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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии  
საქართველოს სამედიცინო სიახლენი

## GEORGIAN MEDICAL NEWS

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**GMN: Georgian Medical News** is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

**GMN: Медицинские новости Грузии** - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

**GMN: Georgian Medical News** – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

### WEBSITE

[www.geomednews.com](http://www.geomednews.com)

## К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html) В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректур авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

**При нарушении указанных правил статьи не рассматриваются.**

## REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html)  
[http://www.icmje.org/urm\\_full.pdf](http://www.icmje.org/urm_full.pdf)

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned  
Requirements are not Assigned to be Reviewed.**

## ავტორთა საქურაღებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დაიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

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## SERUM CALCIUM WAS NEGATIVELY ASSOCIATED WITH SERUM IRON AMONG GENERAL POPULATION: FINDINGS FROM A CROSS-SECTION STUDY

Yi Jin<sup>1</sup>, Zhi Luo<sup>1</sup>, Hua-Qin Su<sup>2</sup>, Cui-Ping Li<sup>1</sup>, Cai-Li Wang<sup>2</sup>, Li-Fen Zhang<sup>2</sup>, Feng-Lian Peng<sup>2</sup>, Lian-Ping He<sup>1</sup>, Xiang-Hu Wang<sup>1</sup>.

<sup>1</sup>Department of Clinical Laboratory, Taizhou Central Hospital (Taizhou University Hospital), Taizhou University, Jiaojiang 318000, Zhejiang, China.

<sup>2</sup>Taizhou Jiaojiang District Xiachen Street community health service centre, Jiaojiang, Zhejiang 318000 China.

### Abstract.

**Introduction:** The progression of ferroptosis has been found to be associated with the onset and progression of many diseases. Disruption of iron homeostasis can lead to ferroptosis. We had previously hypothesized that vitamin D may affect serum calcium levels, which in turn regulates ferroptosis by regulating serum iron levels. However, the relationship between serum calcium level and serum iron level is unclear. The purpose of our study was to explore the relationship between serum calcium level and serum iron level among general population in Taizhou, China.

**Methods:** In this study, a cross-sectional study was conducted. Serum calcium levels and serum iron levels were determined in our work. Pearson's correlation analysis was used to determine the association between serum calcium level and serum iron level.

**Results:** The results showed that serum iron level was negatively correlated with serum calcium level and age. After controlling for age, sex and marital status, serum iron level was still negatively correlated with serum calcium level.

**Conclusions:** The results suggest that improving serum calcium levels may be a potential strategy for regulating iron metabolism homeostasis. Whether calcium supplementation can reduce serum iron levels in people with low serum calcium levels needs further investigation.

**Key words.** Serum iron, Calcium ion, ferroptosis.

### Introduction.

Ferroptosis is an iron-dependent regulated cell death caused by excessive accumulation of lipid peroxidation caused by iron overload and reactive oxygen species [1]. Bioenergetic properties of ferroptosis are regulated by iron accumulation and lipid peroxidation [2]. The progression of ferroptosis has been found to be associated with the onset and progression of many diseases [3], such as cancer [4], neurodegenerative diseases (Alzheimer's, Parkinson's, and Huntington's diseases), liver disease [5], cardiovascular diseases (doxorubicin-induced cardiotoxicity, ischemia/reperfusion-induced cardiomyopathy, heart failure, aortic dissection and stroke) [6] and osteoporosis [7]. Transferrin, which binds and transports free iron into cells, has been shown to regulate ferroptosis [8,9]. High iron stores have been reported to be associated with chronic diseases [10,11]. Serum calcium is an inhibitor of iron transport and inhibits the absorption of iron in the intestine [12]. Based on previous review, we hypothesized that individuals with high serum calcium levels may have lower serum iron levels. To test whether there is a negative correlation between the two, we conducted a cross-sectional survey of the population.

The aims of the present study were: 1) To investigate the serum iron and serum calcium levels of different age populations; 2) To analyze the correlation of serum calcium and serum iron among general population; 3) To provide a potential strategy for regulating iron metabolic homeostasis.

### Materials and Methods.

#### Study design and data collection:

A cross-sectional was conducted in this study. The survey collected general characteristic including age, gender, and marital status.

#### Measurement:

After overnight fasting, venous blood samples were obtained in the morning. Serum calcium levels were measured using an automatic analyzer. According to our laboratory reference range, the reference range for the total serum calcium level was 46.0-84.0 mg/L. Serum iron were measured using a colorimetric assay, the reference range for the total serum iron level was varied between children and adults.

#### Data analysis:

The characteristics of subjects included were analyzed by descriptive statistical analysis. Pearson correlation analysis was used to assess the correlation between serum calcium levels and serum iron levels. Partial pearson correlation analysis was also performed to explore the relationship between serum calcium levels and serum iron levels after controlling for age, gender and marital status. The statistical significance level was  $p < 0.05$ . All analyses were performed at SPSS19.0.

### Results.

#### General characteristics:

A total of 1918 participants (895 males and 1023 females) enrolled in this study, more than half of the marital status in the study sample were marriage (83.40%). They ranged in age from 10 to 93 (mean age:  $67.09 \pm 9.93$ ). The mean levels of serum calcium and serum iron were 58.19mg/L and 476.54mg/L, respectively (Table 1 and Figure 1).

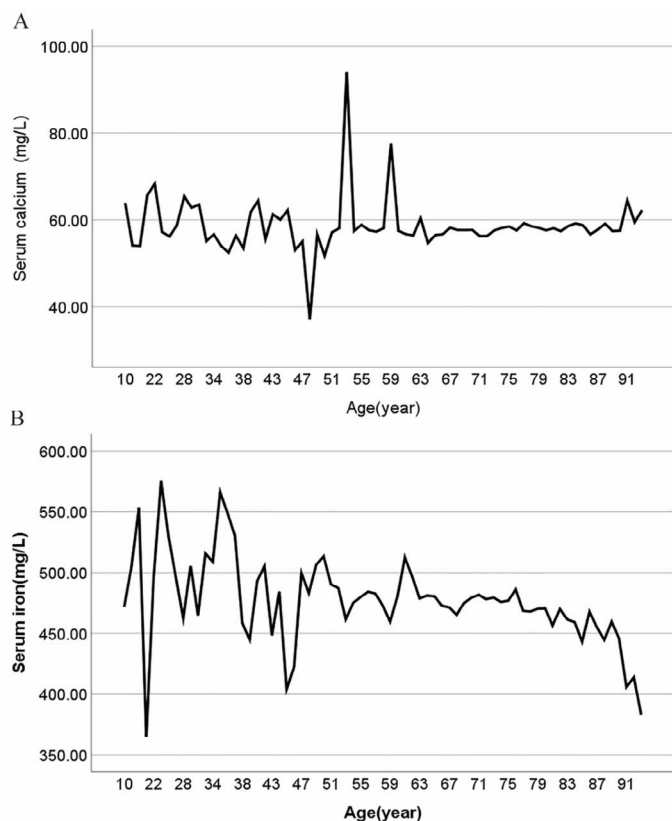
#### The relationship between serum calcium and serum iron.

Our results showed that the serum iron level was negatively correlated with serum calcium level and age. To rule out effects of age, gender and marital status, we found that the serum iron level was also negatively correlated with serum calcium level and age (Table 2).

### Discussion.

We found an inverse correlation between serum calcium and serum iron in general population. Age, gender and marital





**Figure 1.** Trend of serum calcium levels(A) and iron levels(B) with age.

**Table 1.** Characteristics of subjects who participated in this study (N=1918).

Items	Categories	N/mean	Percent/SD
Gender	Male	895	46.70
	Female	1023	53.30
Marital status	Marriage	1600	83.40
	Single	82	4.30
	Unclear	236	12.30
Age (year)		67.09	9.93
Serum iron (mg/L)		476.54	67.81
Serum calcium(mg/L)		58.19	24.72

**Table 2.** Analysis of the correlation of serum iron with serum calcium.

	Serum iron(mg/L)			
	r (Unadjusted)	p	r (Adjusted)	p
Serum calcium (mg/L)	-0.302	<0.001	-0.283*	<0.001
Age (year)	-0.084	<0.001	-0.093#	<0.001

\*Adjusted for age, gender and marital status.

#Adjusted for gender and marital status.

status may be important factors affecting the research results [13,14]. We analyzed the data after excluding age, gender and marital status. The results showed that serum calcium was negatively correlated with serum iron. At present, there is little research literature on the relationship between serum calcium and serum iron in the population. Future studies should further expand race, quantity, and geography to confirm our findings, and further explore the influencing factors of the relationship

between serum calcium and serum iron.

This study concluded that serum calcium and serum iron are negatively correlated, and it is not possible to judge whether there is a causal relationship between the two, which may only be concomitant. In the future, we can first intervene in serum calcium levels, observe whether there are corresponding changes in serum iron, and then analyze the mechanism of action, providing new scientific ideas for the screening of drug targets in the future.

### Limitations.

There were limitations to this study. First of all, serum calcium and serum iron have many influencing factors, such as hyperparathyroidism [15], osteoporosis [16], hemolytic anemia [17], severe liver disease [18]. The effects of these diseases were not excluded in this study. Second, the study participants were all residents of Xiachen community in Taizhou, Zhejiang Province, China, which may limit the validity of our findings in other parts of China. Third, we adopt a cross-sectional survey and research design, and cannot make causal inferences [19-21].

### Conclusion.

The results suggest that improving serum calcium levels may be a potential strategy for regulating iron metabolic homeostasis. Whether calcium supplementation can reduce serum iron level in people with low serum calcium needs further study. Animal study also need to conduct to confirm that vitamin D can affect the serum calcium levels, which further regulates ferroptosis by regulating serum iron levels.

### Conflict of interest statement.

The authors declare that this research was conducted in the absence of any business or financial relationships that could be construed as potential conflicts of interest.

### Data Availability.

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

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### Author Contributions.

Conceived and designed the experiments, Yi Jin, Hua-Qin Su, Lian-Ping He and Xian-Hu Wang; Performed the experiments; Hua-Qin Su, Cai-Li Wang, Feng-Lian Peng, Yi Jin and Cui-Ping Li; Analysed the data; Lian-Ping He and Xian-Hu Wang. Wrote the paper; Cui-Ping Li and Lian-Ping He.

**Yi Jin:** <https://orcid.org/0009-0005-7199-0157>

**Zhi Luo:** <https://orcid.org/0009-0008-6748-6072>

**Hua-Qin Su:** <https://orcid.org/0000-0002-7352-4388>

**Cui-Ping Li:** <https://orcid.org/0000-0002-9410-1835>

**Cai-Li Wang:** <https://orcid.org/0009-0004-9388-1675>

**Feng-Lian Peng:** <https://orcid.org/0009-0001-1465-1950>

**Lian-Ping He:** <https://orcid.org/0000-0002-9627-5599>

**Xiang-Hu Wang:** <https://orcid.org/0000-0001-5515-0514>

Yi Jin, Zhi Luo and Hua-Qin Su contributed equally to the work.

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