

Morphometric, Physiological and Chemical Analysis of Male and Female Rats Inhabiting Malwa Region of Punjab

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Abstract

*South-Western region of Punjab is known for its high pesticide use and deteriorated ground water quality mainly caused due to agrochemical processes and extensive use of phosphate fertilizers. The present study was designed to examine the adverse effects of environmental contaminants on biometric parameters, vital and endocrine organs in *Rattus rattus*, *Tatera indica* and *Bandicota bengalensis* inhabiting South-West region of Punjab in North India. There were significantly decreased length of head, tail, forelimb, hind limb, ear and girth of the field male and female rats as compared to control rats. Significantly decreased weight of kidney, lungs, liver, heart and spleen in male and female rats inhabiting South-West region of Punjab was also observed. The size and weight of the thyroid and parathyroid decreased significantly in field male and female rats of different species as compared to control rats while the weight of adrenal glands did not vary in these rats as compared to control rats except for *Tatera indica* male where it was significantly increased in Bathinda rats as compared to control rats. From present studies we conclude that exposure of multiple pesticide/environmental contaminants for prolonged period has affected the biometrics and health of *Rattus rattus*, *Tatera indica* and *Bandicota bengalensis* field rats thereby disrupting various metabolic and physiological processes*

Keywords: *Biometric parameter, Environmental pollutants, Kidney, Liver and Thyroid.*

1. Introduction

The environmental and occupational exposure determines the detrimental effect that this exposure could have on animal health. In recent years, there has been growing concern regarding the adverse effects of various environmental contaminants on human health. With the advent of industrialization, economic development and urbanization, drastic changes have occurred in the lifestyle and surroundings of humans that have resulted in the extensive production and use of beneficial substances [9]. As a result, many potentially hazardous chemicals have been released into the environment at an alarming rate, and their exposure to both humans and wildlife has become inevitable. These chemicals that have been released into the environment are a leading causative factor in the high incidence of various pathological conditions, including cancers [9].

Contamination of natural resources by indiscriminate and hysterical use of pesticides is potential threat to animal and human health. Pesticides are linked to various chronic diseases like cancers, infertility, kidney failure, reproductive problems and nervous disorders in male and female [1]. South-Western region of Punjab is known for its high pesticide use and deteriorated ground water quality due to Agrochemical processes and extensive use of phosphate fertilizers [4]. Acute occupational exposure for pesticides among sprayers was also high as they occasionally use protective devices while spraying [13-15].

Earlier studies give some indication of increased physiological risks of exposure to pesticide/heavy metals, but the epidemiological evidences do not allow any clear inference to be drawn [13-15]. Reproductive health effects have also been detected in male house rats inhabiting South Western region of Punjab [10]. So the present study was designed to investigate the detectable changes in biometric and vital organs of male and female species of rats viz. *Rattus rattus*, *Tatera indica* and *Bandicota bengalensis* inhabiting South-West region of Punjab in North India.

2. Material and Methods

For this study the male and female rats (*Rattus rattus*, *Tatera indica* and *Bandicota bengalensis*) were trapped from the Bathinda district of South-West region of Punjab by using multicatch rat traps and also from Punjab Agricultural University (PAU), Ludhiana that served as control rats (Fig. 1) Approval of Institutional Animal Ethical Committee, Guru Angad Dev Veterinary and Animal Science University (GADVASU), Ludhiana was obtained for the usage of animals vide letter No. 3901-35 dated 06.08.2012. Animals were brought to laboratory and separated according to age and sex and species. Finally the morphometric observation were made after humane scarification of the different species of male and female rats.

2.1. Biometric Analysis

Upon arrival in the labortary, each specimen was weighed . The biometrics measured included the Head and Body length (HBL), tail length (TL), ear length (EL), forelimb length, hind limb length, and girth diameter of the each animal. Body length is measured from the tip of the nose to the middle of the anus and tail length from the middle of the anus to the tip of the tail. Other parameters such as number of lower teeth, upper teeth, fore digits, hind digits in an animal were also noted in all the rats.

2.2. Organ Weight

Following humane sacrifice, the animals were placed on a dorsal recumbency and a mid-line incision were made, starting from the xiphoid cartilage and extending to the pubic symphysis. The peritoneum was reflected and organs were examined in situ and exteriorized. All the vital organ (kidney, lungs, stomach, liver, heart, spleen and brain) and endocrine glands (thyroid, parathyroid and adrenal glands) were also excised cleaned of the adhering tissue and weighed separately.

2.3. Statistical analysis

Results were expressed as Mean \pm standard error of mean (SEM) and subjected to student t-test. Results were considered statistically significant with $p < 0.05$.

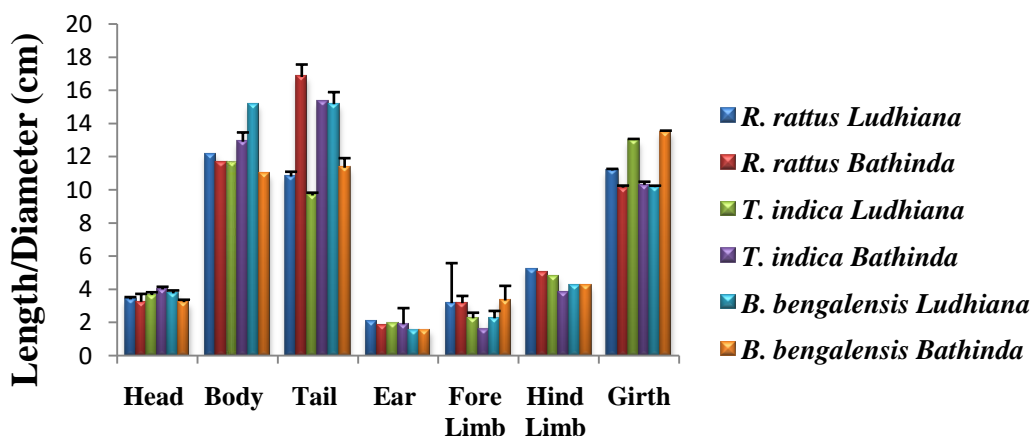


Figure 1. Biometric Analysis of Male Rats *R. Rattus*, *T. Indica* and *B. Bengalensis* inhabiting Bathinda and Ludhiana District of Punjab.

3. Result and Discussion

The head and body length varied nonsignificantly in all the species of female rats *Rattus rattus*, *Tatera indica* and *Bandicota bengalensis* inhabiting Bathinda region as compared to Ludhiana rats. In male *B. bengalensis* the body length was significantly reduced (Fig 1). Tail length was significantly more in male *R.rattus* and *T. indica* and it was less in *B. bengalensis* inhabiting Bathinda region (Fig

1.). In all the female rats the tail length varied nonsignificantly (Fig 2.). Nonsignificant variation in ear length was observed in all male and female rats inhabiting Bathinda and Ludhiana region of Punjab except for *B. bengalensis* where it was significantly reduced (Fig 1. & 2.). Significantly reduction in fore limb and hind limb length was also observed in male and female *T. indica* rats inhabiting Bathinda district as compared to Ludhiana rats. There was no variation in number of upper teeth, lower teeth, fore digits in all the species of male and female rats collected from Bathinda region as compared to control Ludhiana rats.

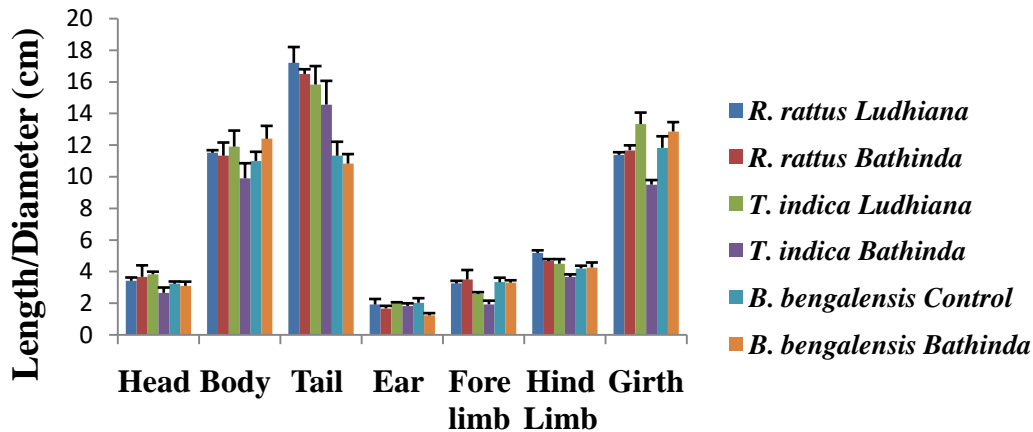


Figure 2. Biometric analysis of female rats *R. rattus*, *T. indica* and *B. bengalensis* inhabiting Bathinda and Ludhiana district.

General body dimension of rats from Bathinda district fall within the range given for species in Punjab [18], although males were on an average slightly larger than females, there was no significant sexual dimorphism which agree with the general trend shown by rat population. [17] also observed larger size of male black rats *R. rattus* from Congreso Island (Chafarinas Archipelago, Spain). Since comparisons of this kind do not allow us to establish precise conclusion, the biometric relationships deduced must be taken as approximate, the differences may be due to several factors such as criteria used in age determination, physiological state of the individuals or ecological factors [17].

The weight of the vital organs of Bathinda rats was compared with control Ludhiana rats. Kidney, liver, lungs and heart weight was significantly low in all the species of male and female *T. indica* and *B. bengalensis* rats residing in Bathinda district (Fig. 3 & 4). In 35.71 % male and 30 % female *R. rattus* and 20% male and 15.3% female.

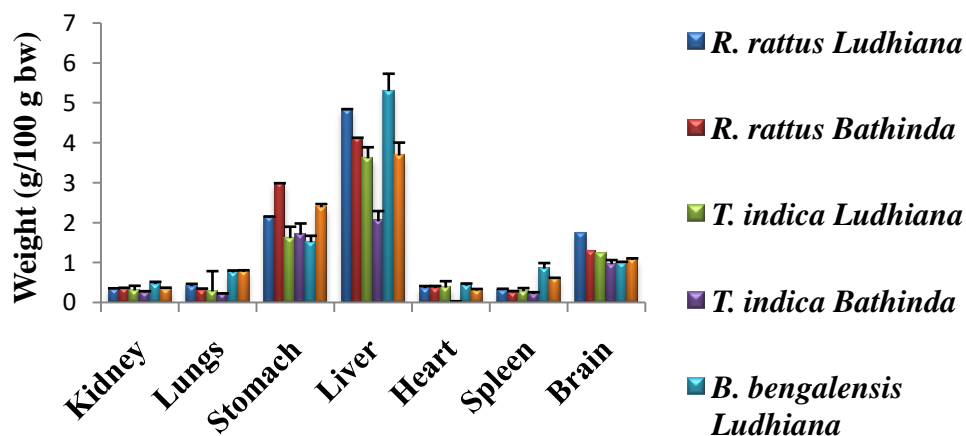


Figure 3. Relative Weight of Vital Organs (g/100 g bw) Indifferent Species of Male Rats.

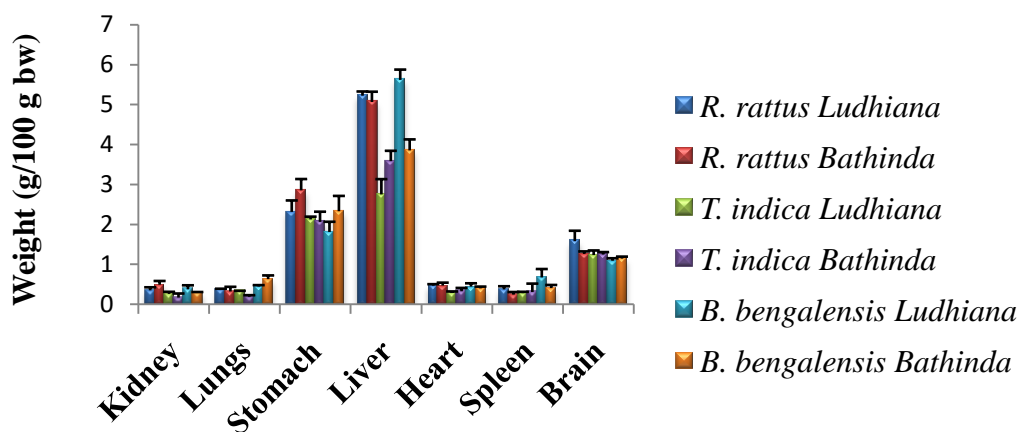


Figure 4. Relative Weight of Vital Organs (g/100 g bw) in Female Rats

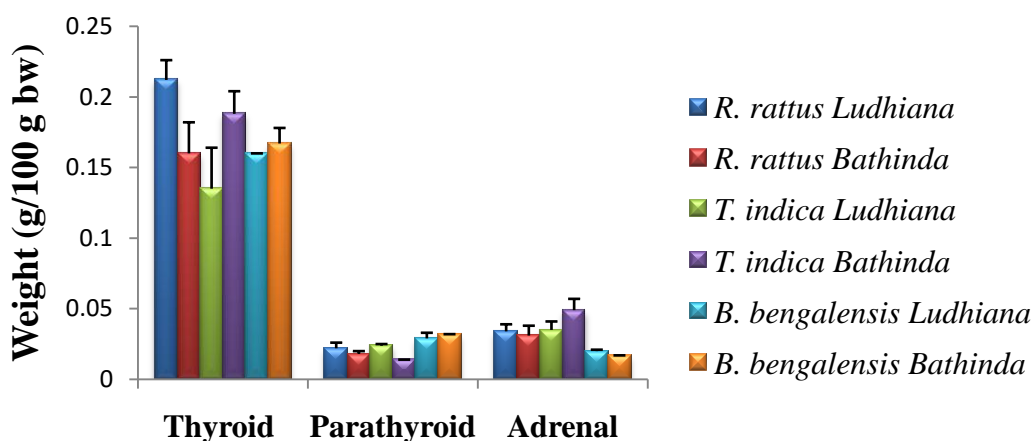


Figure 5. Relative Weight of Endocrine Glands (G/100 G Bw) in Male Rats *R. Rattus*, *T. Indica* and *B. Bengalensis* Inhabiting Bathinda and Ludhiana Districts.

Organ weight were recorded a potential indicator of a dietary effect on the organisms. Organ weight are also the sensitive indicator of an effect of drug toxicity, as significant difference in organ weight may occur in the absence of any morphological change [11]. Out of all the vital organs liver and kidney are central metabolic organs and are important for metabolic and excretory processes and are therefore often regarded as indicator organs for toxic effects. The liver is essential for metabolism of exogenous toxins. The difference in vital organs especially liver and kidney weight are considered as sensitive risk parameters [11]. Reduced weight of liver and kidney may be considered as indicators of toxins induced damage [5]. The environmental contaminants/pesticides might have induced injury that could have induced impairment in metabolic activity of liver and kidney and caused a disturbance in metabolic activity require for maintainance of tissue [3]. Adverse hepatic reactions may present as acute or chronic liver damage. Drug and toxins induced liver damage include vascular damage, induction of liver tumors and development of liver cirrhosis [5]. Liver weights may be influenced by dietary factors that induce hepatic enzymes [2]. Adverse changes in liver tissues in test animals also been observed in cypermethrin treated rats as compared to control rats (Elbietha *et al* 2001). Heikal et al [8] reported a significant increase in liver weight of rats treated with chlorpyrifos and their binary mixture as compared to their control. The subchronic toxicity affected the kidney (increased kidney weight, histopathological lesions) and the liver (increased liver weight, increased liver enzymes) [7, 16]. Unpublished data of our laboratory have also revealed pesticide chlorpyrifos and malathion residues in liver and blood of male and female in *R. rattus*, *T. indica* and *B. bengalensis* rats

inhabiting Bathinda district of Punjab. Enlargement of spleen is indicative of impairment in lymphatic system of exposed animals.

Low weight of endocrine glands, thyroid and parathyroid was observed in male female rats all the species residing Bathinda district although few rats had extra large size of their thyroid gland in *R. rattus* and *T. indica* species (Fig. 5). Significant high adrenal gland weight was observed in male and female *T. indica* Bathinda rats as compared to Ludhiana rats (Fig 5, 6). The significantly increase in the weight of the thyroid in rats treated with alpha cypermethrin which led to a significant decrease in serum concentration of triiodothyronine (T_3) and tetraiodothyronine or thyroxine (T_4) [6]. The adrenal gland is one of the most common endocrine organs affected by chemically induced lesions. Nutritional factors have an important modulating effect on the spontaneous incidence of adrenal medullary proliferative lesions in rats [12]. Dietary restriction may induce significant stress which can affect adrenal glands weights [2].

4. Conclusion

In the present study from all the evidences and literature we conclude that the environmental contaminants specially pesticide alter the natural make up of the rats. The abnormal range of the morphometric, amount of vital organs and endocrine glands may be due to exposure of environmental contaminants and pesticides in the *R. rattus*, *T. indica* and *B. bengalensis* inhabiting Bathinda district of South West region of Punjab in North India.

Conflict of Interest

Authors declare that they have no conflict of interest.

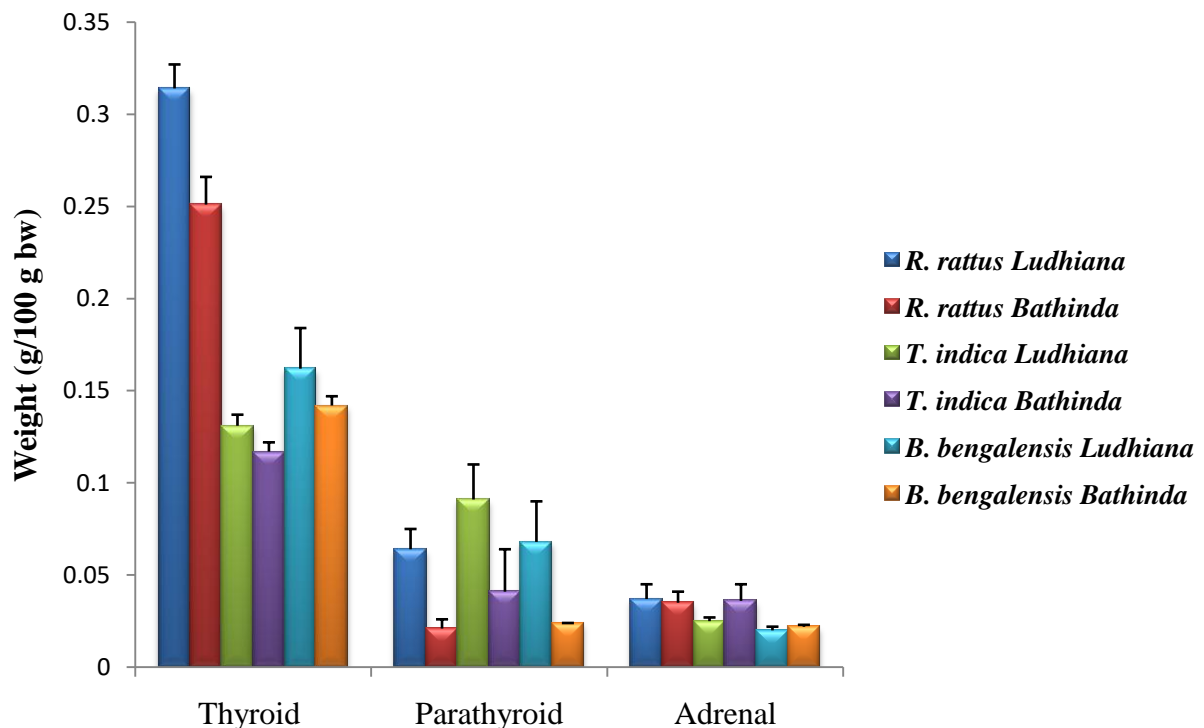


Figure 6. Relative Weight of Endocrine Glands (G/100 G Bw) in Female Rats *R. Rattus*, *T. Indica* and *B.Bengalensis*inhabiting Bathinda and Ludhiana Districts.

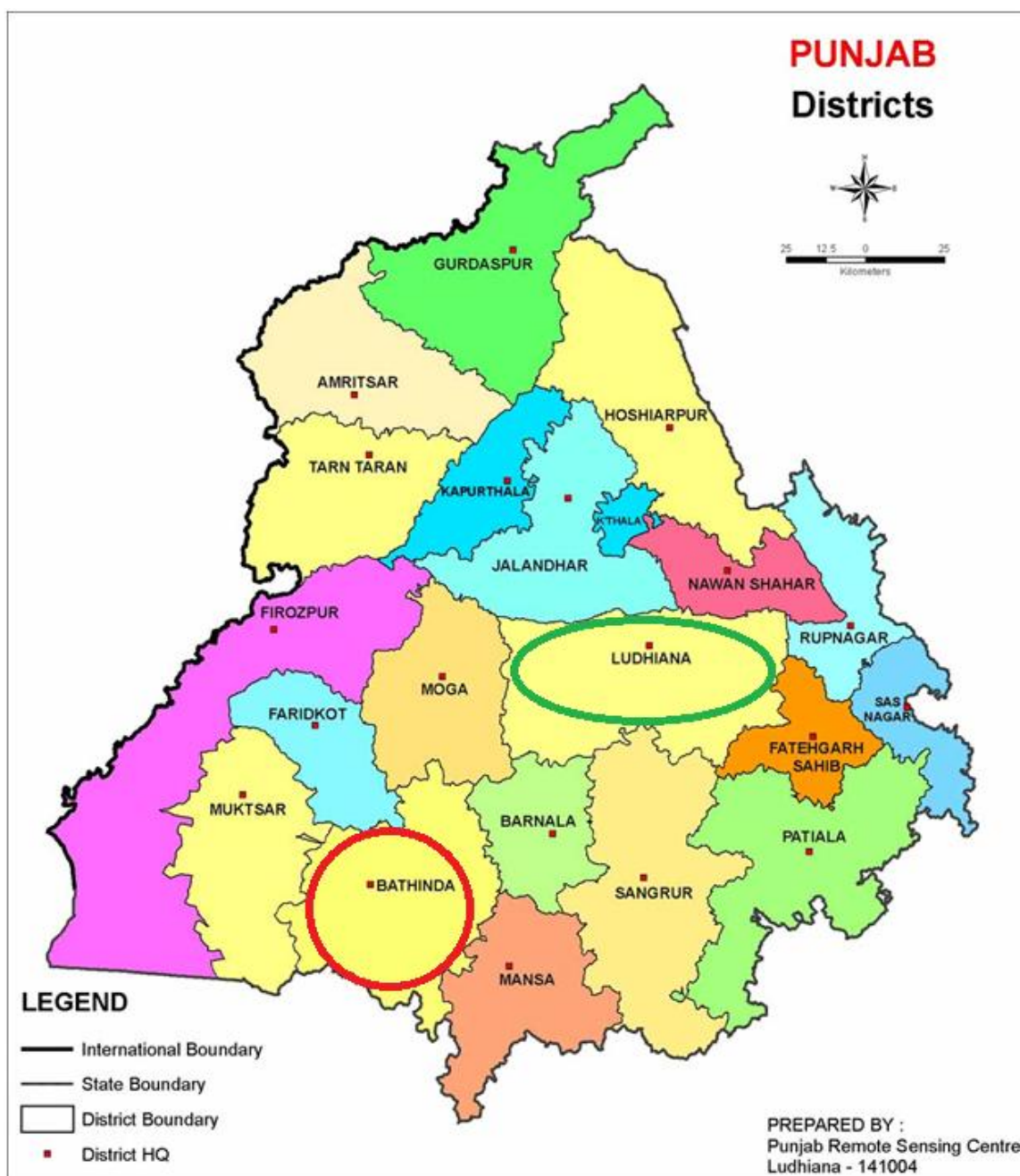


Figure 7. Map of Punjab State Showing Bathinda and Ludhiana Region of Punjab

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