RESEARCH ARTICLE

ROLE OF PHYSICIAN' CHARACTERISTICS IN DRUG PRESCRIPTION: EVALUATION FROM DRUG DATABASE IN IMPROVING PRESCRIBING REGULATION

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ABSTRACT

Introduction: Drugs prescribing is the most important skill for physicians and is strictly regulated by the government. However, factors that contribute to the drug prescribing are not determined yet. The aim of this study is to identify the possible role of physician character in drug prescribing at primary health centers (PHC).

Methods: A cross-sectional study was purposely done over fourteen-days at PHCs of Tangerang Districts. All prescriptions (n=2410) registered in the PHC drug-alert system (CIDIA Database) were analyzed descriptively.

Results: From 2410 prescriptions registered in the PHC drug alert system, 15% prescriptions were prescribed by male physicians and 85% by the females. During the study, there were 964 drugs prescribed by 6 male physicians, 161 drugs per physician in average. There were 5584 drugs prescribed by 12 female physicians, 465 drugs per physician on average. Female physicians tended to prescribe 4 or more drugs compared to its male counterpart at 14% (p=0.006). However, there was no significant difference of drug interactions observed in the prescriptions prescribed by male or female physicians (p>0.05).

Discussion: We identified that physician characteristics including gender played a significant role in the drug prescribing process especially the number of drugs prescribed. Therefore, considering gender differences in prescribing drugs may help the PHCs to improve a better management in drug safety and to comply with the government prescribing regulation.

Keywords: Prescriptions, physicians, male, female, drug interaction

INTRODUCTION

Prescribing drugs is the most important skill that a medical doctor should master. A well-written prescription will lead to a clear instruction of drug usage including dose, frequencies, posology, and probable side effects from physicians to pharmacists. Conversely, an illegible prescription will lead not only to common mistakes including drug dose or frequencies but also to even fatal mistakes causing the death. Evidence had shown that the error rate of prescribing could reach 0.34%. The common errors include incomplete prescribing, improper dose, wrong frequency, improper route of administration, drug-drug interaction, and other administrative errors.[1] The rate of prescribing errors was consistent with the number of drugs prescribed.[1] Many attempts including the involvement of several drug alert systems have been implemented to reduce the prescribing errors. In example, screening tools to alert to the right treatment (START) and screening tool of older people prescriptions (STOP) had been applied to reduce the errors from polypharmacy.[2,3] Other attempts to reduce prescribing errors were achieved through the strict regulation of drug prescribing by the government. In Indonesia, service of excellence in the drug prescribing is regulated through the regulation at the ministry level *Peraturan Menteri Kesehatan Republik Indonesia Nomor 73 Tahun 2016 tentang Standar Pelayanan Kefarmasian di Apotik*.[4] Through this regulation, health workers should fully comply with the standard of excellence in drug prescribing and prevent the possibility of medication error.[4] Health workers should also give full concern that the patients need special precautions including patients receiving abundant drugs (polypharmacy). Therefore, the knowledge of good prescribing in regards to government regulation and the need for a drug alert system are essential for health workers to reduce prescribing errors and to further give excellent and safe services to the people.

Many factors influence physicians to plan rational drugs, to decide the most important choice for giving or not giving the drugs to the patient and then to write the proper drugs in their prescriptions. Policymakers should also understand physician characteristics and behavior in drug prescribing as it may be related to cost from the supply-side factors. Literacy level of the physicians, age and gender had been reported to play a role in the drug prescribing.[5] For example, predisposing factors of higher prescribing rates had been determined as male physicians and general practitioners. Male physicians tended to prescribe a greater number of drugs, newer drugs and tended to choose medical intervention compared to the female physician. The hypothetical answer of these differences was male physicians had more confidence than the female.[5] Additionally, prescribing gender difference existed in the specific setting of anti-hypertensive drugs[6] or in the general setting of new drug adoption.[7] In the context of prescribing anti-hypertensive drugs, female physicians prescribed methyldopa extensively, while male physicians preferred beta blockers.[6] Interestingly, female physicians tended to prescribe more drugs the older they become.[8] Physician' gender is also significantly associated with different drug treatment strategies.[6] Gender differences may influence the response to cost containment in medical services. In detail, male and female physicians had different pattern in the handlings of new drug and cost sharing policy.[9] From the policy-maker perspectives these gender differences require further research to prevent from the loss of potential profit in drug expenditures.[9] Therefore, in the same setting of practice, gender-based drug preference was prominent. Subsequently, considering factors that contribute to rational prescribing of drugs including the role of physician gender will directly relate to the quality of prescribing services and comply with the government regulation.

Recently, medical students were dominated by the female students. Thus, to get a better knowledge of the relation between prescribing patterns with the physician' characteristics, especially gender, in the Tangerang districts, we applied a drug alert system (CIDIA Database) and recorded all prescriptions from nine PHC. To the extent of our knowledge, this is the first study to identify the association between physician gender characteristics and the drug prescriptions. Through this study, we can recommend better regulation in drug-prescribing management for patients' safety.

METHODS

Design of the study

Nine public health centers (PHC) in the Tangerang district were registered in the drug alert system called CIDIA Database. CIDIA was developed as a web-based application for drug information including drug forms, clinical indication and interaction among the drugs. It is registered in Indonesia Ministry of Law and Human Rights with the certificate number EC00201978384. A cross-sectional descriptive study was done through the CIDIA data for over two weeks. Data were purposely collected from the database; however, incomplete data were excluded from the study.

Prescription sampling

All prescriptions received during the study (n=2410) were consecutively analyzed regardless of the diagnosis of the disease and the regiment chosen from nine PHC. The prescriptions were analyzed from the parameter of physician gender, number of drugs prescribed and drug interaction. Other parameters were not analyzed, and it was not adjusted to another factor. Patients less than 5 years old and patients receiving parenteral or pulverized drugs were excluded from the study.

Statistical analysis

All data were shown as descriptive data in the table. For further analytical study, statistical analysis was done using the parametric chi-square test. Probability value less than 0.05 ($p<0.05$) was considered as statistically significant.

ETHICAL APPROVAL

This research proposal was accepted by the Ethics Committee Faculty of Medicine Universitas Islam Negeri Syarif Hidayatullah with the registry number of B-005/F12/KEPK/TL.00/02/2021

RESULTS

General characteristics of the physicians

As depicted in Table 1, 18 physicians were appointed at nine PHCs in the Tangerang district. According to the data, female physicians predominated the PHCs with the composition of 6 male physicians (33%) and 12 female physicians (67%). Among a total of 2410 prescriptions prescribed over 2 weeks from nine PHCs, 366 prescriptions (15%) were prescribed by male physicians while the rest (85%) were prescribed by the female physicians. Additionally, when counting the number of drugs prescribed, male physicians prescribed a total of 964 drugs and females were 5584 drugs. Therefore, the ratio of male to female physicians was 1 : 2, however, the number of drugs prescribed between male and female physicians was almost 1 : 5. Conclusively, female physicians prescribe more drugs compared to their counterparts (Table 1).

Table 1. The general characteristics of the prescriptions in the nine public health centers

Characteristics	Frequencies	Percentages
Physician (n = 18)		
Male physician	6	33
Female physician	12	67
Prescriptions (n = 2410)		
Prescribed by male physicians	366	15
Prescribed by female physicians	2044	85
Number of drugs prescribed (n=6548)		
Prescribed by male physicians	964	15
Prescribed by female physicians	5584	85

Role of physician characteristics in prescribing drug

We further investigated the role of physician' gender in prescribing drugs. Interestingly, female physicians significantly prescribed higher numbers of drugs per person in average than the male physicians (Table 2). Briefly, each female physician prescribed 465 drugs in average for over two weeks of the study, while each male physician prescribed 161 drugs in average. The average reached a significant difference statistically (p = 0.020). Moreover, our data have shown that female physicians significantly prescribed more than 3 drugs when compared to the male physicians (p = 0.006). In detail, 14% male physicians tended to prescribe 4 drugs or more, while 20% female physicians tended to do the same (Table 2).

Table 2. Role of physician characteristics in prescribing drug

Characteristics	Frequencies	P value
Average drug prescribed per physician		0.020
Male physician	161	
Female physician	465	
Number of drugs per prescriptions		0.006
Male physician		
1 to 3 drugs	316	
4 and more drugs	50	
Female physician		
1 to 3 drugs	1641	
4 and more drugs	403	
Number of drug interaction		0.330
Male physician		
Interaction (+)	32	
Interaction (-)	334	
Female physician		
Interaction (+)	149	
Interaction (-)	1895	
Average drug interaction per physician		0.080
Male physician	5	
Female physician	12	

Therefore, female physicians significantly prescribe more drugs to the patients regardless the etiology or the diagnosis compared to the male physician. Interestingly, even though female physicians significantly prescribed more drugs compared to the male physicians, no significant differences were observed in the drug interaction occurred in the prescriptions with the p value of 0.080 (Table 2). Further details about drug interactions occurred in the prescriptions were supplied in the Table 3.

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Table 3. The potential drug interactions

Characteristics	Frequencies
Male physician	
Mefenamic acid – dexamethasone	16
Mefenamic acid – gentamycin	2
Paracetamol – diclofenac	8
Paracetamol – magnesium hydroxide	2
Paracetamol – domperidone	5
Captopril – allopurinol	1
Captopril – mefenamic acid	2
Amlodipine – dexamethasone	1
Amlodipine – simvastatin	4
Nifedipine - amoxycillin	1
Glibenclamide – nicotinate	4
Female physician	
Mefenamic acid – dexamethasone	15
Mefenamic acid - glibenclamide	3
Mefenamic acid – gentamycin	1
Paracetamol – diclofenac	18
Paracetamol – domperidone	37
Paracetamol – magnesium hydroxide	5
Amlodipine – simvastatin	13
Amlodipine - dexamethasone	2
Captopril – mefenamic acid	12
Captopril – allopurinol	1
Ketoconazole – omeprazole	1
Ketoconazole – sukralfat	1
Glibenclamide – omeprazole	16
Metformin - HCT	9

DISCUSSION

The salient findings from this study were: (1) female physicians predominated the physician in the PHCs of the Tangerang district with the ratio of male to female physician was 1 : 2; (2) each female physician significantly prescribed higher number of drugs than the male physicians in average with the ratio of 5 : 1; (3) female physicians significantly prescribe more drugs to the patients regardless the etiology or the diagnosis.

The skill of prescribing drugs is the most important skill for physicians. Writing a good prescription will lead to a clear instruction to other health workers in managing the patient' treatment, while illegible prescription may lead to prescribing errors.[1] The prevention of errors in prescribing were achieved through many attempts including (1) providing strict regulation of drug prescribing from the government and (2) applying drug alert systems that automatically detect errors in the drug prescribing. In Indonesia, service of excellence of the drug prescriptions is regulated through the regulation at the ministry level *Peraturan Menteri Kesehatan Republik Indonesia Nomor 73 Tahun 2016 tentang Standar Pelayanan Kefarmasian di Apotik* (Ministry of Health Regulation, number 73, year of 2016 about Pharmaceutical Service Standard at the Pharmacy).[4]

In brief, pharmaceutical services are not only focused on drug services but also the drug management and clinical application that will further bring in increasing patients' safety. Medication errors can be prevented by following the national standard of drugs prescribing, by understanding the socio-pharmaco-economy aspects of drugs, by applying good coordination among health workers and the most important one is by strictly following the national services standard as requested. Thus, health workers should fully comply with the standard of excellence in drug prescribing, prevent the possibility of medication error and identify factors that contribute to the medication error.[4] As stated in

the *Peraturan Menteri Kesehatan Republik Indonesia Nomor 73 Tahun 2016 tentang Standar Pelayanan Kefarmasian di Apotik,* clinical studies of prescription include drug evaluation, drug dispensing, drug information services, drug counseling, home pharmacy care, drug treatment monitoring and drug side effect monitoring.[4] All health workers should report to the physician if they found any discrepancies related to drugs in the prescriptions. Additional attempts to prevent medication error are by using a drug alert system. Several drug alert systems have been developed to prevent prescribing errors including START and STOP.[2,3] However, still many factors are influencing physicians to write proper prescriptions including age, gender, and physicians' knowledge.[5] Therefore, the knowledge of good prescribing in regards with the government regulation and the need for a drug alert system are essential for health workers to reduce prescribing errors and to further give the excellent and safe services to the people.

Polypharmacy was one aspect that should be prevented according to *Peraturan Menteri Kesehatan Republik Indonesia Nomor 73 Tahun 2016 tentang Standar Pelayanan Kefarmasian di Apotik* since polypharmacy was strongly related to the prescribing error or drug-drug interaction. Health workers must use drugs rationally by considering both the beneficial and the hazardous effect of the drugs. Patients receiving more than 6 drugs should be strictly monitored since prescribing more than 6 drugs will lead to adverse effects, drug-drug interaction, and inappropriate drug dosing.[4,10] In addition, recent reports have shown that prescribing two drugs will lead to 9.8% of drug interaction and prescribing eight or more drugs will lead to 88.3% drug interaction.[11] One population that often-received polypharmacy prescriptions is the elderly since they have multiple disease and disease complications. According to Bushardt et al in one of their studies, they reported that 29.4% elderly received six or more drugs during their visits in the clinics and 15.7% prescriptions are considered as inappropriate.[10] According to this study, the number of drugs prescribed is an important parameter to estimate the errors in prescribing and a systematic approach to recognize polypharmacy should be suggested. Thus, governmental regulation should manage not only the polypharmacy but also the number of drugs prescribed in detail for specific groups of age. The government should also identify factors that play a role in medication error.

Numerous pieces of evidence have been reported that physician' gender contributed to the number of drugs prescribed in prescription writing so that physician' gender may also contribute to error in prescribing. Although unexplainable, recent evidence has shown gender differences affect the decision of prescription writing in both primary and tertiary care. Five years of cumulative analysis from 1661 physicians in Quebec, Canada have shown that male general physicians tended to use new drug utilization compared to the female physicians. Additionally, male physicians tended to prescribe more numbers of drugs and newer classes of drugs than their counterparts. Female physicians focused more time on patient counseling, education, and laboratory analysis. According to the previous studies, the main differences between male and female physicians appeared since male physicians have more confidence in implementing new treatment to patients compared to the female physicians.[5] Male physicians also prescribed less of D and X drugs category to pregnant women than the female physician.[12] In contrast with Tamblyn et al and Weng et al findings, our results have shown that female physicians significantly prescribe more prescriptions and a greater number of drugs per prescription in average than the male physicians. In brief, female physicians predominated the PHCs with the ratio of 2 : 1 compared to the male. However, female physicians significantly prescribed a higher number of drugs per person with the ratio of 5 : 1 compared to the male. Therefore, we agreed with Tuncay et al that the number of drugs prescribed were related to the increasing age of the female physicians.[8] Tuncay et al analyzed 70.000 prescriptions from 38 physicians over 15 years of their practice time.[8] They found that female physicians tended to increase their prescriptions over 15 years of time periods and greater numbers of drugs were prescribed following an increase in their age. The opposite results happened to the male physicians. The hypothetical explanation of this phenomenon is the older the female physician's age, the deeper knowledge of drugs they have and the greater number of drugs they prescribed.[8] Consistent with this finding, we found that even though female physicians tended to prescribe more drugs, there were no statistical differences in the drug interaction incidences between male and female physicians. This result gave an additional enhancement for the condition of deeper knowledge gaining in the older female physician.

Gender differences also contributed to the preference of choosing the drugs. In the context of choosing anti-hypertensive drugs, Sequeira et al had shown that female physicians prefer and prescribe methyldopa rather than other anti-hypertensive drugs, while male physicians prefer the beta blocker drugs.[6] The difference reached statistical significance regardless of the stadium of hypertension. Conclusively, differences in behavior among physicians in prescribing the drug may elicit essential problems directly on patients' adverse effects and indirectly to the cost of healthcare. Thus, policymakers should be aware of prescribers' characteristics including gender that may relate to the drug regulation. Taken together, our result has shown that physician characteristics, especially the physicians' gender significantly contribute to the prescription rates and number of drugs prescribed. This result will support a better knowledge in the prescribing drug regulation.

CONCLUSION

Writing a good prescription will lead to a clear instruction to other health workers in managing the patient' treatment, while illegible prescription may lead to prescribing errors. Several attempts have been issued to prevent errors in prescribing including the use of a drug alert system database and the evaluation of national regulation for drug management and drug prescribing. Many factors influence physicians to plan rational prescriptions and to decide the most important choice for giving or not giving the drugs to the patient and then to write the proper drugs in their prescriptions. We have shown that physician gender is related to the number of drugs prescribed that may lead to polypharmacy or drug interaction. Interestingly, female students dominated medical faculties, thus, specific additional regulation regarding this condition should be fully considered to increase the patients' safety

CONFLICT OF INTEREST
There is no conflict of interest declared.

REFERENCES

1. Yang JH, Liao YF, Lin WB, Wu W. Prescribing errors in electronic prescriptions for outpatients intercepted by pharmacists and the impact of prescribing workload on error rate in a Chinese tertiary-care women and children's hospital. BMC Health Serv Res. 2019 Dec 30;19(1):1013.

2. O'Mahony D, O'Sullivan D, Byrne S, O'Connor MN, Ryan C, Gallagher P. STOPP/START criteria for potentially inappropriate prescribing in older people: version 2.

3. Halli-Tierney AD, Scarbrough C, Carroll D. Polypharmacy: Evaluating Risks and Deprescribing. Am Fam Physician. 2019 Jul 1;100(1):32-38.

4. Ministry of Health. 2016. *Standar Pelayanan Kefarmasian di Apotek.* Peraturan Menteri Kesehatan Republik Indonesia Nomor 73 Tahun 2016, 1-29.

5. Tamblyn R, McLeod P, Hanley JA, Girard N, Hurley J. Physician and practice characteristics associated with the early utilization of new prescription drugs. Med Care. 2003 Aug;41(8):895-908.

6. Sequeira RP, Al Khaja KA, Damanhori AH, Mathur VS. Physician gender and antihypertensive prescription pattern in primary care. J Eval Clin Pract. 2003 Nov;9(4):409-15.

7. Méndez SJ, Scott A, Zhang Y. Gender differences in physician decisions to adopt new prescription drugs. Soc Sci Med. 2021 May;277:113886. doi: 10.1016/j.socscimed.2021.113886. Epub 2021 Apr 4. PMID: 33882439.

8. Tuncay B, Pagano S, De Santis M, Cavallo P. Prescribing Behavior of General Practitioners for Generic Drugs. Int J Environ Res Public Health. 2020 Aug 14;17(16):5919.

9. Duetz MS, Schneeweiss S, Maclure M, Abel T, Glynn RJ, Soumerai SB. Physician gender and changes in drug prescribing after the implementation of reference pricing in British Columbia. Clin Ther. 2003 Jan;25(1):273-84.

10. Bushardt RL, Massey EB, Simpson TW, Ariail JC, Simpson KN. Polypharmacy: misleading, but manageable. Clin Interv Aging. 2008;3(2):383-9.

11. Gören Z, J Demirkapu M, Akpinar Acet G, Çali S, Gülçebi Idriz Oğlu M. Potential drug-drug interactions among prescriptionsfor elderly patients in primary health care. Turk J Med Sci. 2017 Feb 27;47(1):47-54.

12. Weng SS, Chen YH, Lin CC, Keller JJ, Wang IT, Lin HC. Physician characteristics and prescription drug use during pregnancy: a population-based study. Ann Epidemiol. 2013 Feb;23(2):54-9.