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A Preliminary Study of Optimizing Back Pain Medicinal Cupping Points Disease via Graph Colouring

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Abstract. Medical cupping is an ancient method that is still used by many people. It is an alternative method in healing process for much type of diseases by using special cups on the specific points of the skin to create suction. Every disease has their specific cupping points. As a habit, practitioners will cup based on patient request or complaint, where it give effect to the cost and time. Thus, the aim of this paper is to study the effective ways on finding the optimum number of cupping points for back pain disease through graph colouring. In addition, a formulation in C# language is given too in validating the graph model result. The finding shows that the optimum number of back pain medicinal cupping points is two.

1. Introduction

Nowadays, medical science growing rapidly with many modern facilities and medicine produced. In contrast, there are many people that are still looking for traditional treatment where medicinal cupping is one of interest [1]. Cupping therapy is an ancient method, mostly used in Asian and Middle East country, where Ancient Egypt is the oldest manuscript raise about cupping therapy [2]. This therapy can be seen in two points of view, Chinese treatment and also Hijama (in Islamic) which practicing previously by Rasulullah S.A.W [3]. Practitioners will follow a simple procedure by using special cups that made from glass, bamboo or etc. The special cups will be heated and apply on the specific points on the skin to create suction [3,4,5].

Based on [2,6], it believes that this ancient method give many benefits to human body such as to improve blood circulation, immune systems, remove toxins and etc. From previous study, it proves that there are several diseases that benefited from cupping therapy such as asthma, back pain, stroke, diabetes, and migraine [2,6].

This paper will focus on back pain disease since [7,8] shows back pain is the most complaint disease throughout the world after cold. Besides, medicinal cupping is also one of the best alternative methods in healing this disease [2].

Back pain disease has specific points to be cupped as mentioned in [8]. Regarding [8], practitioners always cupped based on patient complaints. If there is no complaint or request, practitioners will automatically use the assigned points. Applying cup randomly to points requested or to assigned points actually gives effect to time and cost. In existing study, researchers studied on collecting data and



statistical analysis on medicinal cupping [7]. Best to our knowledge, there are no specific research that study about the selection of medicinal cupping points. Hence, in this study, a graphical model is proposed to find the optimal number of medicinal cupping points for back pain disease.

2. Method

More points to be cupped means more time and cost needed. As current practice, practitioners will randomly cup based on patient demands. Hence, there is a need to find the optimum number of medicinal cupping points. Even there exist related approaches such as multi objective function and multi criteria decision making, due to limitation of data accessing, graph coloring is used in this preliminary study. As preliminaries, definition of graph is stated below.

Definition 1 [9]: Graph

A graph made up of some points and line that connected the points. Graph $G = (V, E)$ is a set of vertex where nodes V connected by edges called E .

In a simple graph, G , all the cupping points are represented as the vertices V while the nerves connection as edges E . Since graph colouring is selected as a main tool, thus the definition will define next.

Definition 2 [10]: Graph Coloring

A proper graph coloring is an assignment of colors to each vertex in a graph so that no same color for two adjacent vertices.

From a simple graph, G , the first vertex will be chosen randomly and marked color 1. If the existence colour vertex is adjacent with the other vertices, unique colour is prohibited. The process will continue until all the points are coloured. As one of the conditions, a minimum number of colours need to be used in ensured the chromatic numbers can be identified. Following is the definition of chromatic number.

Definition 3 [11]: Chromatic Number

The chromatic $\chi(G)$ number of a graph G is the least possible colours required to create graph coloring.

After all vertices are coloured, the total colour used will be count and present as chromatic number. Then, the least element from the chromatic number will chosen as final decision.

Most application of graph colouring related with solving real life problems. Paper [12] discussed on graph colouring helping in finding the efficient way on assign Wi-Fi channels. In [13], graph colouring is used to solve time table problems that mostly faced in academic field. This shows that graph coloring is one of the alternative methods in making life easier. Thus, this paper will implement the graph coloring approach on finding the optimal number of medicinal cupping points for back pain disease.

3. Results and Discussion

3.1 Graph Colouring

Figure 1 [8], shows the exact 20 medicinal cupping points on human body to be cupped by practitioners for back pain disease. Based on the human nerves system in **Figure 2**, all the 20 points are connected and depicted as in **Figure 3**. From that, two simple graphs, G as in **Figure 4** formed.

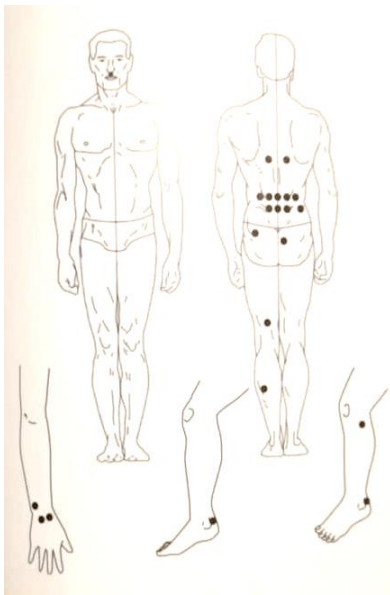


Figure 1: Medicinal cupping points for back pain disease [8].

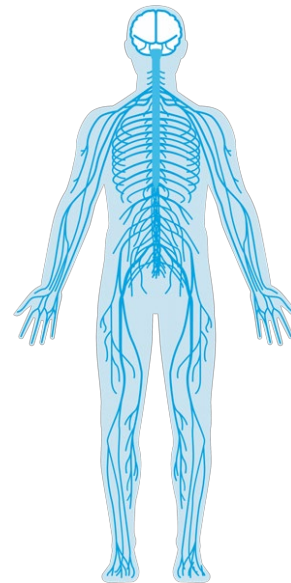


Figure 2: Nerves system of human body.

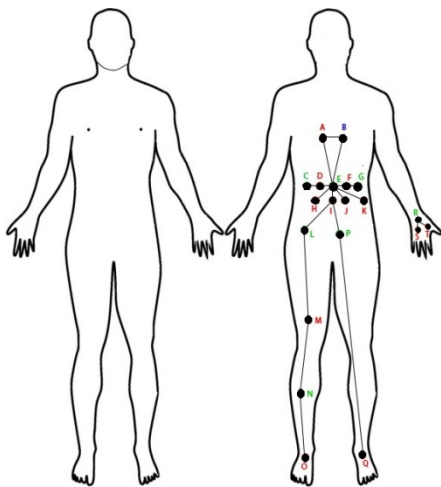


Figure 3: Connected cupping points.

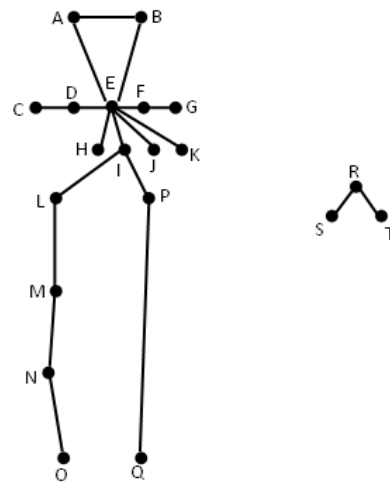


Figure 4: Simple graph, G , for back pain disease.

Based on the definition of graph, all the medicinal cupping points for back pain in **Figure 4** are renamed as vertices $A \leq i \leq T$, $i = A, B, \dots, T$, while the edges of the graph that connect the vertices, represent the connection of the nerve system. Hence, graph coloring concept is applied to the simple graph, G in order to find optimum number of medicinal cupping points. **Figure 5** below shows the steps of implementation the concept of graph coloring on the simple graph G .

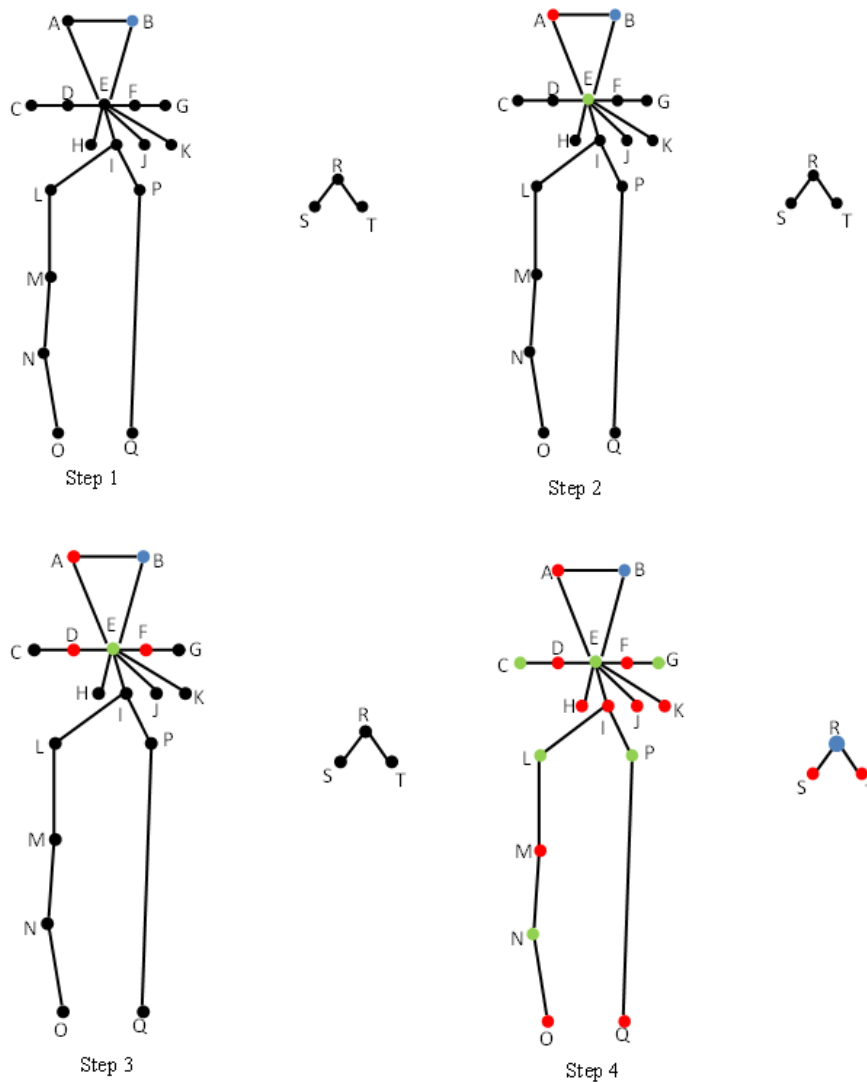


Figure 5: Steps in graph coloring.

First, a random point will be chosen. In Step 1, point B is chosen and coloured with blue. Then, the non-adjacent vertices of B will be coloured as vertex B as well. Since A and E are adjacent with B, automatically A and E are assigned with different colours, red and green respectively. In coloring all the vertices, the first colour chosen should be placed as maximum on the single graph. All the processes are repeated until all the vertices are coloured as shown in Step 4. At the end of the process, the chromatic numbers that acquired is $\chi(G) = 3$.

In order to get the exact result, trial and error method is implemented during applying graph colouring steps. Below are the results that have been obtained from the trial and error method:

Table 1. Results of graph colouring for simple graph, G .

Color	Results					
	Result 1	Result 2	Result 3	Result 4	Result 5	Result 6
Blue	1	3	3	1	2	2
Green	7	7	6	8	6	8
Red	12	10	11	11	12	10

From **Table 1**, there are 6 possible results. But there is only one best answer that gives the optimum number of cupping points for back pain disease. Based on the **Definition 3**, the final result is **Result 1** because the red colour gives maximum points that is 12 vertices, followed by green colour have 7 vertices and the least is blue colour, 1 vertex. Based on the simple graph, G in **Figure 4**, actually there are 2 simple graphs. There are 17 connected vertices in the first graph $G1$, and another 3 connected vertices in the second graph $G2$. This happen due to the cupping points that located at hand parts are not connected to the points that located at human body. Therefore, **Result 1** is not the accurate result for this study. The accurate result is **Result 5** where red color has maximum vertices that are 12, green color has 6 vertices and blue color has 1 vertex only. The following results hold:

Result 5: $\chi(G) = 3$

●: 2 medicinal cupping points, {B, R}

●: 6 medicinal cupping points, {C,E,G,L,N,P}

●: 12 medicinal cupping points, {A,D,F,H,I,J,K,M,O,Q,S,T}

Based on the results, two vertices from 20 are cupped during the first treatment since the blue vertices is the optimum number for back pain disease. If a patient need to re-do the treatment, vertices that marked with green coloured will be chosen first compared to red due the least number of vertices.

3.2 Algorithms

In this section, algorithm on finding the optimum number of medicinal cupping points for back pain disease via C# language is discussed. C# language is a general object-oriented programming (OOP) language for networking and web development. It is a general-purpose, multi-paradigm programming language encompassing strong typing, lexically scoped, imperative, declarative, functional, generic, and component-oriented programming disciplines [14]. C# was used to validate the results that obtained from the graph coloring approach. The algorithm is given in **Figure 6** below.

```

begin
read matrices from .txt files, A=NxN (a[x,y]), B=MxM (b[x,y]),
for all vertices pairs [x,y] ∈ NxN and MxM do
  if a[x,y]=1, then colour x≠y;
    colour 1, colour 2, ..., colour n;
  if b[x,y]=1, then colour x≠y;
    colour 1, colour 2, ..., colour n;

  if a[x,y]=0, then colour x=y.
  if b[x,y]=0, then colour x=y.

X(G)=ΣColour;
display colour1, colour 2, ..., colour n;
end;

```

Figure 6: Algorithm on finding back pain medicinal cupping points.

The algorithm starts by read the matrix A and B from .txt file. Since this study have 2 simple graphs, so there are two matrices as shown in **Figure 7** where the first matrix is matrix A followed by matrix B

where both in size 17×17 and 3×3 , respectively. Each elements in both matrices are denoted as a pair of $[x, y]$. In this algorithm $a_{[x,y]} = 1$ mean x and y are connected while for unconnected is present by 0.

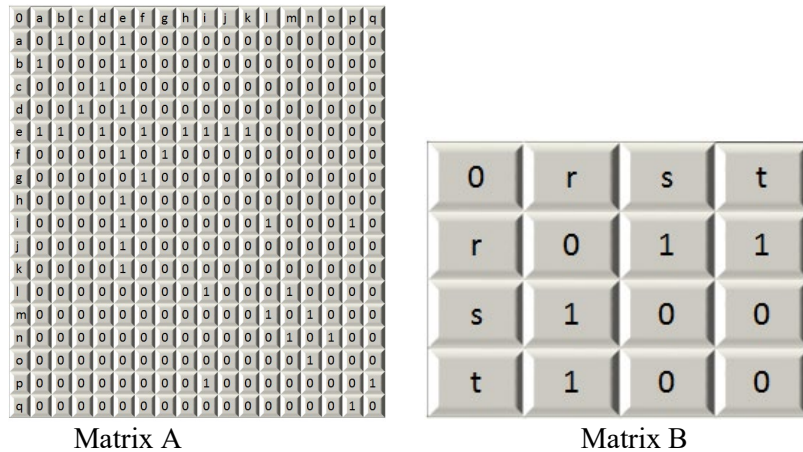


Figure 7: Matrix A with size 17×17 and matrix B with size 3×3 .

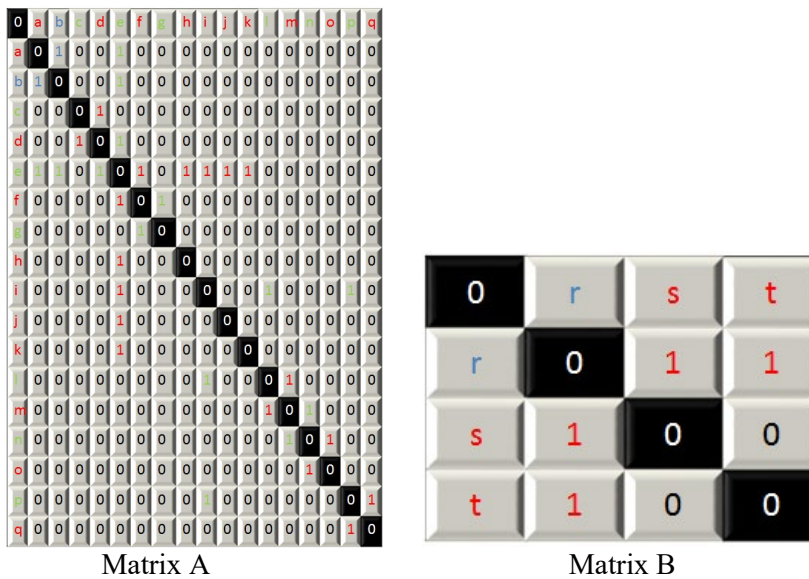


Figure 8: Answer from the algorithm of Matrix A and Matrix B

Figure 8 shows the results obtained after the full code is run via C# platform. The $\chi(G)$ is presented by the number of colours exist in the matrix, while the optimum number of medicinal cupping points is given by the least number of coloured vertices. The obtains results which $\chi(G) = 3$ and the least is 2 proved the Results 5 in section 3.1. Details calculations are summarized as follows:

- $\chi(G) = 3$; colour 1, colour 2, colour 3.
- $a_{a,a} = 0$, colour a = colour 1
- $a_{a,b} = 1$, colour a = colour 1, colour b = colour 2
- $a_{a,c} = 0$, colour a = colour 1, colour c = colour 3
- $a_{a,d} = 0$, colour a = colour 1, colour d = colour 1

$a_{a,e} = 1$, colour a = colour 1, colour e = colour 3
 .
 .
 .
 $a_{b,c} = 0$, colour b = colour 2, colour c = colour 3
 $a_{b,d} = 0$, colour b = colour 2, colour d = colour 1
 $a_{b,e} = 1$, colour b = colour 2, colour e = colour 3
 $a_{b,f} = 0$, colour b = colour 2, colour f = colour 1
 .
 .
 .
 $b_{r,r} = 0$, colour r = colour 2
 $b_{r,s} = 1$, colour r = colour 2, colour s = colour 1
 $b_{r,t} = 1$, colour r = colour 2, colour t = colour 1
 .
 .
 .
 $b_{t,t} = 0$, colour t = colour 1

colour 2 : 2 points, colour 3 : 6 points, colour 1: 12 points

4. Conclusion

As current practice, 20 vertices are found to be cupped for back pain disease. In this study, the graphical model shows that only two vertices is the final results of optimum numbers to be cupped which give less cost and time consume. Furthermore, this result is validates by the C# code constructed.

As an example, the process of one cup cost around RM5 with treatment took around 40 minutes, hence the cost reduce from RM100 to RM10 while time reduce 90% from 40 minutes to 4 minutes.

This result really benefited to practitioners, researcher in medical cupping fields and also society in determining the optimum points to be cupped. However, a deep study needs to be done to verify the effectiveness of this result in real situation. This approach also can be used for other diseases such as diabetes and asthma, besides it is also applicable for acupuncture.

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References

- [1] Gholamreza K, Mohammad R S A, Mansoor K, M. Mohammad M E, Ismaeel N, Maryam M, Arman Z and Hoorieh M K 2017 Cupping therapy can improve the quality of life of healthy people in Tehran. *Journal of Traditional Chinese Medicine* **37(4)**:558
- [2] Tamer S A and Saud A 2018 Cupping Therapy:An Overview from a Modern Medicine Perspective. *Journalof Acupuncture and Meridian Studies* 2005
- [3] Duane T L 2017 Cupping Therapy: An anlysis of the effects of suction on skin and the possible influence on human health. *Complementary Therapies in Clinical Practise* 1744
- [4] Tamer A and Saud A 2018 A brief illustration of the official national standards for the safe use of cupping therapy (Hijama) in Saudi Arabia. *Journal og Integrative Medicine* 2095
- [5] Abdullah M N A B, Ibrahim S E, Naseem A Q, Tamer S A, Gazzaffi I M A, Ahmed T E O, Asim A H K, Mohamed K M K and Meshari S A 2018 The medical perspective of cupping therapy: Effectes and mechanism of action. *Journal of Traditional and Complementary Medicine* **9(2)** 90
- [6] Syed M M U, Aatera H and Haris S 2016 The Use of Hijama (Wet Cupping) in Alternative and

- Complementary Medicine: Efficacious or Perilous? *Journal of Acupuncture and Meridian Studies* 2005
- [7] Sulaiman M M A E, Ashry G M, Raid A A and Abdullah M A 2019 Wet Cupping; Traditional Hijamah Technique versus Asian Cupping Technique in Chronic Low Back Pain Patients: Pilot Randomized Clinical Trial. *Journal of Acupuncture and Meridian Studies* 2005
- [8] Prof . Dr. Ab Aziz Al-Safi Ismail, Dr. Mujahid Bakar, Dr. Suhaily Mohd Hairon 2015 Sains Bekam
- [9] <https://economictimes.indiatimes.com/definition/graph-theory>
- [10] J. Beier, J. Fierson, R. Haas, H. M. Russell, K. Shavo 2016 Classifying coloring graphs. *Discrete Mathematics*
- [11] Rosen K H 2007 *Discrete Mathematics & Its Application* (7th Eddition). McGraw Hill
- [12] D. Orden, I. Marsa-Maestre, J. M. Gimenez-Guzman, E. de la Hoz, A. Alvarez-Suarez. (2018) Spectrum graph coloring to improve Wi-Fi channel assignment in a real-world scenario via edge contraction. *Discrete Applied Mathematics*
- [13] Y. Zhou, B. Duval, Jin-Kao 2018 Improving probability learning based loxal search for graph coloring. *Applied Soft Computing* 1568
- [14] <https://www.techopedia.com/definition/26272/c-sharp>