Presenting a Causal Model of Factors Affecting Metacognitive Awareness: The Mediating Role of Goal Orientation and Self-efficacy with Seamless Flipped Learning among Medical Sciences Students in General English Course

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ABSTRACT

Background: Metacognitive awareness is the most important form of new learning science. It enables the learner to maintain his or her learning path and to think. A seamless flipped learning class reinforces this process. The aim of this study was to investigate the causal relationships between the need to know, metacognitive beliefs, and metacognitive awareness with the mediating role of goal orientation and self-efficacy among students of Shiraz University of Medical Sciences.

Methods: This was a cross-sectional descriptive-correlational study in terms of methodology. The statistical population of this study included all undergraduate Medical Sciences students at Shiraz University of Medical Sciences who were enrolled in a General English course in the academic year 2020–2021 (n=2455). The study sample included 380 students, who were selected by a multistage sampling method based on Morgan's table. Participants completed an integrated questionnaire that included: metacognitive awareness, need for cognition, goal orientation, self-efficacy, and metacognitive beliefs. All the questionnaires had good validity and reliability. Path analysis was used to analyze the data, which was done with Amos 22, Lisrel 8.50, and SPSS 22.

Results: Four factors of metacognitive beliefs, need to know, goal orientation, and self-efficacy have a significant effect on metacognitive awareness in students. Among the endogenous variables, self-efficacy had the most effect (0.19) and metacognitive beliefs had the least effect (0.164) on the metacognitive awareness variable.

Conclusion: The results obtained for the fit indices of the proposed model showed that it had a good fit with the data collected from the respondents. Accordingly, this model can assist educational leaders in their decision-making and policy-making to improve student learning outcomes.

Keywords: Metacognition, Metacognitive beliefs, Need to know, Orientation, Self-efficacy, Seamless flipped learning (SFL)

Introduction

The new science of learning includes active and metacognitive learning (1). This type of science is essential for thinking at high levels of cognition. Metacognitive awareness requires students to reflect on what they know, care about, and are able to do, which not only helps learners to develop self-awareness but also provides them with valuable information to teach them (2, 3). With the arrival of the COVID virus, it has undergone fundamental changes. But education in universities, including medical universities, not only did not close, but also turned restrictions into learning opportunities by adopting new teaching methods. One of these new learning methods is seamless flipped learning (SFL).

SFL is the product of these recent changes, which have many benefits in education. In the current century, one experiences learning continuity and consciously uses multifaceted learning efforts in a combination of places, times, technologies, or social environments. This training transforms traditional courses and leads students to use their knowledge and achieve higher level learning goals (2).

The SFL study motivates students to watch videos before class to make the most of the class time to resolve difficult concepts and ask questions. It also recommends students step forward in their learning and build strong connections with their daily lives (4). It transfers the instructions from the group learning space into an individual learning environment and changes the collective environment into a dynamic, active learning environment. Teachers apply the concepts to students and instruct them to creatively participate in the theme (5).

Extensive research has examined SFL and its effects on student learning outcomes and participation. The results of research by Hwang et al., Hsiao et al., and Luong showed students trained in the SFL had deeper learning, greater satisfaction, and better outcomes (6-8). Students trained in the seamless flipped classroom create deeper learning at higher levels of learning (1) which

highlights the importance and necessity of metacognitive awareness in this research.

Different motivational and cognitive variables affect metacognitive awareness. One of the variables affecting metacognitive awareness is goal orientation. It expresses a coherent pattern of one's beliefs that causes one to approach situations in different ways, to work in that field, and finally to provide an answer (9). Hayati et al. showed that students who mastered the goal orientation of the task and had a high sense of independence and, at the same time, high intrinsic motivation benefited from metacognitive awareness (9, 10).

Another influential variable is self-efficacy, which today has a good place in different levels of thinking (11). Bagci and Unveren found that metacognitive awareness significantly contributes to the perception of self-efficacy in student comprehension. The study also found that metacognitive awareness training has a significant effect on students' self-efficacy (11). Additionally, the other influential variables are metacognitive beliefs about one's cognitive resources in a field, how well one performs in that field, the exploratory strategies and methods one can use, and the nature of that field of knowledge (12). Beliefs using metacognitive awareness strategies have important effects on individual performance. Numerous studies have shown that strengthening and changing metacognitive beliefs leads to significant changes in metacognitive awareness (13).

The last influential variable is the need to know. The need to know is considered as a general and relatively stable internal motivational trait. People who need cognition have a high level of internal consumption of their cognitive resources and actively tend to situations that are cognitively challenging (14). People with high cognition determine how people invest their cognitive resources and how they deal with content that is cognitively challenging (14).

For example, people with high cognition are more likely to engage in and enjoy metacognitive strategies (15). Al-Hamouri and Abu Mokh's study found a positive and

significant relationship between the level of need to know and the level of metacognitive awareness among students, which shows the importance of focusing on the need to know and developing metacognitive thinking skills among university students (13).

Coutinho adds that students who have a high need to know can translate comprehensive and in-depth learning strategies to reach higher levels of comprehension and then to better functional levels for educational practices and the various situations they face. People with low levels of cognitive needs do not enjoy cognitive activities (16). The results of Coutinho's study of American students showed a direct relationship between the need to know and metacognitive awareness, and the need to recognize is an important predictor of mindfulness. (11).

The spread of the Corona virus has made it possible to use modern teaching methods as well as various technologies for learning. Furthermore, due to the virtual nature of the General English class, educational packages in the form of podcasts and video casts were prepared from the content of the textbook, along with additional and supplementary assignments for better and deeper learning on the educational site and the college classroom site. Students were present and absent during the semester. In addition to the educational site, by forming virtual groups and social networks, students were asked to benefit from additional and supplementary assignments by visiting the groups regularly. Also, exchange ideas with the presence of professors in the group. This improves thinking at the highest levels of learning. In fact, this technology can be used anywhere in the absence of learning resources or where complementary instructions are required.

Finally, in view of the discussed literature, no study appears to have explored the results of the factors affecting metacognitive awareness with the SFL method in our proposed conceptual model.

Therefore, the present study used path analysis to investigate the factors affecting metacognitive awareness through the SFL method. In this study, self-efficacy, goal orientation, need to know, and metacognitive beliefs were examined.

Methods
Study Design
This research is a cross-sectional, descriptive-correlational study.

Participants and Settings
The population included all undergraduate students at Shiraz University of Medical Sciences who were studying in the academic year of 2020-2021 (2455 people).

Inclusion and Exclusion Criteria:

The inclusion criteria included: 1) studying in one of the aforementioned programs in the first and second semesters; 2) Attending General English classes throughout the semester; 3) willingness to take part in the study. The exclusion criteria included submitting incomplete questionnaires.

Procedure: The researchers first introduced themselves to the participants and informed them about the purpose of the study. We guaranteed the participants that their information would be treated with confidentiality. Since the general language course was considered common to all disciplines, educational packages in the form of podcasts and video casts were prepared from the content of the English language book. In addition to the content of the book, additional and supplementary materials related to each lesson were also prepared and uploaded on the LMS class site. The duration of training was equal to one semester (16 sessions). Students were asked to download and read the training package before each class session, then enter the classroom.

At the end of the course, an integrated questionnaire was filled out by the students, and 380 questionnaires were returned.

Descriptive (mean and standard deviation) and inferential statistical indices were used for the analysis of the data. Path analysis was applied in the priori section to look over the direct, indirect, and total effects of variables on each other. For the descriptive statistics

section, we used SPSS 22, LISREL 8.50 for path analysis, and AMOS 22 for factor analysis.

The variables in this study were categorized into five categories: metacognitive awareness (criterion variable), need to know, metacognitive beliefs (predictor variables), and goal orientation and self-efficacy (mediator variables). We used an integrated questionnaire (including five standard questionnaires) to assess the variables.

The components of the integrated questionnaire were as follows: metacognitive awareness, need to know, goal orientation, self-efficacy, and metacognitive beliefs. All items of the integrated questionnaire were scored on a five-point Likert scale (1=strongly disagree, 5=strongly agree). The validity of the questionnaires was confirmed by confirmatory factor analysis, which indicated an appropriate correlation coefficient between the variables. The structural validity of all of the questionnaires was previously confirmed by various researchers. The content validity of the questionnaires was also confirmed by five faculty members and two experts in educational sciences. The minimum and maximum obtainable scores were 39 and 195, respectively. The questionnaires that were used as the measurement tools in the study were as follows:

Mokhtari and Richard's Metacognitive Awareness Questionnaire: It contains 17 items designed by Mokhtari and Richard. (6) All questions are in a 5-point range using Likert's scoring scale (16). In their study, Abdelrahman (15) reported a Cronbach's alpha coefficient of 0.86 for this variable. The Cronbach's alpha coefficient for the reliability of the questionnaire stood at 0.88 in the present study. This coefficient was measured at 0.88 in the study by Yazdani et al. (16).

Kasupu & Pti need to know Questionnaire: It contains seven items designed by Kasupu and Pti. All questions are in a 5-point range using Likert's scoring scale (15). In their study (13), Hamouri and Mokh reported a Cronbach's alpha coefficient of 0.89 for this variable in their study (13). In the present study, Cronbach' alpha coefficient for the reliability of the questionnaire was 0.75.

Buofard et al.'s short-form goal orientation questionnaire: It contains five items designed by Buofard et al. (6). All questions are in a 5-point range using Likert's scoring scale (1=strongly disagree, 5=strongly agree). In their study, Rezapour (17) reported a Cronbach's alpha coefficient of 0.86 for this variable. The alpha coefficient for the reliability of the questionnaire was found to be 0.89 in this study.

Self-Efficacy Questionnaire: It contains four items designed by Sheirer (2). All questions are in a 5-point range using Likert's scoring scale. In his study, Masoodi (18) reported a Cronbach's alpha coefficient of 0.82 for this variable. In our study, the alpha coefficient of the reliability of the questionnaires was 0.85.

Short-form of the Metacognitive Beliefs Questionnaire: It contains six items designed by Welz. All questions are in a 5-point range using Likert's scoring scale (1=strongly disagree, 5=strongly agree). In their study, Dehghani & Hekmatiyan Fard (10) reported a Cronbach's alpha coefficient of 0.87 for this variable. In the present study, the alpha coefficient for the reliability of the questionnaire was found to be 0.92.

Sample Size: A total of 380 students were selected based on Cochran's formula.

Sample Method: Randomized multistage cluster sampling was applied in this study. For this purpose, undergraduate students at Shiraz University of Medical Sciences. At first, 5 main faculties (paramedical, nursing, health, medicine, and pharmacy) were randomly selected from among Shiraz medical schools. Therefore, the students who chose the general language course in the second semester were identified.

For analyzing the data, descriptive statistics (mean, standard deviation, skewness, and kurtosis) and inferential statistics (path analysis and Pearson correlation coefficient) were used, and for analyzing the relationships between research variables and

testing hypotheses in the form of a causal comparative model based on theoretical and empirical background, Amos24 and SPSS21 (IBM, Armonk, NY, USA) software were used.

Ethical Considerations

It should be noted that for doing research, the ethics code (IR.PNU.REC.1400.005) was obtained from the ethics committee in biomedical research, and in all cases, including informed consent of the volunteers and the rights of the authors, designing the study, and so on, all ethical principles have been observed. It should be noted that the reliability of the integrated questionnaire in the present study was 0.81 (Figure 1).

Results

The statistical sample included 380 undergraduate students from Shiraz University of Medical Sciences (48% male and 52% female), and their average age was 21 years. Among them, 39% were studying psychology, 28% consulting, and 33% educational sciences.

As seen in the figure, need to know has a direct and significant effect on goal orientation,

self-efficacy, and metacognitive awareness. 2. Metacognitive beliefs have a direct and significant effect on goal orientation, self-efficacy and metacognitive awareness. 3. Goal orientation and self-efficacy have a direct and significant effect on metacognitive awareness. The need for metacognitive knowledge and beliefs through the mediating variables of goal orientation and self-efficacy has an indirect effect on metacognitive awareness. 5. Goal orientation through the self-efficacy mediating variable has an indirect effect on metacognitive awareness. Descriptive statistics and correlation matrix of the research variables are represented in Table 1.

As can be seen in Table 1, according to the obtained values of skewness and Kurtosis for the research variables, which is approximately between -2 and +2, the distribution of all variables is normal, so we can analyze the research findings from the model, use path analysis.

As indicated in Table 2, goal orientation has the highest (0.4) and metacognitive beliefs have the lowest (0.252) correlation with metacognitive awareness. A correlation matrix of study variables is presented in Table 3.

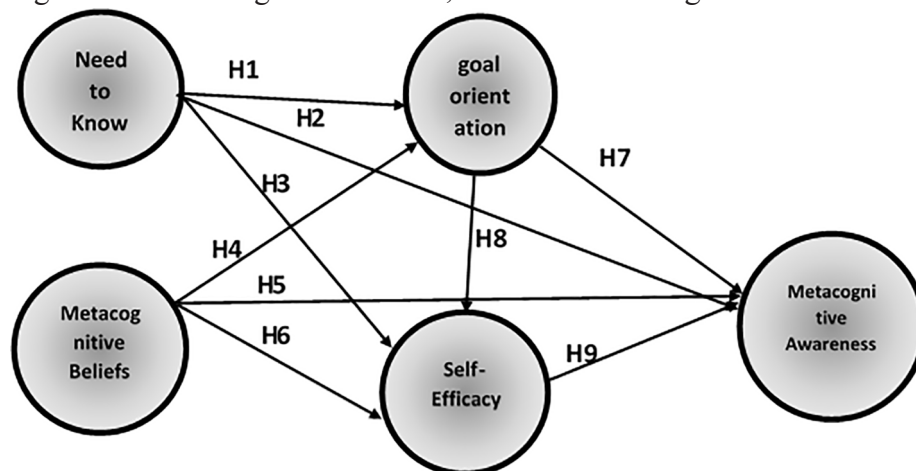According to the direct effect coefficients

Figure 1: Conceptual model of the study

Table 1: Descriptive statistics of the research variables

Variables	Mean	Standard Deviation	Skewness	Kurtosis
Metacognitive beliefs	130/03	13/51	0/13	-0/92
Need to know	47/82	5/41	0/95	1/88
Efficacy	69/67	8/11	-1/07	1/73
Goal orientation	35/86	5/32	-0/356	0/164
Metacognitive awareness	54/43	6/76	-0/923	0/675

Table 2: The metacognitive beliefs and need to know, efficacy, target orientation, and metacognitive awareness are all included in the matrix of variable correlations

Variables	Metacognitive beliefs	Need to know	Efficacy	Goal orientation	Metacognitive awareness
Metacognitive beliefs	1				
Need to know	0.192**	1			
Efficacy	0.378**	0.380**	1		
Goal orientation	0.218**	0.416**	0.341**	1	
Metacognitive awareness	0.252**	0.341**	0.330**	0.400**	1

P<0.05; **P<0.01

Table 3: Estimation of Direct, indirect effect coefficients and the T test

Estimates of variables		Standardized parameter	T	Standardized parameter	T*
Direct effect on the need to know on	Goal orientation	***0.26	5.33		
	Efficacy	***0/283	6.25		
	Metacognitive awareness	***0.173	3.45	0.103	1.49
Direct effect of metacognitive beliefs on	Goal orientation	***0.222	4.41		
	Efficacy	***0.382	8.44		
	Metacognitive awareness	**0.13	2.51	**0.19	2.23
Direct effect of self-efficacy on	Goal orientation	**0.16	3.06		
Direct effect of target orientation on	Metacognitive awareness	**0.164	3.18		
Direct effect of self-efficacy on	Metacognitive awareness	***0.19	3.57	0.026	1.12

***P<0.0001; *Significance of direct and indirect effects

in Table 3 and the conceptual model of research in students at Shiraz University of Medical Sciences, all direct effects of research variables on metacognitive knowledge were significant. Regarding the study of hypotheses according to the obtained results and path coefficients between variables according to the conceptual model, the relationship between variables and the level of significance of each variable with the amount of t-statistic was obtained and in the table at the level of 0.0001 with a sign of star has been identified and evaluated.

Table 4 shows that fitness indices were used to investigate the model fitness. Among the various types of fitness indices, in this study, the ratio of chi square to degrees of freedom (x2 /df), P value, comparative fit index (CFI), goodness-off index (GFI), adjusted goodness of fit index (AGFI), and

root mean square error of approximation (RMSEA) are represented. These features are presented in Table 4. Table 4 shows that the model has good fitness. The fitted model together with estimated parameters (standardized parameters) is presented below (Figure 2).

Table 5 demonstrates that fitness indices were used to investigate the model fitness. Among the various types of fitness indices, the ratio of chi square to degrees of freedom (x2/df), P value, comparative fit index (CFI), goodness-of-fit index (GFI), adjusted goodness of fit index (AGFI), and root mean square error of approximation (RMSEA) are represented in this study. These features are presented in Table 5. Table 5 reveals that the model has good fitness. The fitted model along with estimated parameters (standardized parameters) is presented below (Figure 2).

Table 4: Explanatory and predictive power of the variables and the model's goodness of fit

Index	Estimation
Ratio of chi square to degrees of freedom	3.53
P value	0.13
Comparative fit index (CFI)	0.94
Goodness-of-fit index (GFI)	0.98
Adjusted goodness of fit index (AGFI)	0.91
Root mean square error of approximation (RMSEA)	0.02

***P<0.0001
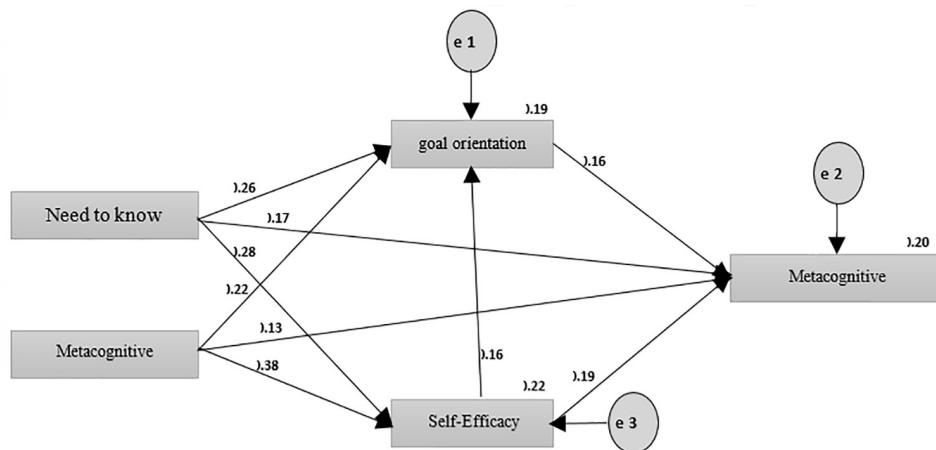
Figure 2: The Fitted Model for the Whole Sample with Standard Coefficients

Table 5: Fine indices of students' metacognitive awareness prediction model

Index	Estimation
Ratio of chi square to degrees of freedom (x^2/df)	3.53
P value	0.13
Comparative Fit Index (CFI)	0.94
Good Fit Index (GFI)	0.98
Adjusted goodness of fit index (AGFI)	0.91
Root Mean Square Error of Approximation (RMSEA)	0.02

Discussion

The general purpose of this study was to provide a causal model and investigate the relationship between the need to know, metacognitive beliefs, and metacognitive awareness with the mediating role of goal orientation and self-efficacy among students at Shiraz University of Medical Sciences. In the study of the conceptual model of the research, according to the indicators of good fit and also the study of the whole model in the study group, the model had a good fit in terms of indicators and can be used in decisions and policies and is in line with theoretical and experimental foundations. One of the most important results of this study is the direct effect of the variable of need to know on goal orientation, self-efficacy, and metacognitive awareness. This is in line with the study of Hashemi, Kazemi, Al-Humori, and Abu Makh, which showed the need to know the predictors of self-efficacy and metacognitive knowledge of professors, and there is a positive and significant relationship between them.

Explaining this finding, it can be said that students who need more cognition are more likely to have metacognitive awareness. Also, the significant effect of the need to know on goal orientation conveys the message to educators that the atmosphere of schools and educational environments should be arranged in a way that enhances the independence and competence of students. The indirect effect of the need to know on metacognitive awareness was not significant through the mediation of goal orientation and self-efficacy. The results of this study are consistent with the research of

Al-Hamouri and Woodruff but contradict the study of the exempted (13, 19). Metacognition includes both cognitive processes and experiences, or cognitive regulation of emotion and mindfulness. On the other hand, the results showed that the direct effect of metacognitive beliefs on goal orientation, self-efficacy, and metacognitive awareness is significant. Also, the results showed that metacognitive beliefs have an indirect effect on metacognitive awareness. In other words, metacognitive beliefs have a positive effect on metacognitive awareness through the mediation of goal orientation and self-efficacy, which is consistent with the research of Soubasi (20) and Wimmer et al. (21).

Explaining this finding, it can be said that since goal orientation is one of the motivational variables related to metacognition; this finding is not unexpected and shows that the effort that learners show in learning tasks and the type of strategies they use are influenced by the goals that they choose (15). Masudi found that there is a significant relationship between performance avoidance goals and metacognition, which is in line with our study (18). This finding is consistent with the findings of Wimmer and et al.'s research. Explaining this finding, we can say that students who use high-level metacognitive strategies learn significantly. This leads to a more complete understanding of the information, the ability to keep the content in mind for a longer period of time, and the ability to test the lessons more successfully, which eventually leads to higher awareness (22). Other findings of this study include the direct effect of self-efficacy on goal orientation. In other words, students with goal orientation had high self-efficacy (23). This result is in line with the results of Abdelrahman and Mohammad Ali Lu's research, which showed that goal orientation has a very positive and significant relationship with self-efficacy (15, 23). It can be said that students who believe in low self-efficacy and believe that they do not have the ability to do activities or assignments in a particular course, most likely just try to get

an acceptable grade in that course. These students avoid appearing incompetent in the eyes of others. That is, their main goal is simply to avoid the failure and unfavorable judgement of others. This finding is consistent with the self-constructed concept of goal avoidance performance and is consistent with the results of previous research. Other results of this study include the direct effect of goal orientation on metacognitive awareness. This finding is in line with the research of Yang and Shaykh al-Islami. This finding results from the fact that mastery-oriented people seek to learn and understand the real content. Therefore, in order to achieve their goal, they need more cognitive effort and to adjust and use their knowledge and learning optimally, consciously or unconsciously, using metacognitive skills. Therefore, such people are sensitive to their learning, and in order to learn better and more, they set goals for themselves and seek to learn better ways to improve their cognitive abilities. Such concerns are associated with metacognitive activity (24). According to the results of various studies, metacognition and metacognitive awareness play a very important role in the learning process. Other results of this study can be said to indicate that the direct effect of self-efficacy on metacognitive awareness was significant. This finding is consistent with the findings of Yazdani et al., Najafizadeh et al., Siqueira, Nakhostin Goldoust et al., who confirmed the effect of self-efficacy on metacognitive awareness (16, 24-26). It is expected that when a person's awareness of the content of learning strategies is high and he/she easily identifies the right situation to use them, then his/her perception of competencies and his/her confidence in the correct solution to challenges will increase. Although this research was methodologically sound and the path analysis related to various variables with new metacognitive awareness, it also had some limitations. Considering that the statistical population of the present study belongs to a university (Shiraz University of Medical Sciences), the results of this study

cannot be generalized to other universities and also due to the fact that many variables cannot be used in causal models, one of the main limitations of this study is the low-use variables. In this regard, it is suggested that for future research, other variables in relation to metacognitive awareness should be measured.

Limitation and Suggestions

One of the main limitations of this research is the lack of similar research in the country, which originates from the novelty of this issue in the global arena. Other limitations of this study include the use of questionnaires as the only means of data collection, geographical limitations, difficulties in accessing the real sample of all students, and a failure to examine other variables affecting metacognitive awareness.

Conclusion

Finally, findings showed that in students of Shiraz University of Medical Sciences, the greatest overall effect on metacognitive awareness is related to self-efficacy and goal orientation. It can be concluded that people with high self-efficacy are more inclined to use metacognitive awareness. Thus, such people are sensitive to their own learning and set goals for themselves in order to learn better and more and seek to learn better ways to improve their cognitive abilities. As a result, the more self-efficacy and goal orientation are strengthened in students, the more their metacognitive awareness increases, and as a result, we see better results in the educational system.

Authors' Contributions

F.R. devised the study concept, designed the study, supervised data collection and analysis, participated in the coordination of the study, and critically revised the manuscript.

MHS collected the data, ran the study intervention, participated in the study concept, performed the analyses, and revised the manuscript.

MRS contributed to the design and analysis of the study data and drafted the manuscript.

All authors contributed to the draft and approved the final manuscript.

Conflict of Interest

None declared.

Ethical Considerations

The ethics code (IR.PNU.REC.1400.005) has been received from the ethics committee in biomedical research, and all ethical principles have been observed in all cases, including informed consent of the volunteers and the rights of the authors, designing the study, and so on.

Availability of Data and Materials

The datasets that support the findings of this study are available from the corresponding author on request.

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