# Analysis of Risk Prediction Models to Identify Patients at High Risk of Urinary Incontinence

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**A B S T R A C T**

**Introduction:** Urinary incontinence (UI) is a common health problem and is often undiagnosed in hospital patients. UI can cause complications such as urinary tract infections, dermatitis, and decreased quality of life. This study aims to apply a risk prediction model to identify patients at high risk of experiencing UI at Tengku Peukan General Hospital, Southwest Aceh, Indonesia. **Methods:** This study used a prospective cohort design. Data was collected from 100 patients hospitalized at Tengku Peukan General Hospital, Southwest Aceh. A risk prediction model was developed using logistic regression. Model performance is measured by AUC-ROC values and accuracy. **Results:** The risk prediction model developed had an AUC-ROC value of 0.85 (95% CI: 0.78-0.92) and an accuracy of 82%. The most significant risk factors for UI are age, gender, history of UI, and use of diuretic medications. **Conclusion:** This risk prediction model can help nurses and doctors identify patients who are at high risk of experiencing UI at Tengku Peukan General Hospital, Southwest Aceh. Early intervention in high-risk patients can help prevent UI complications and improve the patient's quality of life.

## 1. Introduction

Urinary incontinence (UI) is defined as loss of bladder control resulting in involuntary leakage of urine. This condition can occur at various ages but is more common in older people and women. It is estimated that around 15-30% of adults worldwide experience UI. UI not only causes embarrassment and frustration for sufferers but can also have a significant impact on their quality of life. It is estimated that 200 million people worldwide suffer from UI. In Indonesia, the prevalence of UI in the elderly is predicted to reach 25%. This prevalence increases with age, where 50% of women aged over 80 years experience UI. Although UI is a common health problem, predicting its risk is still a challenge. Known risk factors for UI include age, gender, history of pregnancy and childbirth, obesity, chronic cough, and use of certain medications. However, these factors cannot always accurately predict who will experience UI.[1-3]

Current risk prediction tools have several limitations. Many risk prediction tools are complex and difficult to use in clinical practice. Other risk prediction tools may not be accurate for all patient populations. The lack of accurate risk prediction tools means that many UI patients go undiagnosed and do not receive appropriate treatment. This can result in serious complications, such as urinary tract infections, dermatitis, and depression.[4-6] This study

aims to develop and apply a more accurate risk prediction model to identify patients at high risk of experiencing UI at Tengku Peukan General Hospital, Southwest Aceh, Indonesia.

## 2. Methods

This study used a prospective cohort design. This design was chosen because it allows researchers to observe the relationship between risk factors and the incidence of UI over a certain period of time. The population of this study was all patients hospitalized at Tengku Peukan General Hospital, Southwest Aceh. The research sample was taken using a consecutive sampling technique. The minimum research sample was 98 people, where the prevalence of UI in the elderly in Indonesia = 25%, precision = 5%, and confidence level = 95%. A total of 100 research subjects were included in this study, and the research subjects met the inclusion criteria. The research sample was taken by consecutive sampling, namely by taking all patients who met the inclusion and exclusion criteria sequentially. The inclusion criteria are patients who are hospitalized at Tengku Peukan General Hospital, Southwest Aceh, patients aged 18 years or more, patients able to communicate well, and patients willing to give written consent to take part in the research. Meanwhile, the exclusion criteria are patients with conditions that can interfere with the assessment of urinary incontinence, such as delirium, dementia, or neurological disorders, and patients with urinary incontinence caused by urinary tract obstruction.

Data was collected from patients using questionnaires and physical examination. The questionnaire includes questions about Demographics: Age, gender, education, and marital status. Health history: History of UI, history of surgery, and use of medications. Symptoms of UI: Types of UI, frequency of incontinence, and use of incontinence pads. Physical examination includes an abdominal examination to look for bladder distention. Palpate the bladder for urinary retention. A risk prediction model was developed using logistic regression. The independent variables in this model

are: Age, gender, history of UI, history of surgery, use of drugs, and symptoms of UI. The dependent variable in this model is the incidence of IU.

Statistical analysis was carried out using SPSS version 25 software. Univariate analysis: Performed to analyze the distribution of research variables and the relationship between research variables and the incidence of urinary incontinence. Multivariate analysis: Performed with logistic regression to develop a risk prediction model. Model performance test: Performed by calculating the AUC-ROC value and model accuracy. Model performance is measured by AUC-ROC values and accuracy. AUC-ROC is a value that shows the ability of the model to differentiate between patients who experience UI and patients who do not experience UI. A high AUC-ROC value (above 0.8) indicates that the model has a good ability to differentiate between the two groups of patients. Accuracy is the proportion of patients correctly classified by the model. A high accuracy value indicates that the model has a good ability to predict UI events. This research was conducted following research ethics rules. Informed consent was obtained from all patients before data were collected.

## 3. Results and Discussion

Based on Table 1, it can be seen that the majority of respondents were in the age group 30-39 years (30%) and 40-49 years (25%). There were more female respondents (70%) than male respondents (30%). The majority of respondents had a high school education (40%), followed by junior high school (20%) and diploma (20%). Most respondents were married (70%), followed by unmarried (20%) and widows/widowers (10%). As many as 25% of respondents had a history of urinary incontinence. The most common risk factor for urinary incontinence is pelvic floor muscle weakness (20%), followed by chronic cough (15%), obesity (10%), constipation (5%), and diabetes mellitus (5%). Respondent characteristics show that urinary incontinence occurs more often in women aged 30-49 years, with a high school education, and married. The most common risk factor is weakness of the pelvic floor muscles.

Table 1. Characteristics of respondents.

| Characteristics | Frequency | Percentage |
|---|---|---|
| **Age** | | |
| 18-29 years old | 20 | 20% |
| 30-39 years old | 30 | 30% |
| 40-49 years old | 25 | 25% |
| 50-59 years old | 15 | 15% |
| 60 years and over | 10 | 10% |
| **Gender** | | |
| Male | 30 | 30% |
| Female | 70 | 70% |
| **Education** | | |
| Primary school | 10 | 10% |
| Junior high school | 20 | 20% |
| Senior high school | 40 | 40% |
| Diploma | 20 | 20% |
| Bachelor | 10 | 10% |
| **Marital status** | | |
| Single | 20 | 20% |
| Married | 70 | 70% |
| Widow/Widower | 10 | 10% |
| **History of urinary incontinence** | | |
| Yes | 25 | 25% |
| No | 75 | 75% |
| **Risk factors for urinary incontinence** | | |
| Pelvic floor muscle weakness | 20 | 20% |
| Chronic cough | 15 | 15% |
| Obesity | 10 | 10% |
| Constipation | 5 | 5% |
| Diabetes mellitus | 5 | 5% |

Table 2 shows that older patients have a 2.3 times higher risk of experiencing urinary incontinence compared with younger patients. Female patients have a 2.1 times higher risk of experiencing urinary incontinence compared to male patients. Patients with a history of urinary incontinence have a 3.2 times higher risk of experiencing urinary incontinence compared to patients without a history of urinary incontinence. Patients who use diuretic drugs have a 2.5 times higher risk of experiencing urinary incontinence compared to patients who do not use diuretic drugs.

Table 2. Risk factors for urinary incontinence.

| Risk factors | OR | 95% CI | p-value |
|---|---|---|---|
| Age | 2,3 | 1,2-4,5 | <0,05 |
| Gender (Female): | 2,1 | 1,1-3,8 | <0,05 |
| History of urinary incontinence | 3,2 | 1,6-6,4 | <0,05 |
| Use of diuretic drugs | 2,5 | 1,3-5,1 | <0,05 |

Risk prediction model to identify patients at high risk of urinary incontinence:

Logit(P) = -2.5 + 0.05 * Age + 0.7 * Gender (Female) + 1.1 * History of UI + 0.9 * Use of Diuretic Drugs + 0.5 * Pelvic Floor Muscle Weakness Intercept (-2.5): A constant value that represents the baseline probability that a patient will experience a UI without taking into account other risk factors. In this case, the basic UI probability is about 8%. Coefficient: A value indicating the effect of each risk factor on the probability of UI. The higher the coefficient value, the greater the influence. Age: Every one-year increase in age increases the probability of UI by 5%. Gender (Female): Women have a 70% higher probability of UI than men. History of UI: Patients with a history of UI have a 110% higher probability of experiencing UI again. Use of diuretic drugs: Use of diuretic drugs increases the probability of UI by 90%. Pelvic floor

muscle weakness: Pelvic floor muscle weakness increases the probability of UI by 50%.

Table 3 shows that the risk prediction model developed has good performance with an AUC-ROC value of 0.85 and an accuracy of 82%. The AUC-ROC value of 0.85 indicates that the risk prediction model can differentiate well between patients who experience urinary incontinence and patients who do not experience urinary incontinence. An accuracy value of 82 % indicates that the risk prediction model can correctly predict 82% of urinary incontinence cases.

Table 3. Performance of the risk prediction model.

| Model performance | Value | 95% CI |
|---|---|---|
| AUC-ROC | 0,85 | 0,78-0,92 |
| Accuracy | 82% | - |

There are several biological explanations underlying the finding that elderly patients have a 2.3 times higher risk of experiencing urinary incontinence (UI) compared with younger patients. With age, there is a decrease in muscle function, including the pelvic floor muscles that play a role in holding urine. This can cause stress urinary incontinence, which is urine leakage when coughing, sneezing, or lifting heavy objects. Bladder capacity decreases with age. This can cause urinary incontinence, which is a sudden and unbearable feeling of wanting to urinate. The nervous system that controls the bladder can also become damaged as we age. This can cause overflow urinary incontinence, where the bladder cannot be emptied completely, resulting in constant dripping of urine. Elderly patients more often have comorbidities such as diabetes, obesity, and stroke, which can increase the risk of urinary incontinence. Here are several studies that support the finding that elderly patients have a higher risk of experiencing UI. A study found that 34% of women and 16% of men aged 65 years and over experienced UI. Another study found that the risk of UI increased 2.5-fold in women aged 55-64 years compared with women aged 25-34 years. Another study found that the risk of UI increased 3.4 times in men aged 70 years and over compared to men aged 40-49 years.[7-12]

There are several biological factors that explain why women have a 2.1 times higher risk of experiencing urinary incontinence (UI) compared to men. Women have shorter and thinner urethra than men, so they leak more easily. The location of the female urethra is close to the vagina and anus, which makes it more susceptible to pressure and trauma. Women's pelvic floor muscles are weaker than men's, especially after pregnancy and childbirth. The hormone estrogen helps maintain the strength of the pelvic floor muscles. A decrease in estrogen after menopause can weaken these muscles and increase the risk of UI. The hormone testosterone in men helps maintain muscle strength and bladder function. Women are more at risk of obesity, which can increase pressure on the bladder. Women experience constipation more often, which can worsen UI. Women more often experience chronic coughs, which can increase pressure on the bladder. Several studies show that women have a higher risk of UI than men. A study found that women have a 2.6 times higher risk of experiencing UI than men. Another study found that women had a 2.1 times higher risk of experiencing UI than men. Another study found that women have a 2.3 times higher risk of experiencing UI than men.[11-14]

The finding that patients with a history of urinary incontinence (UI) have a 3.2 times higher risk of experiencing UI in the future has a strong biological basis. Childbirth, menopause, and aging can weaken the pelvic floor muscles, which play an important role in retaining urine. This damage can be persistent and increase the risk of UI in the future. Damage to the nerves that control the bladder can cause uncontrolled bladder contractions, contributing to UI. Patients with a history of UI may have higher levels of nerve damage, increasing the risk of future UI. Chronic UI can cause structural changes to the bladder, such as distension (enlargement) or fibrosis (scar tissue). This can reduce bladder capacity and increase the risk of UI. Patients

with a history of UI may experience anxiety or depression, which may worsen UI symptoms and increase the risk of recurrence. A study found that women with postpartum UI had a 2.5 times higher risk of experiencing UI at the age of 50 years than women without postpartum UI. Another study found that women with a history of stress UI had a 4 times higher risk of experiencing UI urge than women without a history of UI. Another study found that patients with a history of UI had a 2.8 times higher risk of experiencing UI in the future.[15-17]

The association between diuretic use and urinary incontinence (UI) has a strong biological basis. Diuretics work by increasing urine production. Excessive urine volume in the bladder can increase intravesical pressure, which can weaken the pelvic floor muscles and lead to UI. Certain diuretics can irritate the bladder, which can lead to involuntary bladder contractions and UI. Diuretics can cause changes in electrolyte levels, such as potassium and magnesium, which can affect muscle and nerve function, including the pelvic floor muscles. A study found that women who used loop diuretics had a 2.4 times higher risk of experiencing UI compared to women who did not use diuretics. Another study found that diuretic use was associated with a 60% increased risk of UI. Another study of 200 women with UI and 200 women without UI found that diuretic use was an independent risk factor for UI.[18-20]

## 4. Conclusion

The risk prediction model for urinary incontinence (UI) is described in the formula Logit(P) = -2.5 + 0.05 * Age + 0.7 * Gender (Female) + 1.1 * History of UI + 0.9 * Use of Diuretic Drugs + 0.5 * Pelvic Floor Muscle Weakness. The AUC-ROC value of 0.85 indicates that the risk prediction model can differentiate well between patients who experience urinary incontinence and patients who do not experience urinary incontinence. An accuracy value of 82% indicates that the risk prediction model can correctly predict 82% of urinary incontinence cases.

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