

## 論文内容要旨

Association of Socio-Demographic and Climatic Factors with the Duration of Hospital Stay of Under-Five Children with Severe Pneumonia in Urban Bangladesh: An Observational Study.

(バングラデシュ都市部における5歳未満の重症肺炎患児の入院期間と社会人口統計学的大体気象要因との関連：観察研究)

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This study was designed to assess the association between factors related to the parents' socio-demographic characteristics, children's birth history, nutritional status, and variations in climatic factors (temperature, humidity, and rainfall) with the length of hospital stay (LoS) of under-five year old children for severe pneumonia in urban areas of Bangladesh.

### ***Introduction***

Pneumonia is a leading cause of death accounting for about 15% of all deaths under-five years old, particularly in South Asia and sub-Saharan Africa in 2017. Several socio-demographic factors, such as age, gender, maternal education, and family income have been shown to be associated with the severity of pneumonia. Pneumonia in malnourished children has a greater risk of death, compared to pneumonia alone, worldwide. Children who were preterm and low birthweight had a higher risk of developing severe pneumonia compared to full term and normal weighted babies. Infants born by caesarean section had an increased risk of having severe pneumonia. A study in China noted higher deaths from pneumonia in rural areas compared to urban areas.

Climate change impacts the health of children regarding all types of infectious diseases, including pneumonia. The duration of the hospital stay is usually indicative of the severity of disease, and its rise causes a significant economic burden in both developed and developing countries. Therefore, climate variability can affect the severity of childhood pneumonia and might influence the length of the hospital stay.

Children with severe pneumonia are recommended to be managed in the hospitals. Unfortunately, 22% of such children in Bangladesh are not admitted to those health care facilities due to a shortage of beds, leading to their heightened risk of morbidity and death. A longer LoS in the hospital increases the occupancy of the beds and the total cost of hospitalization.

There has been no study in Bangladesh that has assessed the correlation of the socio-demographic and climate factors with the LoS of under-five children with severe pneumonia in urban sites. Identifying such correlating factors could enable the targeting of measures to reduce LoS, which would in turn result in the availability of hospital treatment to more children suffering from severe pneumonia.

### ***Methods***

We extracted data from two different resources. The clinical data were collected from a cluster randomized control trial (ClinicalTrials.gov:NCT02669654) where the participating children were admitted to different hospitals for the management of severe pneumonia. We analyzed the data of 944 children for this study. The clinical trial was conducted between February 2016 and February 2019. We used the hospitals' data during the period of

hospitalization of the children and computed the LoS in days. For our analysis, we considered individual parents' background socio-demographic characteristics: birth (full-term, preterm, post-term), delivery history (normal vaginal, cesarean section) of the children, and their nutritional status. We collected data on the climatic factors during the study period from the Meteorological Department of Bangladesh. Then, from the climate data, we extracted and used the temperature, humidity, and rainfall data for only those days corresponding to the dates of each child's stay in hospital. We analyzed study data with 95% confidence intervals (CI) and  $p$ -values of the socio-demographic and climatic factors with respect to the LoS in days that were estimated in the bivariate and multivariate analyses in gamma generalized linear model.

### ***Results***

Children's age ( $\beta$ : 0.996, 95% CI: 0.994–0.999,  $p = 0.006$ ), and the well-nutritional status ( $\beta$ : 0.936, 95% CI: 0.881–0.994,  $p = 0.031$ ), number of household family members ( $\beta$ : 1.020, 95% CI: 1.005–1.036,  $p = 0.010$ ), the humidity variation ( $\beta$ : 1.040, 95% CI: 1.029–1.052,  $p < 0.001$ ), average rainfall ( $\beta$ : 0.980, 95% CI: 0.973–0.987,  $p < 0.001$ ), and rainfall variation ( $\beta$ : 1.014, 95% CI: 1.008–1.019,  $p < 0.001$ ) were significantly associated with the LoS among under-five children with severe pneumonia.

### ***Discussion***

Our study demonstrated an association that malnourished children in the lower age group and having more household family members had more risk of a longer LoS in the hospital. Humidity and rainfall variation, and reduced average rainfall, also increased the risk of a longer LoS in the hospital.

### ***Conclusions***

As Bangladesh is a climate-susceptible country, mass awareness and health education are needed for parents/caregivers and health staff. On the basis of our study findings, the variation of humidity and rainfall issue could be adopted as one of the mitigation strategies, such as air conditioning in order to shorten the LoS and prevent the delay in severe pneumonia recovery time at the hospital, especially for such resource-impooverished countries. Further prospective studies could be conducted among hospitalized children with severe pneumonia in some other countries with similar socio-demographic and climatic factors, where the actual humidity and rainfall measurements are taken inside hospitals so to limit the confounding effects, and for external validation.

本研究は、バングラデシュ都市部における 5 歳未満の重症肺炎患児の入院期間と、親の社会人口統計学的特性、児の出生歴・栄養状態および気象要因（温度、湿度、降雨量）の変動との関連を明らかにすることを目的に行った。

**緒言：**肺炎は、南アジアとサハラ以南のアフリカで、5 歳未満の全死亡の約 15%（2017 年）を占める主要な死因である。年齢、性別、母親の教育レベル、家族の収入、早産・低出生体重児、帝王切開での出産など、社会人口統計学的要因や出生歴、低栄養状態は肺炎の重症度と関連していることが示されている。また、気象の変化も肺炎を含むあらゆる感染症に関して、影響を与えることが示されている。

入院期間は通常、疾病の重症度と関連し、その長期化は重大な経済的負担を引き起こす。重度の肺炎児は入院管理を必要とするが、バングラデシュのような医療資源が限られる国では、子供の 22%はベッド不足のために入院できず、死亡のリスクが高い。そのため、重症肺炎児の入院期間に影響を与える要因を検討し、対策を打つことは、より多くの児を入院治療で救済することにつながる。バングラデシュでは、未だこの関連性を指摘した研究は報告されていない。

**研究方法：**2つの異なるデータベースを活用した。臨床データは、研究者（Huq）が参加した「重症肺炎児（5 歳未満）の回復における治療場所のクラスターランダム化比較試験：病院入院治療群 vs プライマリ・ケアでのデイケア治療群」1 (ClinicalTrials.gov: NCT02669654)のうち、入院治療群で得られたデータである（被験者（児）944 人、試験期間：2016 年 2 月から 2019 年 2 月）。各児の在院日数、社会人口統計学的特性（児の性別・月数、親の年齢・職業・教育レベル、世帯収入、きょうだいの数）、児の出産歴（満期/早産/後期、正常分娩/帝王切開）、児の入院時の栄養状態である。気象データについては、バングラデシュ気象局から調査期間中の気象要因に関するデータ（温度、湿度、降雨量）で、児の入院日に対応する日のみのデータを抽出した。その後、在院日数を応答変数とし、社会人口学的要因と気象要因を説明変数とした一般化線形モデルを構築し、各説明変数が在院日数に与える影響を推定した。一般化線形モデルの応答変数の誤差分布はガンマ分布を仮定した。

**結果：**児の月齢（ $B: 0.996$ 、95%CI: 0.994–0.999、 $p = 0.006$ ）、および栄養状態（ $B: 0.936$ 、95%CI: 0.881–0.994、 $p = 0.031$ ）、世帯家族員数（ $B: 1.020$ 、95%CI: 1.005–1.036、 $p = 0.010$ ）、湿度の変動（ $B: 1.040$ 、95%CI: 1.029–1.052、 $p < 0.001$ ）、平均降雨量（ $B: 0.980$ 、95%CI: 0.973–0.987、 $p < 0.001$ ）、および降雨量の変動（ $B: 1.014$ 、95%CI: 1.008–1.019、 $p < 0.001$ ）は、重症肺炎に罹患している 5 歳未満児の在院日数と有意に関連していた。

**考察：**本分析の結果、低年齢層の栄養失調の児、より多くの家族員がいる世帯は、在院日数が長くなるリスクが高いという関連性を示すことができた。湿度と降雨量の変動、および平均降雨量の減少も、入院期間の延長リスクを高めることが示された。

**結論：**入院期間の短縮、重症肺炎の回復の遅延を防ぐために、空調の整備の必要性などの一つの根拠として、医療資源の乏しい国々においても、医療政策的に採用されることが重要である。今後、交絡因子を調整するために、重症肺炎患児の回復と入院期間との関連について、実際の湿度と降雨量の測定を病院内で行う前向き観察研究、そして、外部妥当性を高めるために、類似した条件をもつ他の国々においても、研究を展開することが必要とされる。