Scientific Investigation of Ancient Sri Lankan Private Labor Room (*Thimbiri Geya*)

U. S. Rathnayake[1], D.M. Suratissa[2], T. Hashan[3], K.N.T. Siriwardena[3], D.C. Udugama[3]

[1]Department of Civil Engineering, Faculty of Engineering, SLIIT, Malabe, Sri Lanka

[2]Department of Zoology and Environmental Sciences, University of Colombo, Colombo, Sri Lanka

[3]Gnanodaya Maha Vidyalaya, Kalutara, Sri Lanka

upakasanjeewa@gmail.com

Abstract

Sri Lanka is a proud nation in the world for its ancient architectural and irrigational structures. Unlike today, the hospitals were not served for purpose of natural labor and delivery. Most of the houses have had a private labor room (Thimbiri Geya) for the purpose. However, the architectural plan of the labor room was different from the other bedrooms of the house. The room had provided the better quality of hygienic level and health conditions to the expecting mothers and the newborn babies. The room was sometimes used for other functions including the control of epidemic diseases, control of post childbirth psychosis and for healing wounds. It is interested to understand the scientific concepts behind this labor room and then, to learn and practice them if possible, for today's world. Therefore, experiments were carried out using three sample labor rooms (3×4 square feet sized) under the same environmental conditions to scientifically investigate the ancient architecture. Unit A were constructed similar to the ancient labor room while unit B was constructed similar to the ancient labor room, but the walls were built by cement blocks and unit C was constructed according to the modern-day room with cement floors. These three rooms were monitored for atmospheric temperature, atmospheric humidity, dissolved oxygen (DO) of water samples of well water and pipe born water and microbial actions on some selected food (bread, meat and fish). It was found out that the room temperature and humidity levels of unit A were much lower to the other rooms and the three strata of floor in unit A could be reason for those. In addition, higher DO levels and lower microbial activities were recorded in unit A. The results suggest the usage of ancient system is a way forward approach in the path of sustainability in health care facilities in the modern world. However, it is also advised to have more experiments in a longer time span to reveal more interesting features of the ancient labor room (Thimbiri Geya) in Sri Lanka.

Keywords: *DO levels, microbial activities, relative humidity, room temperature, Thimbiri Geya*

Introduction

Ancient Sri Lankans used their own technology in building storage facilities to store traditional medicine and cultivated harvest. These storage facilities were not only built to a greater technology, but also to a greater success in the architecture. In that era, people did not use the hospitals for natural labor and delivery. It was not because of lack of hospitals (There were many hospitals in ancient Sri Lanka. Each village had a traditional doctor’s house (weda gedara) and it was very well equipped for both outdoor and indoor patients), but due to the availability of the labor facilities at homes. Ancient inscriptions (Wickremasinghe, 1994) and Great Chronicle (Mahawamsa, 500 AD) clearly give the evidence of usage of hospitals in ancient Sri Lanka. Eighteen hospitals during the era of King Dutugemunu (161 – 137 BC) and King Parakramabahu I (1153 – 1186 AD) are some of the examples for the high technologies used in ancient Sri Lanka for the health sector. Figure 1 shows the conserved ruins of two ancient hospitals in Sri Lanka.

(a) Mihintale hospital

(b) Polonnaruwa hospital

Figure 1: *Ruins of ancient hospitals in Sri Lanka (Prematilleke and Aluvihare, 2011 and 2012)*

Therefore, the hospital culture was not a strange activity to Sri Lanka. Nevertheless, as it was said earlier, the delivery of baby was practiced mostly in lady’s parents' house at a specially designed room. This was called *Thimbiri Geya* or *Wedum Geya* in local language (i.e. in Sinhala). However, if the facility is not available in her parents' house, the expectant mother was taken to the common labor room in the village. This common labor room was well equipped with facilities and many senior ladies used to help the process. One of the national newspapers; Daily Mirror, Sri Lanka had reported (on 15/07/2014) the experience of (probably the last) a senior lady who has voluntarily worked as a midwife in this *Thimbiri Geya.* She has given the helping hand to deliver more than 300 babies in these *Thimbiri Geya* and surprisingly no baby had died during the delivery (Jayarathna, 2014).

There was a separate culture for the newborn and to the mother. The mother and the baby usually stayed in this room for couple of months and people believed, the mother and the newborn baby were protected from common issues like, post-delivery stress and belly button infection (Karunarathna, 2001).

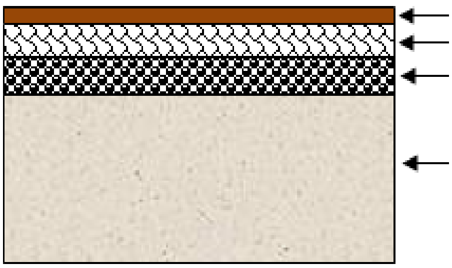
This *Thimbiri Geya* room was not only used as the labor room, but also it was used as the protection area for the patients with Measles, Chickenpox, and other spreading deceases. Consequently, this room had been used as a restroom. Therefore, it is very interested to understand the specific architecture that the ancient people had used. Muddy walls, wooden floors, smaller door, lengthier window, coconut fronds roof or tile roof, thick thread hanging from the roof are common factors in the ancient labor room. In addition, a traditional medicine pack was kept inside the room.

The roof of the labor room was usually covered by Calicut tile (Sinhala tile) or thatched. The walls were constructed by mud or laterite bricks; however, plastered by lime. Front door was smaller compared to the other room doors in the house. The room had one rectangular window or fan light. An important architectural plan was there for the floor of the room. It was covered by timber, mainly by Neem timber (*Margosa* timber). However, underneath the timber layer there were three layers consisting of, 3 – 4 feet sand, mud, and charcoal layers from bottom to top. In between two layers, there was a lime layer.

Therefore, this research presents an experimental investigation of the ancient labor room which was practiced in Sri Lanka. Three rooms were constructed in the same environment and used to observe and analyze the important architecture of the ancient *Thimbiri Geya*.

Experimental Setups

A model *Thimbiri Geya* (Unit ***A***) was constructed to observe the positive impact of ancient architecture. The dimensions of the room were 4 ft × 3 ft × 4 ft (length × width × height). The room has a front door opening (3 ft height × 1ft width in dimensions) and a side wall window (6 inches × 8 inches in dimensions). The floor of the model *Thimibiri Geya* was structured according to the ancient architecture. A 3 – 4 ft pit was dug and filled it by sand for 3.5 ft. Then, a 3-inch charcoal layer was layered. On top of this charcoal layer a 3-inch limestone layer was placed, and the floor was finished with a 1-inch-thick Neem timber wood on the top (refer Figure 2a). Calicut tiles (Sinhala tiles) were used to cover the structure (refer Figure 2b) as the roof and usual mud compiled with bamboo sticks were used to make the walls (refer Figure 2c).



A – Neem, B – Limestone, C – Charcoal, D - Sand

(a) Floor structure

(b) Bamboo sticks and mud for walls

(c) Side window

(d) Unit ***C***

Figure 2: *Experimental setups*

Two other units ***B*** and ***C*** were constructed to compare the unique architecture of the Unit ***A***. Unit ***B*** and Unit ***C*** were placed at the same environment (Kaluthara district, Sri Lanka) at same size and same dimensions with openings. Cement blocks were used for the walls of Unit ***B***, but the floor architecture was kept as the Unit ***A***. However, the floor in Unit ***C*** was cemented while its walls were constructed by cement blocks.

These three units were tested for several parameters, including the room temperature, relative humidity, dissolved oxygen level (DO), dehydration levels and bacteria growth. Three thermometers (same brand) were used to measure the room temperatures. The room temperature was measured at three times per day (8 am, 2 pm and 8 pm) for 15 days. The readings were recorded at 1ft above the floor level. In addition, three wet and dry humidity meters were kept measuring the humidity of the three units at 8 am, 2 pm and 8 pm for the 15 days. Five well water samples and five tap water samples of similar volumes were kept at each unit to measure the DO levels. Initial and 5 days DO levels were measured using multi-parameter water quality instrument.

Tomatoes, eggplants (brinjals) and bread slices each of 200 g were kept on petri dishes for 5 days to analyze the dehydration levels of the three units. In addition, 100 g of two samples of meat and fish from the same sample were kept in the units for 3 days. However, these meat and fish samples were steamed for 30 minutes before they were kept on sterilized petri dishes. After 3 days, they were observed by magnifying glasses; however, these were analyzed in detail at National Institute of Health Sciences, Katutara, Sri Lanka.

Results and Discussion

Table 1 shows the average room temperatures of the 15 consecutive days for the three units. The average atmospheric temperatures of the units ***A***, ***B*** and ***C*** were 24.3 ± 1.1 ^{0}C, 26.23 ± 1.13 ^{0}C and 29.65 ± 0.49 ^{0}C, respectively. Therefore, it can be clearly seen that the average temperature of Unit ***C*** is 4 – 6 ^{0}C higher than that of units ***A*** and ***B***. one of the main differences from unit C from other two (A and B) was the floor architecture. Therefore, it can be discussed that the room temperature was controlled to a livable temperature by the special floor arrangement. In addition, Unit A has the lowest average room temperature compared to other two units. Therefore, the special arrangement of the floor and muddy walls have impacted for the room temperature.

Day number	Room temperature (^{0}C)		
	Unit ***A***	Unit ***B***	Unit ***C***
1	26.3	27.7	29.3
2	26.1	28.3	29.3
3	25.1	27.0	30.3
4	25.2	27.1	30.0
5	24.1	27.2	29.3
6	25.4	26.1	30.1
7	23.9	25.3	30.2
8	24.1	25.3	30.3
9	24.1	25.1	30.3
10	24.0	25.3	29.1
11	23.1	24.7	29.2
12	23.0	24.7	29.7
13	22.9	26.3	29.3
14	23.0	27.0	29.0
15	24.2	26.3	29.4
Average	24.3	26.23	29.65

Table 1: *Average room temperatures*

In addition, the average humidity levels of the units showed a similar pattern. Unit ***A*** had a relative humidity level of 68.07% (SD ± 5.71) while the units ***B*** and ***C*** had relative humidity levels of 70.05% (SD ± 10.30) and 89.00% (SD ± 2.01), respectively. Three strata of floor could be the reason for the lower temperatures and lower humidity levels. When the room temperature is at milder, humans feel an un-tired environment. When the relative humidity is at a lowered level (60s and 70s) the sweat of the human body would be easily vaporized and felt a refreshing and pleasantness environment (Tsutsumi et al., 2007). Therefore, these conditions can be expected from the ancient *Thimibiri Geya.*

Table 2 shows the dissolved oxygen levels in two types of water samples after 5 days. The initial DO levels of the water samples of tap water and wet water were 7.4 and

6.9 mg/L, respectively. It can be clearly seen that the DO levels in the Unit ***A*** is and ***B*** are higher than those of the DO values of Unit ***C***. DO levels are a measure of the BOD_5 levels in the water samples (Beck and Young, 1975; Boano *et al.,* 2006; Koivo and Phillips, 1971; Padgett and Papadopoulos, 1979).

Sample	Dissolved oxygen level (mg/L)		
	Unit ***A***	Unit ***B***	Unit ***C***
T_1	7.2	7.2	7.1
T_2	7.3	7.3	7.1
T_3	7.1	7.1	6.9
T_4	7.2	7.1	7.1
T_5	7.2	7.2	6.9
W_1	6.5	6.5	6.4
W_2	6.5	6.4	6.3
W_3	6.4	6.4	6.2
W_4	6.3	6.3	6.2
W_5	6.3	6.3	6.1
T_i	Tab water samples		
W_i	Well water samples		

Table 2: *Dissolved oxygen levels after 5 days*

Furthermore, lower microbial actions were recorded in unit ***A*** and ***B*** compared to unit ***C***. Lower atmospheric temperatures and lower humidity levels could be led to an unfavourable environment to microbial growth. Therefore, the structure of the floor has direct and indirect impact on the living conditions of the *Thimbiri Geya*. The Neem timber has an antiseptic property due to the Azadirachtin. Therefore, that could also be a reason for lower microbial growth.

Unit	Sample number	Bread moisture (g)	Tomato (g)	Eggplant (g)
A	i	1.0	9.9	5.5
	ii	1.8	9.0	5.0
	iii	1.4	8.1	5.5
B	i	1.3	8.4	6.3
	ii	1.8	9.5	5.8
	iii	1.3	8.4	5.7
C	i	2.4	10.5	7.3
	ii	3.2	10	7.8
	iii	2.6	10.03	8.3

Table 3: *Dehydration levels of units*

Table 3 presents the moisture dehydration levels after 5 days. It can be seen that Unit A dehydrates lower amount of moisture compared to other two units. However, the dehydration levels are the highest in Unit C. Therefore, the overall results suggest the usage of ancient *Thimbiri Geya* is a way forward approach in the path of sustainability in health care facilities to the modern world. However, it is also advised to have more experiments in a longer time span to reveal more interesting features of the ancient labor room (*Thimbiri Geya*) in Sri Lanka.

Conclusions

The results revealed that the room temperature in Unit ***A*** has much lowered room temperatures compared to other two units (***B*** and ***C***). In addition, the average room temperatures in Unit ***A*** are usually identified in between the best living temperatures (Speakman, J. and Keijer, J. 2013) in tropical countries, like Sri Lanka. Furthermore, the relative humidity levels of the three units revealed that the humidity in Unit ***A*** is lower than that of other two units. Therefore, there is a clear correlation of the temperature, humidity to the architecture of the units. This was further justified by the bacterial growth of the food items and these analyses conclude that Unit ***A*** has a much better living condition compared to the other two units. Therefore, the special floor arrangement has good impact. However, it is advisable to conduct more experiment for the sound conclusions.

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Data Availability

The experimental data and the analysis data are available from the corresponding author upon request.

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Conflicts of Interest

The authors declare that there are no conflicts of interest. The first author is a Senior Lecturer in Civil Engineering in the Faculty of Engineering, Sri Lanka Institute of Information Technology, Sri Lanka. The second author is a Senior Museum Curator in Department of Zoology and Environmental Sciences, University of Colombo, Colombo, Sri Lanka.

References

Beck, M., & Young, P. (1975). A dynamic model for DO—BOD relationships in a non-tidal stream. *Water Research*, *9*(9), 769-776. doi: 10.1016/0043-1354(75)90028-7

Boano, F., Revelli, R., & Ridolfi, L. (2006). Stochastic modelling of DO and BOD components in a stream with random inputs. *Advances in Water Resources*, *29*(9), 1341-1350. doi: 10.1016/j.advwatres.2005.10.007

Karunarathna, D. (2001). *Eda Heladiwa (Sinhala translation of An Historical Relation of the Island Ceylon in the East Indies, by Robert Knox)*. 1st edition, Colombo: M D Gunasena Publishers.

Koivo, A., & Phillips, G. (1971). Identification of Mathematical Models for DO and BOD Concentrations in Polluted Streams from Noise Corrupted Measurements. *Water Resources Research*, *7*(4), 853-862. doi: 10.1029/wr007i004p00853

Jayarathna, N. (2014). Valliamma has seen 300 births. *Daily Mirror, Sri Lanka*. [online] Available at: https://www.pressreader.com/sri-lanka/daily-mirror-sri-lanka/20140715/281865821585500 [Accessed 14 Jun. 2019].

Padgett, W., & Papadopoulos, A. (1979). Stochastic models for prediction of bod and do in streams. *Ecological Modelling*, *6*(4), 289-303. doi: 10.1016/0304-3800(79)90042-5

Prematilleke, L. and Aluwihare, A. (2011). *The National Trust – Sri Lanka*.

Prematilleke, L. and Aluwihare, A. (2012). The Archaeology of Buddhist Monastic Hospitals in Ancient Lanka. In: *SAARC International Conference on Archaeology of Buddhism*. Colombo: SAARC Cultural Center, Sri Lanka, pp.84 - 86.

Speakman, J., & Keijer, J. (2013). Not so hot: Optimal housing temperatures for mice to mimic the thermal environment of humans. *Molecular Metabolism*, *2*(1), 5-9. doi: 10.1016/j.molmet.2012.10.002

The Mahavamsa; Great Chronicle. (500 AD). Written by Mahavihara temple, Anuradhapura, Sri Lanka:

Tsutsumi, H., Tanabe, S., Harigaya, J., Iguchi, Y., & Nakamura, G. (2007). Effect of humidity on human comfort and productivity after step changes from warm and humid environment. *Building and Environment*, *42*(12), 4034-4042. doi: 10.1016/j.buildenv.2006.06.037

Wickremasinghe, D. (1994). *Epigraphia Zeylanica being Lithic and other inscriptions of Ceylon Vol 1*. New Delhi, India: Asian Educational Services.