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# COMPARISON OF THE HEART RATES AND BLOOD PRESSURE OF NORMOTENSIVE AND HYPERTENSIVE BETEL NUT (ARECA CATECHU) CHEWERS

**[1] *Rodney Itaki, [2.3] Isi H. Kevau, [2,3]Ben Miam, [2,3]Mogan Giva, [2,3]Reubeen Mari and [2,3]James Waigiebu**

[1]Division of Pathology, [2]Division of Clinical Sciences, School of Medicine and Health Sciences, University of Papua New Guinea, [3]Sir Buri Kidu Heart Institute, Port Moresby General Hospital, Papua New Guinea,

***Correspondence author**: itaki7@gmail.com

# COMPARISON OF THE HEART RATES AND BLOOD PRESSURE OF NORMOTENSIVE AND HYPERTENSIVE BETEL NUT (ARECA CATECHU) CHEWERS

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**ABSTRACT**:
Betel nut chewing is a common habit in Papua New Guinea. Although much is known about this habit and its link to oral cancer, there is paucity of data on its effect on the cardiovascular system. The acute effect of betel nut chewing on the heart rate and blood pressure of 44 normotensive and 10 hypertensive subjects who volunteered to participate in this study were assessed. The heart rate and blood pressure of each subject in both groups were measure before and after chewing betel nuts. The results showed statistically significant increase in the mean heart rate from baseline after two (P=0.032, df=4) and seven minutes (P=0.024; df=4) in the normotensive but not in the hypertensive subjects. The results for the blood pressure were variable in both groups. Our findings indicate that betel nut chewing acutely increases the heart rate in normotensive compared to hypertensive subjects.

**Key words**: betel nut, areca catechu, heart rate, blood pressure response, cardiovascular effects
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## INTRODUCTION

Betel nut chewing has been shown to increase the heart rate [1]. This effect lasts for 17 minutes regardless of whether the chewer is a novice or habitual chewer [1]. Although the main active compound in betel nut is thought to be arecoline, which is a naturally occurring analogue of acetylcholine, the effect observed after chewing suggest sympathetic stimulation [2]. There are several hypotheses trying to explain the transient tachycardia in betel nut chewers. Nicotinic receptors are present on adrenal medulla [3] and it has been proposed that stimulation of these receptors may release Catecholamines causing tachycardia [4, 5]. Betel nut chewing has also been shown to increase basal secretions of catecholamines [4]. Piper betel inflorescence that is chewed

with the betel nut has also been shown to release catelcholamines in-vitro [1, 6]. However, the exact mechanism explaining tachycardia observed in betel nut chewers is yet to be elucidated.

Few studies have examined the blood pressure response after chewing betel nut. Systolic blood pressure has been observed to be elevated in first time chewers but not the diastolic [1]. In an epidemiological survey, chronic chewers were found to have high prevalence of hypertension [4]. Hence, the acute and chronic effects of betel nut chewing on blood pressure are still unknown.

Betel nut quid chewing is a popular habit in Papua New Guinea (PNG). There are no published data comparing the heart rate and blood pressure among normotensive and hypertensive chewers of betel nut quid in PNG. This baseline study was prompted by the lack of such data. The major aim of this baseline study was to compare the heart rate and blood pressure of normotensive and hypertensive chewers of betel nuts. It is hoped that the results obtained in this study will set the stage for detailed study to assess the effects of betel nut chewing on the cardiovascular system.

**SUBJECTS AND METHODS:**

This was partly a hospital based cross-sectional study. The study sites were the Port Moresby General Hospital (PMGH), which is the major specialist, general and referral hospital in the National Capital District and PNG and the School of Medicine and Health Sciences (SMHS) University of Papua New Guinea (UPNG). Two study groups were used. In the first group were healthy normotensive subjects and in the second group were hypertensive patients. Convenience sampling was used to select the normotensive subjects from the SMHS UPNG and the hypertensive subjects from the hypertensive consultation clinic in PMGH.

All subjects were screened using pre-defined criteria. The exclusion criteria included - non-betel nut chewers, history of angina, history of angina on chewing betel nut, past history of ECG evidence of arrhythmia, heart block or any abnormal conduction, past history of abnormal echocardiography findings and history of allergies. All the hypertensive patients were on Propanolol, which is a beta blocking anti-hypertensive agent. The subjects were appropriately informed about the study and the option to withdraw at anytime during the course of the study.

Informed consent was obtained from 44 healthy normotensive subjects selected from the SMHS UPNG and 10 hypertensive patients from the hypertension consultation clinic in PMGH. Betel nuts, piper betel inflorescence and lime powder were purchased from local markets in Port Moresby.

Measurements of the various parameters were carried out in the Sir Buri Kidu Heart Institute located within the PMGH. Cardiac resuscitation equipment was set up and standardized

appropriately. The study protocol was explained to each subject before commencement of the procedure. Each subject was given time to acclimatize to the environment to allow the heart rate and blood pressure to reach resting levels, while sitting comfortably on a chair.

After ten minutes of rest, baseline heart rate was obtained using radial pulse and recorded as beats per minute (bpm); then blood pressure was measured using a mercury sphygmomanometer and listening for Korotkoff sounds over the left brachial artery. Korotkoff sound phase I was taken as systolic blood pressure (SBP) and phase V was recorded as diastolic blood pressure (DBP) [7]. Three separate measurements were recorded for each subject. Baseline measurements were recorded as zero time. The recordings were done by the same investigator for the entire study period to reduce any inter-observer variability.

Each subject was then given a betel nut, betel inflorescence and lime powder to chew. A hand held digital stop-watch was used for time keeping. After the subjects started chewing, heart rate and blood pressure were measured at two, seven, 12 and 17 minutes. Measurements were obtained while the subject was still sitting on a chair.

Ethical clearance and approval for the study were obtained from the Ethics and research grant committee in SMHS UPNG. The study was done in accordance with the Declaration of Helsinki [8].

The heart rate and blood pressure measurements before and after chewing were analysed using Microsoft Excel data pack. Paired student t-test was done to assess the statistical significant of the changes in the mean heart rate and blood pressure from the baseline measurements. A $p<0.05$ was defined as statistically significant with the null hypothesis being no change in the mean heart rate and blood pressure after chewing betel nut [9].

**RESULTS:**

**Mean Heart rate after chewing betel nut**:

In the normotensive subjects the mean heart rate increased significantly to 95±18 bpm (mean ± standard deviation) ($p=0.032$, df=4) after two minutes from the baseline (zero time) heart rate of 69±11 bpm (Table 1).

The difference from baseline remained significant after seven minutes (HR=88 bpm; $p=0.024$; df=4). It then decreased gradually close to baseline level after 12.0 and 17.0 minutes. The corresponding mean heart rate at 12.0 minutes and 17.0 minutes were not different statistically compared to the mean baseline heart rate. In the hypertensive patients, the mean heart rate increased to 78±11 bpm after two minutes from a mean baseline of 70±12 bpm (Table 1). The difference was not statistically significant

(p=0.18; df=4)). The heart rate then decreased gradually after two minutes to the baseline level. Figure 1 shows the changes in the heart rate of the normotensive subjects compared to the hypertensive patients.

The significant increase in the heart rate of the normotensive subjects after two minutes was significantly different from the non-significant increase observed among the hypertensive patients.

Table 1: Mean heart rate of normotensive subjects and hypertensive patients

| | Mean Heart Rate of Normortensive subjects | | Mean Heart Rate of Hypertensive patients | |
|---|---|---|---|---|
| Time (minutes) | bpm ± std dev (n =44) | P-value | bpm ± std dev (n =10) | P-value |
| 0 (baseline) | 69 ± 11 | | 70 ± 12 | |
| 2.0 | 95 ± 18 | 0.032* | 78 ± 11 | 0.180 |
| 7.0 | 88 ± 12 | 0.024* | 77 ± 10 | 0.193 |
| 12.0 | 83 ± 12 | 0.060 | 74 ± 10 | 0.423 |
| 17.0 | 77 ± 9 | 0.118 | 71 ± 10 | 0.836 |

*Statistically significant

Figure 1: Mean heart rate of Normotesive subjects and Hypertensive patients

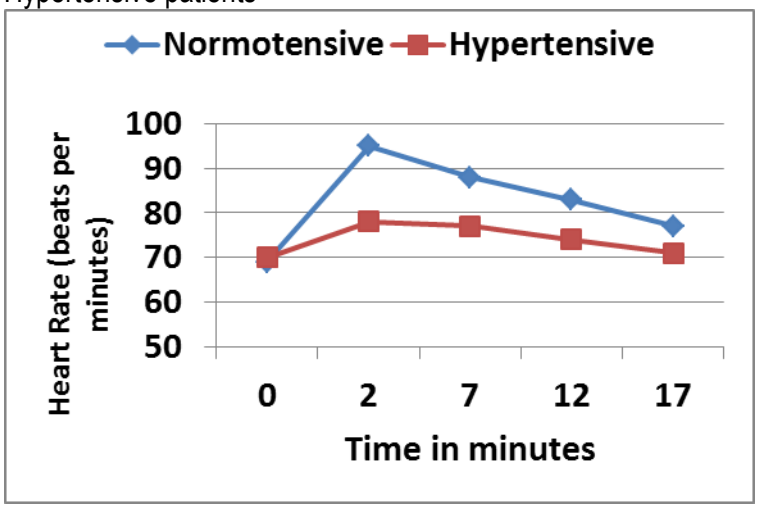

Table 2: Mean systolic (SBP) and diastolic (DBP) blood pressure of normotensive subjects and hypertensive patients.

| | Mean Blood Pressure of Normotensive subjects (n = 44) | | | | Mean Blood Pressure of Hypertensive patients (n = 10) | | | |
|---|---|---|---|---|---|---|---|---|
| **Time (minutes)** | **Mean SBP (mmHg)** | **P value** | **Mean DBP (mmHg)** | **P value** | **Mean SBP (mmHg)** | **P value** | **Mean DBP (mmHg)** | **P value** |
| 0 (baseline) | 117±7 | | 80±9 | | 146±14 | | 90±12 | |
| 2.0 | 117±14 | 1.0 | 75±12 | 0.405 | 134±10 | 0.088 | 83±9 | 0.158 |
| 7.0 | 118±12 | 0.866 | 80±12 | 1.0 | 142±16 | 0.091 | 89±10 | 0.836 |
| 12.0 | 119±11 | 0.709 | 83±10 | 0.539 | 140±16 | 0.089 | 90±12 | 1.0 |

**Blood pressure after chewing betel nut**:

The mean systolic and diastolic blood pressure recorded for the normotensive subjects at baseline and at 2.0, 7.0 and 12.0 minutes after chewing betel nut is presented in Table 2. There were no statistically significant changes in the mean SBP from the baseline value. The mean DBP decreased slightly, from baseline, but the difference was not statistically significant (p=0.4; df=4). The mean SBP and DBP for the hypertensive patients decreased from the baseline values after two minute of chewing betel nut. The differences in both cases were not statistically significant (Table 2). The drop was transient, in each case, returning to the baseline values in subsequent readings.

## DISCUSSION

Betel nut contains four alkaloids; arecoline, arecaidine, guvacoline and guvacine that may be responsible for its pharmacological effects [10]. Current evidence suggests that arecoline may be the most active compound [3, 10]. Arecoline is an acetylcholine agonist acting on muscarinic and nicotinic receptors [3, 10]. Pharmacological effects of betel nut chewing are thought to be due to parasympathetic stimulation which includes euphoria, central nervous system stimulation, vertigo, excessive salivation, miosis and tremor [3, 10].

Physiologically acetylcholine is a neurotransmitter in the autonomic nervous system and is broken down by Acetylcholinesterase to acetate and choline [3, 10, 11]. An iso-enzyme of Acetylcholinesterase, called Pseudocholinesterase, is in plasma or serum where it is used to monitor cholinesterase-inhibiting properties of pesticides and toxicity among agricultural workers [11, 12]. Data from in-vitro studies

suggest arecoline may be broken down by Pseudocholinesterase and Carboxylestarase [13].

We observed a statistically significant increase in the mean heart rate two minutes after chewing betel nut in the normotensive subjects. This increase was transient and may have been induced through stimulation of the sympathetic nervous system. Nicotinic receptors are present on adrenal medulla [3] and stimulation of nicotinic receptors by arecoline may release catecholamines into the circulation thus causing tachycardia [4, 6]. Betel nut chewing has been reported to increase basal secretion of catecholamines from adrenal chromaffin cells and in low doses stimulates the sympathetic system [4]. Chu [1, 2] reported that there was rise in the heart rate lasting 16.8 minutes in betel nut chewers regardless of whether they are chronic, occasional or novices, and that only the systolic blood pressure was increased. Our results support these findings although the increase in heart rate among the hypertensive patients was not statistically significant, which may have been caused by beta blockers; all the hypertensive patients in our study were on Propanolol, a beta blocking anti-hypertensive agent. No statistically significant changes were observed in the SBP and DBP in our study. Acetylcholine has been shown to cause vasodilation in vessels with intact endothelium [12, 15, 16]. Arecoline may also be a peripheral vasodilator, albeit less potent than acetylcholine, which may explain the trend towards hypotension observed in the present study. More studies are needed to explain these changes in blood pressure among betel nut chewers. Epidemiological data from studies in the Asian population suggest a link between hypertension and habitual betel nut chewing [1, 4]. This may be a chronic effect rather than acute. Further, addition of spices to betel nut for chewing as practiced in most Asian countries may be a contributing factor towards development of high blood pressure in habitual betel nut chewers [1, 4].

In our study the observed mean heart rate changes from baseline were transient. This may possibly due to rapid metabolism of arecoline by Pseudocholinesterase, a similar mechanism as for acetylcholine, although the role of Pseudocholinesterase in arecoline metabolism is unclear [12]. The acute transient tachycardia may be a risk factor for cardiac arrhythmias in predisposed patients [17, 18]. Betel nut chewing has also been implicated in acute myocardial ischaemia [19, 20], these earlier observations are now supported by epidemiological data showing association between betel nut chewing and cardiovascular death [5, 21, 22, 23, 24].

In the presence of lime, arecoline is hydrolyzed to arecaidine which has sympathetic effects via inhibition of Gamma-Aminobutyric Acid (GABA)

uptake [25]. Piper betel inflorescence has been shown to release catecholamines in-vitro [6, 25] which may also explain the tachycardia in betel nut chewers. There is no clear scientific evidence to indicate if the sympathetic effects of betel nut chewing have direct cause-effect relationship to clinical or sub-clinical ischaemic heart disease. The results obtained in this study strongly indicate the need for detailed study to assess the effects of betel nut chewing on the cardiovascular system of chewers in Papua New Guinea.

## CONCLUSIONS:

Betel nut chewing has effect on the cardiovascular system. The acute effects appear to be transient increase in the mean resting heart rate noted two minutes after chewing and returned to baseline readings after 15 minutes. The exact mechanisms for the increase in resting heart rate after chewing betel nut are yet to be confirmed by detailed studies. There is no change in blood pressure.

Study limitations:

The sample size of the hypertensive patients was very small because of the difficulty in getting such volunteers to participate in research studies. The subjects were not separated according to gender.

This study excluded occasional and novice betel nut chewers. The results from our study should be interpreted as preliminary data, which should serve as baseline for more detailed multidisciplinary study.

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