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## Original Research Article

## Socio-demographic and medico-legal study of hanging and strangulation deaths in South Kerala

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## ABSTRACT

Hanging is a quick and very effective method used to commit suicide. The ligature material used for hanging is one of the important factors that determine the type of ligature mark or the pressure abrasion. The study was carried out at the Department of Forensic Medicine and Toxicology, Govt. Medical College in Thiruvananthapuram. The demographic characteristics of victims of hanging and strangulation as well as medico-legal findings in such situations were the key variables of the study. There were total 75 asphyxial fatalities, out of which 70 were caused by hanging and 5 by strangulation, were examined. According to the study's findings, men and young people between the ages of 21 and 40 are more likely to die violently from asphyxia. Suicidal hanging was a prevalent method among the unemployed. In the married group, hanging and strangulation deaths are more common. In most cases, a current psychological issue was the cause of suicide. Ligature marks from hanging were usually clearly defined, higher than the thyroid cartilage, discontinuous, and free of internal neck injuries.

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## 1. Introduction

The act of unnatural death may be accomplished in different ways like trauma, poisoning, and violent asphyxia. In violent asphyxia, the entry of air into the air passage is prevented. Hanging and strangulation are common types of violent asphyxiation that prevent the entry of air into the lungs. Hanging is one of the most common methods of suicide in India, other types of hanging are, homicidal hanging, judicial hanging, and autoerotic hanging." Hanging can also occur accidentally while at work, during playing, exhibiting hanging exercises, or showing some performances in the circus etc. Lynching is a type of homicidal hanging. Hanging differs from

strangulation in which the neck is constricted irrespective of any effect caused by the weight of the body. The various structures damaged in hanging and strangulation include the soft tissue like skin, subcutaneous tissue, fascia, muscle, blood vessels, lymph nodes, the bony and cartilaginous tissues like the hyoid bone and larynx. Strangulation is assumed to be homicidal until the contrary is proved otherwise. Various forms of strangulation are ligature strangulation, throttling, mugging, garroting, etc.' The ligature mark on the neck is the principal, most important, and specific sign of death in hanging. The ligature mark is usually situated over and above the thyroid cartilage between the larynx and the chin and is a pressure abrasion. Depending upon the type of ligature material it will be a patterned pressure abrasion with or without grooving. Initially, it will be pale in color and as time advances

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it becomes yellow-brown or dark brown and hard like parchment, due to the drying of the slightly abraded skin. Any article such as rope, cord, metallic chain and wires, leather strap, belt, bed sheet or other cotton or synthetic material, turban, etc. which are readily available will be used for suicidal hanging. The ligature mark on the neck depends on the composition of ligature, width, and multiplicity of ligature, the weight of the body suspended and degree of suspension, the tightness of encircling ligature, the length of time the body has been suspended, position of the knot and slipping of ligature during the suspension. Sometimes, the pattern of the ligature material is impressed on the skin, and characteristic diagonal marks of the strands of the rope are seen. The presence of a ligature mark alone is not diagnostic of death from hanging like this and this can also be a purely cadaveric phenomenon as it may be produced if a body has been suspended after death. Often a body is suspended after the murder to simulate suicidal hanging. Casper has observed that a mark similar to the one observed in persons hanged alive can be produced if suspended within two hours or even a longer period after death. Internal findings include bruising into the soft tissues, injury to the blood vessels, and congested lymph nodes of the neck. The solid structures of the neck like the hyoid and larynx are also damaged in some cases. But, Smith and Fiddes (1955) have said that the hyoid bone is practically never injured. On the other hand, Weintraub (1961) found a hyoid bone fracture in 27% of cases of hanging. Fracture of thyroid cartilage was more frequent in persons over 40 years of age in whom thyroid cartilage was ossified. Fractures of the hyoid bone and larynx are almost exclusively due to homicidal strangulation especially when the structure is ankylosed or ossified. Weintraub (1961) reported fracture of the hyoid bone in 50% of cases of manual strangulation and one in two cases of ligature strangulation. All the fractures occurred through the greater horn of the body or in cases with faint ligature marks, pseudo ligature marks are seen in obese persons and infants due to skin folds, coagulation of subcutaneous fat in refrigeration, body swelling of neck tissue in decomposition ligature mark-like marks seen on the neck. It will be difficult to differentiate these marks from the pressure abrasion caused by ligature material." In routine autopsy examination, mostly the above-mentioned, gross external and internal findings are noted in the structure of the neck (in hanging and strangulation deaths).

## 2. Materials and Methods

This is an observational cross-sectional study approved by ethics committee of Government Medical College, Thiruvananthapuram. Informed consent had been taken from deceased family members prior to study. Seventy five cases were included in the study. Out of the seventy five cases, seventy cases were from victims of hanging and five cases were from victims of strangulation. The

details mentioned in the inquest report, relevant personal history and other available records were collected from the accompanying police officer or a friend or relative. Detailed autopsy was performed using modified Letulle's technique. Then flap dissection of the neck was carried out and gross findings were noted. Data was entered into excel sheet and were analysed using IBM SPSS 20. Objective of the study is to Socio-demographic and medico-legal study of hanging and strangulation deaths in South Kerala.

Study population included cases brought for post mortem examination in mortuary wing of the department of Forensic Medicine with history of death due to hanging and strangulation. Cases were selected from dead bodies brought to medical college with history of death due to hanging/ strangulation as per the investigating agency. Cases excluded from this study were decomposed bodies, cases with other injuries on neck and cases with unknown history.

## 3. Results

### 3.1. Age

Hanging - This group consisted of seventy cases and were between 14 to 82 years of age. There were six cases in the age group of less than 20. A maximum number of victims were in the age group 21-40 years. 50% of the victims were below the age of 40 years. Strangulation – All five cases belonged to the age group of 25 to 46 years.

### 3.2. Sex

Hanging- Among the seventy cases studied, 78.6% of the victims were males and 21.4% of the victims were females. Strangulation- among the five cases studied, four cases (80% of victims) were males and 1 case was female.

### 3.3. Weight of the victim

In hanging and strangulation, 68.6% and 80% of the victims respectively weighed between 51-70 kg. In hanging 10% of the victims weighed less than 50kg and 5.7% of the victims weighed more than 80kg.

### 3.4. Occupation

Analysis of cases of hanging according to occupation revealed that the majority were unemployed (32.9%). Next in order were manual laborers (18.6%) followed by private employees and students (12.9%). In cases of strangulation, 40% of them were manual laborers.

### 3.5. Marital status

Married victims were more in cases of both hanging and strangulation. Of the 70 cases of suicides by hanging 63% were married. Of the 5 cases of strangulation 80% of the cases were married.

**Table 1:** Age, sex and weight of victims

Age, sex and weight of victims	Hanging		Strangulation	
	Frequency	Percentage	Frequency	Percentage
<b>Age in completed years</b>				
<20	6	8.6	0	0
21-40	29	41.4	3	60
41-60	22	31.4	2	40
61-80	12	17.1	0	0
>80	1	1.4	0	0
Total	70	100	5	100
<b>Sex distribution</b>				
Male	55	78.6	4	80
Female	15	21.4	1	20
Total	70	100	5	100
<b>Weight (kg)</b>				
41-50	7	10	0	0
51-60	24	34.3	2	40
61-70	24	34.3	2	40
71-80	11	15.7	1	20
>80	4	5.7	0	0
Total	70	100	5	100

**Table 2:** Occupation and marital status of victims

Occupation and marital status of victims	Hanging		Strangulation	
	Frequency	Percentage	Frequency	Percentage
<b>Occupation</b>				
Unemployed	23	32.9	0	0
Professional	1	1.4	0	0
Government servant	3	4.3	0	0
Private employee	9	12.9	1	20
Manual labourer	13	18.6	2	40
Farmer	2	2.9	0	0
Student	9	12.9	0	0
Self employed	5	7.1	1	20
Others	5	7.1	1	20
Total	70	100	5	100
<b>Marital Status</b>				
Unmarried	19	27.1	1	20
Married	44	62.9	4	80
Divorced	6	8.6	0	0
Widow	1	1.4	0	0
Total	70	100	5	100

### 3.6. Reason for suicide in cases of hanging

Analysis of the reason behind suicide revealed that obscure psychological problems precipitated death in 50% of the cases. A positive history of mental illness was present in only 14.3% of the cases. Alcoholism was the reason for suicide in 14.3% of the cases. Failure in examinations was the reason behind committing suicide in 7.5% of the cases. One person had committed suicide by hanging following a police inquiry on alleged criminal activities.

**Table 3:** Reason for suicide

Reason for suicide	Frequency	Percent
Unknown	1	1.4
Obscure Psychological	35	50
Failure in examinations	6	7.6
Mental illness	10	14.3
Alcoholism	10	14.3
Disease	8	11.4
Total	70	100

### 3.7. External findings

#### 3.7.1. Status of tongue

The tongue was found protruding and bitten in 58.6% of the cases and not bitten in 41.4% of cases. The tongue was bitten and protruded in all 5 cases of strangulation.

#### 3.7.2. Salivary dribble

Salivary dribble was obvious in 32.9% of the cases of hanging. It was absent in any strangulation.

### 3.8. Ligature material

#### 3.8.1. Type of ligature material

Soft materials used as ligatures in hanging were lungies (28.6%), sarees (4.3%), shawls (11.4%), and bed sheets (1.4%). Hard materials that produced patterns included ropes of nylon and coir rope. Nylon rope was used in 27.1% of cases and coir rope was used in 1.4% of cases. No ligature material was brought with the body in 22.9% of the cases.

#### 3.8.2. Consistency of ligature material

Soft ligature material was used in 45.7% of cases and hard ligature material was used in 28.6% of the cases.

### 3.9. Ligature mark

The appearance of pressure abrasion in hanging, 92.9% of the victims there were well-defined pressure abrasion and 7.1% showed faint pressure abrasion. Pressure abrasion was well-defined in all 5 cases of ligature strangulation.

#### 3.9.1. Continuity of pressure abrasion

Pressure abrasion (ligature mark) was either continuous or noncontinuous. Noncontinuous pressure abrasion was present in 68.6% of the cases while continuous pressure abrasion was present in only 31.4% of the cases in hanging. In strangulation all the cases showed continuous pressure abrasion.

#### 3.9.2. Location of pressure abrasion

In hanging, in 82.9% of cases, the ligature mark was over and above the level of the thyroid cartilage. In 8.6% of cases, it was below the level of the thyroid cartilage. In another 8.6% of cases, it was above the level of the thyroid cartilage. In strangulation, in 60% of the cases it was above the level of the thyroid cartilage and in 40% of cases it was over and above the level of the thyroid cartilage.

#### 3.9.3. Gross internal neck injury

In cases of hanging 88.6% of the cases, a gross internal neck injury was absent. It was present in 11.4% of cases. In cases of strangulation internal neck injuries were present in 80% of the cases.



**Fig. 1:** Commonest material used as ligature material: Mundu



**Fig. 2:** Measuring ligature mark



**Fig. 3:** Patterned pressure abrasion in hanging

**Table 4:** External findings

External findings	Hanging		Strangulation	
	Frequency	Percentage	Frequency	Percentage
<b>Status of tongue</b>				
Protruding and Bitten	41	58.6	5	100
Not bitten	29	41.4	0	0
Total	70	100	5	100
<b>Salivary dribble</b>				
Not present	47	67.1	5	100
Present	23	32.9	0	0
Total	70	100	5	100

**Table 5:** Ligature material features

Ligature material	Hanging		Strangulation	
	Frequency	Percentage	Frequency	Percentage
<b>Type of ligature material</b>				
Saree	3	4.3	0	0
Shawl	8	11.4	0	0
Lungie	20	28.6	0	0
Bed sheet	1	1.4	0	0
Nylon rope	19	27.1	0	0
Coir rope	1	1.4	0	0
Others	2	2.9	0	0
No ligature was brought with the body	16	22.9	5	100
Total	70	100	5	100
<b>Consistency of ligature material</b>				
Soft material	32	45.7	0	0
Hard material	20	28.6	0	0
Not known	18	25.7	5	100
Total	70	100	5	100

**Table 6:** Ligature mark features and internal neck findings

Ligature mark features and internal neck findings	Hanging		Strangulation	
	Frequency	Percentage	Frequency	Frequency
<b>Appearance of pressure abrasion</b>				
Well defined	65	92.9	5	100
Faint	5	7.1	0	0
Total	70	100	5	100
<b>Continuity of pressure abrasion (nature)</b>				
Discontinuous	48	68.6	0	0
Continuous	22	31.4	5	100
Total	70	100	5	100
<b>Location of pressure abrasion</b>				
Above thyroid cartilage	6	8.6	3	60
Over and above thyroid cartilage	58	82.9	2	40
Below thyroid cartilage	6	8.6	0	0
Total	70	100	5	100
<b>Gross internal neck injury</b>				
Absent	62	88.6	1	20
Present	8	11.4	4	80
Total	70	100	5	100



**Fig. 4:** Neck dissection under bloodless field



**Fig. 5:** Neck dissection in strangulation victim showing hemorrhage

#### 4. Discussion

The present study was conducted in the Department of Forensic Medicine and Toxicology, Govt. Medical College, Thiruvananthapuram w.e.f Feb 2016 to July 2017 which consists of the post-mortem examination of 75 cases of which 70 cases were due to hanging and 5 were due to strangulation. The observation of the present study is compared with the findings of the previous studies carried out by various forensic authors.

In the present study, a total of 75 dead bodies were received for postmortem examination due to hanging(70 cases) and strangulation (5 cases), from Feb 2016 to July 2017. The reason for the higher frequency of suicides in our study can be explained by considering the various factors such as nuclear family, urban culture, failure in love matters, urban stressful lifestyle, psychiatric disorders like depression, mania, etc. Further, the low incidence of strangulation can be explained based on a peaceful society and a lower incidence of heinous crime in the part of southern Kerala where the study was conducted.

The majority of the victims were in the age group of 21 to 40 years (29%) (Table 1). The youngest was a male of

14 years who committed suicide due to problems at school. The eldest was female of age 82 years of female. This substantiates Modi's statement that "age is no bar to suicidal hanging".<sup>1</sup> Polson and Gee reported the suicide of a 10-year-old child by hanging. In a study by Sharija S, the age of victims ranged from 2 years to 86 years.<sup>2</sup>

In the present study, males formed about 78.6% of the victims and females 21.4% (Table 1). This study was found to agree with a study by Sharija S in the same geographical area 70.9% of the victims were males, females formed only 29.1% of the cases.<sup>2</sup> In a similar study by Anil Yadav in a different geographical area, in the western part of India, 74% of the victims were males and females counted for only 26% of the cases.<sup>3</sup> All the above studies and many more proclaims that the male gender is more prone to suicide. This may be because of the unique difficulties that boys and men encounter. Society does not offer enough opportunities for men to express their emotions, especially grief. There is always a saying 'Real men don't cry', and there is a never-ending search for the 'real man'. This may also be the reason why men form about 95% of the prisoners. It would be wise to teach the male child to express emotions in an accurate and measured way. The majority of the victims weighed between 51 to 70 kg (Table 1) in both groups 68.3% and

80% respectively in hanging and strangulation.

While analyzing the cases based on occupation it had been found that 32.9% of the victims who were hanged were unemployed and 18.6% of the victims were manual laborers and 12.9% of the victims were students (Table 2). In study conducted by Sharija S 24% of the victims were manual laborers. Students were only 12% in this study.<sup>2</sup> In a study by Harish, 22% were students followed by private employees 16%, and unemployed (14%).<sup>4</sup> In the present study, there was a steep increase in the number of unemployed who committed suicide. This may be due to the change in the mindset of the youngsters who are looking for white-collar jobs, while the majority of the manual labor positions in Kerala are filled by migrant populations from other states.

While analyzing the reasons leading to suicide obscure psychological reasons or immediate psychological upsets served as a motive to commit suicide in 50% of the cases. The next major cause was chronic alcoholism accounting for about 14.3% of the cases (Table 3). In 11.4% there was the presence of chronic disease. Mental illness was reported as the major reason for suicide. But in the present study, it was only 14.3%. Sharija S in her study reported 28% of cases had psychological problems and this was in agreement with the present study.<sup>2</sup>

All the materials used as ligatures were easily available similar to that stated by Modi.<sup>1</sup> In the present study 'Lungi' as ligature material was used in 28.6% of the cases (Table 5). The lungi is a type of traditional garment worn around the waist in Kerala and parts of South India. It is particularly popular in regions where the heat and humidity create an unpleasant climate for trousers. Hence, the easy availability at hand is used in suicide. This finding was in agreement with studies by Sharija S (29%) and Harish S (25%) which were conducted in the same geographical location.<sup>2,4</sup> In a study by Anil Yadav which was conducted in a different geographical location in the north-western part of India the most common ligature material was rope (35.16%) and chunni (29.6%). "Chunni" is a common part of the dress code of females in Rajasthan and another part of North India.<sup>3</sup> The rope was used as ligature material in 28.5% of the cases. The reason for selecting the rope can be explained based on its easy availability. In Japan, the towel is the material that is commonly used for suicide. In a study by Sharija S, soft material was used in 61.7% of the cases, and hard material in 36.9% of the cases.<sup>2</sup> In the study soft material was used in 45.7% of the cases while in 28.6% of the cases hard material (Table 5). It may be because of the general belief that the usage of soft material may decrease the pain that may be encountered at the time of hanging. These findings are not tallying with the strangulation deaths in all the cases the ligature material was not available at the scene of the crime which proves that it is essentially homicidal with the tendency of the criminal to abscond

along with the ligature material to conceal the nature of the crime.

The appearance of ligature marks on the neck is the principal external sign in cases of hanging. A ligature mark in form of pressure abrasion was present in all 70 cases of hanging (Table 6). It was well-defined in 92.9% of the cases and faint in 7.1% of the cases of hanging. Ligature mark was also present in all 5 cases of strangulation. In a similar study by Harish S, it was faint in 56% of the cases but well-defined in 44% of the cases.<sup>4</sup>

In the present study, the level of constricting force (ligature mark) was found to be over and above thyroid cartilage in 82.9% of cases of hanging (Table 6). In a study conducted by Sharija S and Harish S. the ligature material was above thyroid cartilage in 80% and 88% of cases respectively.<sup>2,4</sup> This finding is tallying with these two studies conducted in the same center. The ligature mark was at the level of the thyroid cartilage in 44.4% of cases. In strangulation cases, in 60% of the cases, ligature material was above the level of the thyroid cartilage. This is not in accordance with a study conducted by Sharija S only 22.2% of the cases were above the level of the thyroid cartilage.<sup>2</sup> According to Modi and Mukherjee, the ligature mark is placed above the thyroid cartilage in 80% of cases, at the level of the thyroid cartilage in 15%, and below thyroid cartilage in 5% of cases.<sup>1,5</sup>

The ligature material was discontinuous in 68.6% of cases of hanging and was continuous in 31.4% of cases of hanging (Table 6). This is in accordance with the study by Sharija S in which 37.5% were continuous and 62.5% of cases showed noncontinuous ligature marks around the neck.<sup>2</sup> In strangulation, all the cases were found to have continuous ligature marks.

In the present study, 32.9% of victims of hanging death showed dribbling of saliva, whereas 67.1% of hanging death had not shown dribbling of saliva. In any case of strangulation death, dribbling of saliva was not found (Table 4). Evidence of dried marks of dribbling of saliva is suggestive of ante mortem hanging as it occurred due to pressure upon the salivary glands but its absence alone will not suggest that the body was suspended after death. Dribbling of saliva from the angle of the mouth may not occur when the death is due to vagal inhibition or injury to the spinal cord. In a study by Sharija S salivary dribble mark was present in 25.9% of the cases.<sup>2</sup> The absence of salivary dribble marks could be because the clothes if any, worn at the time of committing the act were removed by the police before the body was brought to the mortuary for postmortem examination and it was not available for scrutiny.

The tongue was bitten and protruded in 58.6% of the cases (Table 4). This could be due to pressure exerted by the ligature on the neck as stated by Spitz and Fischer.<sup>6</sup> This is in accordance with work done by Sharija S in which the tongue was bitten and protruded in 50.8% of the cases.<sup>2</sup>

Gross internal neck injuries were present in 11.4% of cases of hanging (Table 6). These included contusions seen in subcutaneous tissue, rupture of the lower attachment of sternocleidomastoid muscle, contusion of sternocleidomastoid, and fracture of neck skeleton including the hyoid bone and the thyroid cartilage. The carotid intimal tear was the rarest finding and was present in only 1% of the cases. In work done by Sharija S injuries to internal neck structures were present in 15.4% of the cases.<sup>2</sup> In a study by Luke JL hyoid bone and/or thyroid cartilage fractures (found in 26% of cases) are most frequently identified in those persons found completely suspended and in victims in the older age ranges. No hyoid bone/thyroid cartilage fractures, internal soft tissue injury, or petechiae were present in 13 (21%) cases.<sup>7</sup> In a similar study by Anil Yadav hyoid bone was found fractured in only 3.19% of mechanical asphyxial deaths.<sup>3</sup> Internal neck injuries were present in 80% of the cases of strangulation in the present study, this may be due to more than the required force that is always present in cases of ligature strangulation.

## 5. Conclusion

In death due to hanging and strangulation, the number of males was more as compared to females, M: F is 3.67: 1. Majority of victims 41.4% of hanging deaths and 60% of strangulation deaths were in the age group of 21-40 years and there was no case in the age group of 0-10 years. 68.3% of the victims of hanging weighed between 51 to 70 kg and 4 out of 5 victims of ligature strangulation weighed between 51 to 70 kg. Suicide by hanging was common among the unemployed (32.9%) followed by manual laborers (18.6%). All the cases of hanging were suicidal and all the cases of ligature strangulation were homicidal. None of the hanging cases was homicidal and none of the cases of ligature strangulation were suicidal. Associated trauma was found in 11.4% of cases of hanging and all the cases of strangulation. The prevalence of hanging and strangulation death is more in the married group (63%) as compared to the unmarried age group (37%). Immediate psychological problem was the reason behind suicide in 50% of the cases of hanging followed by alcohol dependence in 14.3% of the cases. 'Lungi' was the most common ligature material (28.6%) used for hanging. The majority (45.7%) used soft ligature materials like lungi, shawl, saree, etc. Hard materials were used in 28.6% of the cases. The dribbling of saliva was found in 32.9% of cases of hanging deaths whereas, in 67.1% of cases, there was no dribbling of saliva. Dribbling of saliva was absent in all 5 cases of strangulation. Ligature mark in the form of pressure abrasion was seen in all 70 cases of hanging. It was well-defined in 92.9% of the cases and faint in 7.1% of the cases. The ligature mark was placed

over and above the level of the thyroid cartilage in 82.9% of cases of hanging while in 60% of cases of strangulation, the ligature mark was placed above the level of the thyroid cartilage. In cases of hanging discontinuity was present in 68.6% of the cases. It was continuous in all five cases of strangulation. The tongue was bitten and protruded in 58.6% of the cases. Internal neck injuries were present only in 11.4% of the cases of hanging and these include contusions seen in subcutaneous tissue, rupture of the lower attachment of sternocleidomastoid muscle, contusion of sternocleidomastoid and fracture of neck skeleton including hyoid bone and thyroid cartilage.

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None.

## 7. Conflict of Interest

None.

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