen A, Zhang Y, Samet JM, Taylor CE, et al. Smoking cessation in China: findings from the 1996 National Prevalence Survey. *Tob Control* 2001;10:170–4.
- [5] Nides M. Update on pharmacologic options for smoking cessation treatment. *Am J Med* 2008;121:S20–31.
- [6] Rigotti NA. Clinical practice. Treatment of tobacco use and dependence. *N Engl J Med* 2002;346:506–12.
- [7] Stead LF, Lancaster T. Combined pharmacotherapy and behavioral interventions for smoking cessation. *Cochrane Database Syst Rev* 2012;10:CD008286. <http://dx.doi.org/10.1002/14651858.CD008286.pub2>.
- [8] Yang GH. Tobacco harm to health and tobacco control strategy. *Chin J Prev Contr Chron Non-commun Dis* 1999;7:97–9 (In Chinese).
- [9] Brandon TH, Vidrine JJ, Litvin EB. Relapse and relapse prevention. *Annu Rev Clin Psychol* 2007;3:257–84.
- [10] Catley D, Harris KJ, Goggins K, Richter K, Williams K, Patten C, et al. Motivational interviewing for encouraging quit attempts among unmotivated smokers: study protocol of a randomized, controlled, efficacy trial. *BMC Public Health* 2012;12:456.
- [11] Meredith LS, Yano EM, Hickey SC, Sherman SE. Primary care provider attitudes are associated with smoking cessation counseling and referral. *Med Care* 2005;43:929–34.
- [12] Heckman CJ, Egleston BL, Hofmann MT. Efficacy of motivational interviewing for smoking cessation: a systematic review and meta-analysis. *Tob Control* 2010;19:410–6.
- [13] Hettema JE, Hendricks PS. Motivational interviewing for smoking cessation: a meta-analytic review. *J Consult Clin Psychol* 2010;78:868–84.
- [14] Miller WR, Rollnick S. Ten things that Motivational Interviewing is not. *Behav Cogn Psychother* 2009;37:129–40.
- [15] Lai DT, Cahill K, Qin Y, Tang JL. Motivational interviewing for smoking cessation. *Cochrane Database Syst Rev* 2010;20:CD006936. <http://dx.doi.org/10.1002/14651858.CD006936.pub2>.
- [16] Sun HQ, Guo S, Chen DF, Jiang ZN, Liu Y, Di XL, et al. Family support and employment as predictors of smoking cessation success: a randomized, double-blind, placebo-controlled trial of nicotine sublingual tablets in Chinese smokers. *Am J Drug Alcohol Abuse* 2009;35:183–8.
- [17] Pipe A, Sorensen M, Reid R. Physician smoking status, attitudes toward smoking, and cessation advice to patients: an international survey. *Patient Educ Couns* 2009;74:118–23.
- [18] Janice T, Velicer WF. Expert system and family assisted interventions for Chinese smokers. San Francisco, CA: University of California; 2008. Accessed at: (<http://clinicaltrials.gov/show/NCT00714467>).
- [19] Yu HX, Lin JT. Analysis the practice application value of various of quitting from the perspectives of evidence-based medicine. *Int J Respir* 2006;26:199–202.
- [20] Yang Y, Yang H, Yang XL. Analysis impact factors of smoking quit success—one year follow-up research of smoking quit competition in 2002, China. *J Hyg Res* 2004;33:478–80 (In Chinese).
- [21] Zhu GP, Jiang H, Li Q, Hu LP, Hu JS, Yin L, et al. Comparison of smoking characteristics among smokers in Changsha and five other cities in China. *Pract Prev Med* 2008;5:1691–4 (In Chinese).
- [22] Bitton A, Fichtenberg C, Glantz S. Reducing smoking prevalence to 10% in five years. *J Am Med Assoc* 2001;286:2733–4.
- [23] Ma HJ, Fan HJ, Jiao HB, Xie JH. The effect of post-discharge nursing intervention on smoking-quit rate of patients. *J Nurs (China)* 2006;13:49–50 (In Chinese).
- [24] The people's government of Yuelu district of Changsha municipality. Available (<http://www.yuelu.gov.cn/tabid/76/Default.aspx>) (online) [access Jan 2015], (In Chinese).
- [25] Prochaska JO, Diclemente CC, Norcross JC. In search of how people change. Applications to addictive behaviors. *Am Psychol* 1992;47:1102–14.
- [26] SRNT Subcommittee on Biochemical Verification. Biochemical verification of tobacco use and cessation. *Nicotine Tob Res* 2002;4:149–59.
- [27] Moyers TB, Martin T, Manuel JK, Hendrickson SML, Miller R. Assessing competence in the use of motivational interviewing. *J Subst Abuse Treat* 2005;28:19–26.
- [28] Colby SM, Nargiso J, Tevyaw TO, Barnett NP, Metrik J, Lewander W, et al. Enhanced motivational interviewing versus brief advice for adolescent smoking cessation: results from a randomized clinical trial. *Addict Behav* 2012;37:817–23.
- [29] Brandon TH, Collins BN, Juliano LM, Lazev AB. Preventing relapse among former smokers: a comparison of minimal interventions through telephone and email. *J Consult Clin Psychol* 2000;68:103–13.
- [30] Klesges RC, Haddock CK, Lando H, Talcott GW. Efficacy of forced smoking cessation and adjunctive behavioral treatment on long-term smoking rates. *J Consult Clin Psychol* 1999;67:952–8.
- [31] Zhu XM, Yang Y, Nan Y, Wei XS, Zhou G, Zhao J, et al. Evaluation of effects on the one-year follow-up for the international “Quit & Win” campaign in China in 2004. *Chin J Epidemiol* 2007;28:98–9 (In Chinese).
- [32] Erol S, Erdogan S. Application of a stage based motivational interviewing approach to adolescent smoking cessation: the Transtheoretical Model-based study. *Patient Educ Couns* 2008;72:42–8.
- [33] DiClemente CC, Prochaska JO, Fairhurst SK, Velicer WF, Velasquez MM, Rossi JS. The process of smoking cessation: an analysis of precontemplation, contemplation and contemplation/action. *J Consult Clin Psychol* 1991;59:295–304.
- [34] Velicer WF, Norman GJ, Fava JL, Prochaska JO. Testing 40 predictions from the transtheoretical model. *Addict Behav* 1999;24:455–69.
- [35] Yang GH, Ma JM, Liu N, Zhou LN. A survey of smoking and passive smoking among Chinese smokers in 2002. *Chin J Epidemiol* 2005;26:77–83 (In Chinese).
- [36] Rollnick S, Kinnerley P, Stott N. Methods of helping patients with behavior change. *Brit Med J* 1993;307:188–90.