ปริมาณนิโคตินและโคตินีนในปัสสาวะของผู้ที่สูบบุหรี่ม้วนเอง ผู้ที่สูบบุหรี่ก้นกรอง และผู้ที่สัมผัสกับควันบุหรี่

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บทคัดย่อ

การสูบบุหรี่เป็นภัยต่อสุขภาพของผู้สูบและผู้สัมผัสกับควันบุหรี่ ราคาบุหรี่ก้นกรองเพิ่มขึ้นตามภาษี และความเชื่อว่า บุหรี่ม้วนเองเป็นพิษต่อสุขภาพน้อยกว่าบุหรี่ก้นกรอง ทำให้ผู้สูบบุหรี่ก้นกรองบางส่วนเปลี่ยนมาสูบบุหรี่ม้วนเอง การศึกษานี้ใช้ค่านิโคตินและโคตินีนในปัสสาวะเป็นดัชนีประเมินความเป็นพิษของบุหรี่ทั้งสองชนิดนี้ ผลการศึกษาพบว่า ปัสสาวะของผู้ที่สูบบุหรี่ทั้งสองชนิดให้ค่านิโคตินและโคตินีนไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ ในปัสสาวะของผู้สูบบุหรี่ทั้งสองชนิดพบปริมาณโคตินีนสูงกว่าในปัสสาวะของผู้ที่สัมผัสกับควันบุหรี่ ในปัสสาวะของผู้ที่สูบบุหรี่ม้วนเองมีปริมาณนิโคตินสูงกว่าในปัสสาวะของผู้ที่สัมผัสกับควันบุหรี่ซึ่งพักอาศัยอยู่ด้วยกัน ปริมาณนิโคตีนและโคตินีนในปัสสาวะของผู้ที่สัมผัสกับควันบุหรี่ที่บ้านไม่แตกต่างจากผู้ที่ไม่ต้องสัมผัสกับควันบุหรี่ที่บ้าน ดังนั้น บุหรี่ม้วนเองมีความเป็นพิษต่อสุขภาพไม่น้อยกว่าบุหรี่ก้นกรอง ปริมาณนิโคตินที่ผู้สูบได้รับไม่ขึ้นกับชนิดของบุหรี่ที่สูบแต่สัมพันธ์กับพฤติกรรมการสูบ การสัมผัสกับควันบุหรี่น่าจะเกิดขึ้นในสถานที่สาธารณะไม่น้อยกว่าที่เกิดขึ้นที่บ้าน กฎหมายห้ามสูบบุหรี่ในที่สาธารณจึงน่าจะมีการบังคับใช้อย่างจริงจัง

คำสำคัญ: บุหรี่ม้วนเอง บุหรี่ก้นกรอง นิโคติน โคตินีน

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Urinary nicotine and cotinine concentrations in hand-rolled cigarette smokers, filter cigarette smokers, and passive smokers exposed to ETS

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ABSTRACT

Cigarette smoking is a serious health risk for both active and passive smokers. Due to the prices have gradually increased, some smokers have switched from filter-tax included cigarettes to the cheaper hand-rolled cigarettes. Regardless of their prices, some smokers believe that hand-rolled cigarettes are less harmful to their health than are the filter cigarettes. In this presentation, urine nicotine and cotinine concentrations were used as indicators of health risk associated with smoking and exposure to environmental tobacco smoke (ETS). Statistical analysis indicates non-significant differences in urine nicotine and cotinine levels in hand-rolled cigarette smokers' samples compared with filter cigarettes smokers' samples. There are, however, highly significant differences in urine cotinine concentrations in both filter and hand-rolled cigarette smokers' samples compared with passive smokers exposed to ETS at home. But only the hand-rolled cigarette smokers' samples show statistically significant difference in urinary nicotine levels compared with the samples of passive smokers living with them. Urine samples of passive smokers exposed to ETS at home show non-statistically significant differences in both urine nicotine and cotinine levels compared with samples of non-smokers unexposed to ETS at home. Thus, hand-rolled cigarette smoking is at least as harmful as filter cigarette smoking. Exposure to ETS in public places is possibly more common than exposure to ETS at home. Passive exposure to ETS in public places is difficult to avoid, thus, legislation banning smoking in public places should be strictly implemented for public health safety.

Keywords: Hand-rolled cigarette, Filter cigarette, Nicotine, Cotinine

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Introduction

Cigarette smoking has enormous negative health consequences and causes premature mortality, not only to smokers but also to people who involuntarily inhale tobacco smoke present in the air or environmental tobacco smoke (ETS).[1, 2] Due to publicity about the health risks of smoking increased, cigarette manufacturers have been concerned about the lack of social acceptability of their products. As a result, filter cigarettes have been developed and marketed worldwide.[3, 4] Although the addition of a filter can reduce throat and nose irritation of smokers, medical information has shown that the health risk associated with filter cigarette smoking was not reduced.[5] Based on the health concerned, many countries have implemented policies and laws for specific preventive actions including restriction of advertising, increasing taxation on tobacco, and adoption of stringent nonsmoking policies in public places. Increasing taxation on tobacco always leads to increasing prices of cigarettes especially the factory made ones. For economic reasons, some factory made cigarette smokers may switch to use cheaper hand-rolled or roll your own (RYO) cigarettes. Compared with manufactured filter cigarettes, hand-rolled cigarettes seem to be health safer since they have no additives and have less tobacco weight per cigarette (0.45 vs. 0.7 g).[6] As the result, RYO smokers were most likely to believe RYO cigarettes posed less risk compared with factory made cigarettes.[6, 7] Because of this believing, involuntarily exposed subjects may be unaware of their exposure and may not prevent themselves from exposing to ETS of hand-rolled cigarettes. For both economic and health concerns, RYO cigarettes may gain more popularity in the future. To prove whether hand-rolled cigarette smoking is really less harm than filter cigarette smoking, the relative hazard associated with these tobacco smoking should be monitored by measuring biomarkers derived from the smoke such as carbon monoxide and thiocyanate. However, nicotine and its main metabolite, cotinine, have been reported as specific markers of exposure to tobacco smoke.[8, 9] In this presentation, urinary nicotine and cotinine concentrations were used to compare health risk associated with filter cigarette smoking, hand-rolled cigarette smoking, and the ETS exposure.

Materials andMethod

Subjects

In this study, all subjects were 18 year olds or over and in good general health. A volunteer who registered as a smoker must have an adult healthy non-smoker living with them enroll as a passive smoker exposed to ETS at home. A volunteer who claimed themselves as a non-smoker also has to have an adult healthy non-smoker living with them enroll as a non-smoker unexposed to ETS at home. The enrolled volunteers were screened by physical check up and interviewing to determine whether they were a filter cigarette smoker, a hand-rolled cigarette smoker, a passive smoker exposed to ETS at home, or a non-smoker unexposed to ETS at home. The smokers recruited in this project were allowed to smoke as usual without any limitation or intervention. All subjects gave written informed consent, and the study was approved by Srinakharinwirot university ethic committee (SWUEC) responsible for human experimentation which is in compliance with the Helsinki declaration. Eligible volunteers were received detailed information about study goals and procedures.

Urine collection and analysis

Urine samples were collected after the eligible volunteers signed the informed consent. All were done in morning after the daily first cigarette of smokers; they were asked to collect their 5-10 mL urine in a prepared container. A single urine sample was collected from each volunteer. Samples were frozen on the day of collection and stored at -20°C until time of analysis. Batches of samples were defrosted and analyzed for nicotine and cotinine concentrations by GC/MS according to the previous published methods.[10] Statistical analysis was performed using SPSS 11.0 for Windows software program (SPSS Inc., Chicago, IL, USA). The one tail t-test with 95% confidence intervals was used and a $p < 0.05$ was considered statistically significant.

Results

Thirty three filter cigarette smokers and their matched passive exposed subjects were recruited in this study. As shown in table 1, most filter cigarette smokers, approximately 97%, were men. From 44 hand-rolled cigarette smokers recruited, only 70% were men. Total number of passive smokers exposed to ETS at home was 77 about 87% were women. In 161 non-smokers, about 80% were women. The study populations are as shown in Table 1.

The amount of tobacco and number of cigarette smoked were not recorded because the smoking and exposing to the smoke in this project were set as daily life. Although higher average and maximum urinary nicotine and cotinine concentrations were observed in urine of hand-rolled cigarette smokers than in urine of filter cigarette smokers (table 2), the statistical differences from these samples were not found to be significant at the 95% confidence interval (table 3). Statistical analysis of urinary cotinine concentrations did reveal significant differences between smokers and the passive smokers exposed to ETS at home (table 3). Passive exposure to hand-rolled cigarette smoke at home also had significantly lower urinary nicotine concentrations than hand-rolled cigarettes smokers (table 3). Urinary nicotine and cotinine concentrations in passive smokers' samples showed non-statistically significant differences compared to those in samples of non-smokers unexposed to ETS at home (table 3).

Discussion

Compared to factory made filter cigarettes, hand-rolled cigarettes usually contain less tobacco weights. Thus, they seem to be less toxic. However, our analytical information indicates that hand-rolled cigarette smoking is at least as harmful as filter cigarette smoking. The urinary nicotine and cotinine levels in hand-rolled cigarette smokers' samples were not significantly different from the amounts found in filter cigarette smokers' samples. Darrall and Figgins[11] have reported that nicotine yields in main stream smoke from hand-rolled cigarette were actually found to be higher than those obtained from manufactured cigarettes. By observing smoking pattern and measuring CO boost per gram of tobacco, Laugesen and colleagues[6] also have reported that RYO smoking was associated with increased smoke exposure per cigarette. Therefore, our results support that health risk associated with tobacco smoking is not related to the weight of tobacco used. Habitual smokers most likely have compensatory behavior which is adjusting their smoking habits to receive a desired amount of nicotine, the driving force behind the urge to smoke. The intake of nicotine as well as tars during smoking, in fact, depends on puffing topography such as the puff volume, the rate of puffing, the intensity of puffing, and the depth of inhalation as well as the number of cigarettes smoked per day and the extent of dilution with room air.[12-16]

Urinary nicotine and cotinine concentrations in filter and hand-rolled cigarette smokers were compared with the amounts of nicotine and cotinine in urine samples of passive smokers exposed to ETS at home. Urinary cotinine concentrations are significantly higher in smokers' samples than in passive smokers' samples. But only samples of hand-rolled cigarette smokers had statistically higher nicotine concentrations than samples of passive smokers who exposed to hand-rolled cigarette smoke at home. Since nicotine has shorter half life than cotinine, it is best suited to quantifying exposure over a period of a few hours only.[17, 18] For filter cigarette, filter tip is designed to dilute nicotine and tars in mainstream smoke but the side stream smoke is unfiltered since it does not pass through the column of tobacco or the filter of the cigarette.[13, 15, 16, 19] On one hand, passive exposure to side stream smoke from filter cigarette within a few hours, hence, may receive high amount of nicotine into their body. On the other hand, the believing that hand-rolled cigarette posed less risk compared with commercial cigarette may cause hand-rolled cigarette smokers to inhale the mainstream smoke intensively, which, in turn, leave quite small amount of nicotine in the side stream smoke. Urinary cotinine concentrations can be a reliable marker of current daily-life intermittent exposure to tobacco smoke within the past several days.[17, 18] The significant higher urinary cotinine concentrations in smokers compared with samples of passive smokers exposure to

ETS at home may indicate that ETS at home is not as much as it was concerned. People who live with smokers may be more aware of the health risk from second hand smoking and prevent themselves from smoke exposure.

Compared to urine samples of non-smokers unexposed to ETS at home, urine samples of passive smokers exposed to ETS at home had non-statistically significant differences in both nicotine and cotinine concentrations. The results may indicate that ETS is most common in locations other than at home. This evidence may support that non-smokers unexposed to ETS at home are virtually impossible to avoid completely exposure to ETS in public places in the present as long as they still have socializing with smokers. Likewise, people who live with smokers, although preventing themselves from ETS at home, are unavoidable from exposure to ETS in public places. In fact, passive exposure to ETS in public places is often not realized by the exposed subjects because, unlike exposure to ETS at home, it is difficult to indicate who is smoking in a public place and the ETS will be emitted randomly which is difficult to avoid. Notwithstanding, passive exposure to ETS in public places will be intermittently and chronically. The banning of cigarette smoking in public places may be an effective way to protect non-smokers' health from ETS toxicity.

Table 1 Study populations

Type of smoking	**Number of subjects**		
	Male	**Female**	**Total**
Filter cigarette smokers	32	1	33
Passive-smokers living with filter cigarette smokers	2	31	33
Hand-rolled cigarette smokers	31	13	44
Passive-smokers living with hand-rolled cigarette smokers	8	36	44
Non-smokers living with non-smokers	32	129	161

Table 2 Ranges and mean values of urinary nicotine and cotinine concentrations

Type of smoking	Urine nicotine concentration (nmol//L)		Urine cotinine concentration (nmol/L)	
	Range	Mean	Range	Mean
Filter cigarette smokers	80 - 72896	4494	108 - 18517	4942
Passive-smokers living with filter cigarette smokers	0 - 13764	666	0 - 3732	392
Hand-rolled cigarette smokers	135 - 153188	9850	341 - 64775	5345
Passive-smokers living with Hand-rolled cigarette smokers	0 - 13641	456	0 - 7736	579
Non-smokers living with non-smokers	0 - 10953	431	0 - 4362	403
All non-smokers	0 - 13764	481	0 - 7736	449

Table 3 Statistical analysis of urinary nicotine and cotinine concentrations

Compared groups	Statistic test	p-value	
		Nicotine	Cotinine
Filter cigarette smokers vs. Non-smokers living with them	Paired t-test	0.07553	9.29355×10^{-9}
Hand-rolled cigarette smokers vs. Non-smokers living with them	Paired t-test	0.00855	4.7551×10^{-5}
Filter cigarette smokers vs. Hand-rolled cigarette smokers	Unpaired t-test	0.120705	0.389585
Non-smokers living with smokers vs. Non-smokers living with non-smokers	Unpaired t-test	0.360833	0.267286

Acknowledgement

The financial support of the HRH Princess Maha Chakri Sirindhorn Medical Center, Srinakharinwirot University is gratefully acknowledged.

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