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Chewing farm fresh Betel Quid: a healthy practice in major arecanut (*Areca catechu* L.) growing region of South India

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Abstract:
Background: *There are reports that chewing arecanut or betel quid is carcinogenic or harmful to humans. On close examination of such reports it was seen that there are so many lacunae, including improper identification of the actual chewing product, method of approach, etc. in most of such research. In some others the data were collected on certain readily available chewing products, containing arecanut as one of the ingredients, such as pan masala or gutkha where either the total ingredients used are fully disclosed or their quality ascertained, and correlated the results to arecanut or betel quid chewing without taking cognizance of the effects of other ingredients used in such chewing products. In some others, the extract of arecanut was injected on lab animals, mostly in high doses and reported arecanut or betel quid chewing as dangerous. Hence, in order to find out the actual effects of chewing arecanut or betel quid a survey was conducted in the village side of certain major arecanut growing regions of Karnataka and Kerala where the villagers use to chew the farm fresh chewing material such as arecanut or betel leaf harvested directly from their farm.*
Materials and Methods: *This study was carried out in certain villages of Kasaragod Dt of Kerala and Dakshina Kannada, Uttara Kannada and Shivamogga Districts of Karnataka during May - July 2019. House to house survey was conducted on people of 18 years and above and their chewing habits and health status were recorded. People chew packaged chewing products such as pan masala, gutkha, etc and those people who smoke or take alcohol were excluded. Only those people who chew the farm fresh materials were included in this study. The family history of each family, especially on the mortality of individuals, their chewing habits and the cause of death, if known clearly, was also recorded.*
Results: Data were collected from 527 people. Among them, non chewers were 37.38%, people chewing arecanut alone were only 0.95%, chewers of betel quid without tobacco (BQ) were 22.77% and those with tobacco (BQT) were 38.90%. Both BQ and BQT were chewed for15-30 minutes by spitting out the liquid very often. The frequency of chewing was significantly more in BQT chewers compared to BQ chewers. In non chewers there were none in 90 years and above category, whereas there were 1 and 4 individuals in BQ and BQT chewing groups, still living in that very old age by chewing 3 to 10 times a day for 35 to 70 long years without any major health problems. There were more number of healthy people in chewers of BQ and BQT when compared to non chewers. Not a single instance of cancer was reported by BQ and BQT chewers, but there were three such patients in non chewers. Family history was also in conformity with this. There was a substantial decrease in tooth problem in both BQ and BQT chewers when compared to non chewers.
Conclusion: *The present study reveals that chewing of farm fresh BQ and BQT are really good for health as reported in ancient Sanscrit* scripts*. The health problems reported in recent times on chewing might be due to several other factors as discussed in this paper.*
Key Words: *arecanut; betel nut; Areca catechu; betel quid; human health; tooth problem; cancer.*

I. Introduction

Betel quid is one of the popular chewing products in several countries[1]. It generally consists of a mixture of arecanut (the nut or endosperm of an oriental, slender and tall palm called *Areca catechu* L. of Palmae/Arecaceae family), betel leaf (the leaf of an ever green perennial vine called *Piper betle* L. of Piperaceae family) and slaked lime (Calcium hydroxide). Some people also add a piece of tobacco (the dried leaf of a robust annual herb called *Nicotiana tabacum* L. of Solanaceae family). Several other materials and condiments such as katha (extract of the bark of a deciduous thorny tree called *Acacia catechu* L.), dried kernel of coconut (the endosperm of the nut of C*ocos nucifera* L. palm), etc. and certain sweeteners are also added to betel quid by some people in some localities according to the local preferences and habits[1]. In certain countries such as Taiwan, Papua New Guinea, etc the people use the inflorescence of *P. betle* instead of its leaf for preparing betel quid[2]. As arecanut is commonly chewed along with the leaf of the betel vine, this nut is also called as 'betel nut' in several localities. Apart from that, arecanut has nothing common with the betel plant. Arecanut is also called as 'supari' in Hindi.

India is the major arecanut growing country in the world where this crop is mainly grown in two southern States, viz., Karnataka and Kerala which together contribute for 76% of arecanut production in India[3]. Some minimum processing of arecanut is done in most parts of these states for its marketing. One type of arecanut, called as 'red supari' is obtained by dehusking tender / unripe arecanut at different stages of its maturity, slicing or without slicing the endosperm / nut, boiling, coating with kali (the concentrated liquid obtained after boiling unripe arecanut) and drying under bright sunlight for 10 to 15 days. This type is common in Uttara Kannada and Shivamogga Districts of Karnataka. Another type, called as 'white supari' is obtained by properly drying ripe arecanut with husk for 40 to 45 days under bright sunlight and dehusking it later on and marketing the dried endosperm as whole nut. This is also called as 'chali'. This type is most common in Dakshina Kannada Dt of Karnataka and Kasaragod Dt of Kerala[4].

Chewing betel quid is a good old practice as it sweetens the breath, removes bad taste from the mouth, strengthens the gums, checks perspiration, improves overall health conditions, etc[5]. The antiquity of its chewing dates back to 650 BC as seen in the work of Magha in the epic 'Shishupala Vadha[6]. The presence of arecanut in India was cited even earlier to this. Its citation was there as early as in 1300 BC as mentioned by Sisu Mayana in 'Anjana Chaitra'[7]. In Vietnam, there are reports to show the stains of arecanut in the dentition of the fossil remains of human beings of Bronze age[8]. In very old Indian Sanscrit scripts, such as Vagbhata (4th century) and Bhavamista (13th century), betel nut has been described as a therapeutic agent for leucoderma, leprosy, anemia, obesity and de-worming[9].

Arecanut is well known for its medicinal uses in the ancient Indian system of medicines such as Ayurveda, Unani and Homeopathy[10-12]. This nut is widely used in the clinical practices in several other countries such as China[13-14], Philippines[15] and Bangladesh[16]. WHO[17] has listed out as many as 25 different beneficial effects of *A. catechu* on mankind and included areca palm in the list of medicinal plants of Papua New Guinea. In China as many as 30 medicines prepared using arecanut as one of the ingredients are already in use for the treatment of several human disorders and parasitic infections[14]. In India two to three Ayurvedic preparations containing arecanut as one of the ingredients are being prescribed for the management of diabetes[18].

Arecanut has lots of medicinal properties[19]. All such properties are well validated by Scientific evidences. This nut has potent antioxidant, antiulcer, antidiabetic and neuroprotective properties[20-23]. It is also traditionally used in a number of ailments due to its laxative, digestive, carminative, antiulser, antidiarrhoeal, anthelmintic, antimalarial, antihypertension, diuretic, prohealing, antibacterial, hypoglycaemic, antiheartburn properties[24]. The therapeutic value and pharmacological uses of arecanut have been reviewed in detail by several workers[14, 25-28]. All the seven alkaloids (arecoline, arecaidine, guvacine, guvacoline, isoguvacine, arecolidine and homoarecoline) present in arecanut possess good drug-like properties[29].

In spite of such medicinal properties of arecanut, there are several reports highlighting arecanut chewing as carcinogenic or harmful to humans or on similar line[1, 30- 45]. But, on close observation of such papers it was noticed that there are so many pitfalls or lacunae in most of such observations[46,47]. Lots of contaminations and adulterations were already reported in several ready to use chewing materials containing arecanut[48]. Chewing such adulterated and contaminated products would definitely pose problem for human health. Hence, in order to find out the actual effects of chewing pure forms of unadulterated and uncontaminated arecanut / betel quid on human health, a house to house survey was undertaken in the village sides of certain major arecanut growing regions of South India such as Kasaragod Dt in Kerala, undivided Dakshina Kannada, Uttara Kannada and Shivamogga Districts in Karnataka, where the villagers mostly chew the farm fresh forms of arecanut or betel quid without adding or using any artificial or unknown substances. The results obtained by such studies on human health are more realistic and reliable for arecanut or betel quid than those conducted using pan masala, gutkha, zarda, khaini.etc where neither the ingredients are clearly disclosed nor the quality of ingredients assured.

II. Materials and methods

House to house survey was conducted for three months from May to July 2019 in the village sides of the above four major arecanut growing regions of South India, with the help of local volunteers who were familiar with the area and families of the concerned locality. People who chewed farm fresh arecanut, betel quid without or with tobacco were included in this study. Those who chewed only tobacco or the packaged chewing products such as pan masala, gutkha, khaine, zarda, etc., where the ingredients and their qualities are not clearly known and those indulged in smoking or drinking alcohol were not included in this study. Houses were selected at random, the family members were interviewed after getting oral consent individually and data collected on the following:

Number of people in each family above 18 years of age and their gender and age were recorded. Numbers of non chewers, chewers of arecanut alone or betel quid without tobacco (arecanut, betel leaf and calcium hydroxide) or betel quid with tobacco are noted separately. The method of chewing (whether they spit out the liquid or swallow), how many times they chew in each day (frequency / times of chewing) and how long they have been chewing (the years of chewing) were also noted. Those people who chewed 30 times or more per day are considered as chain chewers. Opinion of chewers on the health effects of such chewing and the overall health status of each individual as reported by them were also recorded. The cause of death of family members and their chewing habits, if known clearly, were also recorded from such families.

III. Results

Ways of chewing farm fresh arecanut / betel quid in the study area: Altogether 206 households (Ninety two in Kasaragod and Dakshina Kannada Dts and 114 in Shivamogga and Uttara Kannada Dts) were surveyed. Data were collected from 527 people. Among them, non chewers were 197 (37.38%), people chewing arecanut alone were only five (0.95%), chewers of betel quid without tobacco (BQ) were 120 (22.77%) and those with tobacco (BQT) were 205 (38.90%). As the number of people who chewed arecanut alone was very less, they were excluded from this report. Hence, the effective figure for this report is 522 subjects. The villagers were using the farm fresh forms of arecanut and betel leaf grown by them for preparing BQ. The BQ generally consisted of about 2.5g (fresh wet weight) of arecanut, about 2.7g of betel leaf (wet weight of the green leaf of a perennial vine, *Piper betle*) and a pinch (about 0.6g) of slaked lime (Calcium hydroxide). Apart from these ingredients, in BQT a small piece (about 0.8g) of processed and dried tobacco leaf is also added. In Kasaragod Dt of Kerala and Dakshina Kannada Dt of Karnataka people generally used the ripe, farm fresh arecanuts whereas in Shivamogga Dt of Karnataka people mostly used the red type of arecanuts processed by themselves to prepare BQ or BQT. However, in Uttara Kannada Dt of Karnataka people used either white or red type of arecanuts for preparing BQ, according to the individual preference and taste. People used to chew both BQ and BQT for 15-30 minutes, mostly immediately after intake of food, and spit out the liquid regularly. Not a single instance of consuming the liquid or keeping the quid in one particular location inside the mouth was noticed.

Percentage of non chewers and chewers of BQ and BQT in different age groups: When the age of people was observed it was seen that in non chewers there were more number of people in younger age groups than in older groups (Fig 1). Among 197 people in non chewers, 73% were in less than 60 years of age and only 27% in 60 years and above (senior) category. On the other hand, in chewers of farm fresh BQ, only 38% were in less than 60 years of age and 62% were in senior age category. In chewers of BQT also more (55%) number of people was seen in senior age category. Most of the people in super senior age category (80 years and above) were noticed in such BQ and BQT chewers. In non chewers there were only 3.05% in super senior age category, whereas there were 5.83% in BQ and 12.20% in BQT chewers in that age. Very interesting observation was that in non chewers there were none in 90 years and above age, whereas there were 1 (0.83%) in BQ and 4 (1.95%) in BQT chewers still living in that very old age by chewing farm fresh chewing materials 3 to 10 times a day for 35 to 70 long years. The maximum surviving age noticed was 85 years in non chewers, 100 years in BQ chewers and 94 years in BQT chewers.

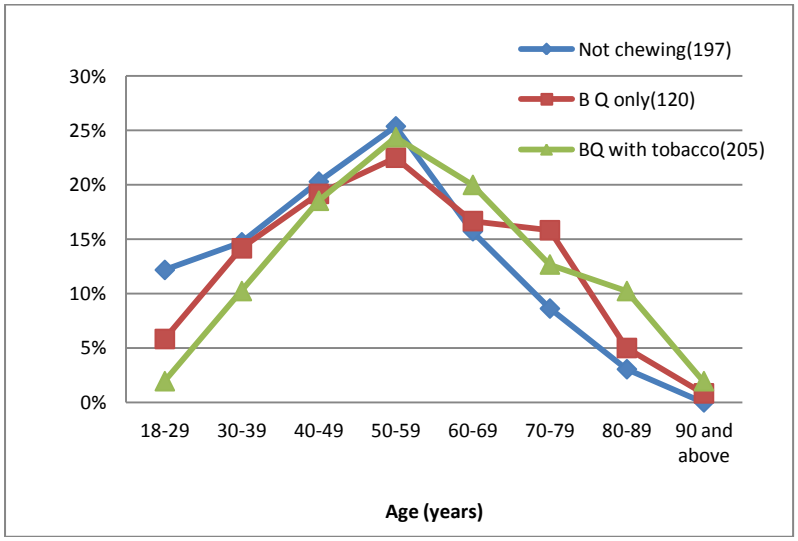

Fig 1. Percentage of non chewers and chewers of BQ and BQT in different age groups.

Times of chewing BQ and BQT per day: Data on the times of chewing farm fresh BQ and BQT show that there was a significant variation ($p < 0.05$) between such chewers (Table no1). BQ chewers chewed for lesser times per day than that of BQT chewers. In BQ chewers, majority of them (64.2%) chewed less than 5 times per day, whereas in BQT chewers very few (7.8%) of them chewed in that frequency. In the BQT chewers, majority (55.6%) of them chewed for 10 times or more per day whereas only 13.2% of BQ chewers chewed in that rate. In the high frequency category of chewing (twenty times or more per day), there were only 4.1% of BQ chewers whereas there were 16.6% in BQT chewers in such high frequency. People who chewed for more than 30 times per day (chain chewers) were noticed only in BQT chewers and there was none in that very high frequency category in BQ chewers.

Table no 1: Times of chewing per day by BQ and BQT chewers.

Times of chewing per day	Chewing types			
	BQ (N= 120)		BQT (N= 205)	
	Number	%	Number	%
< 5	77	64.2	16	7.8
5-9	27	22.5	75	36.6
10-14	7	5.8	48	23.4
15-19	4	3.3	32	15.6
20-24	4	3.3	11	5.4
25-29	1	0.8	9	4.4
30 and more	0	0	14	6.8
Chi-squ Chi-square = 12.5; D.F. = 6; $p < 0.05$				

Years of chewing BQ and BQT: It is seen from the data that as many as 67.5% of people who chewed farm fresh BQ and 77.6% of people who chewed such BQT were chewing for 20 years and more and as many as 40.0% of BQ chewers and 51.3% of BQT chewers chewed for 30 years or more (Fig 2). As many as 10.8% of BQ chewers and 13.7% of BQT chewers have been chewing for 50 years and even more. It is interesting to note that in spite of chewing farm fresh materials for such a long period, 5.83% of BQ chewers and 12.20% of BQT chewers attained 80 years and above, but in non chewers the percentage of such super seniors was only 3.05 (Fig 1).

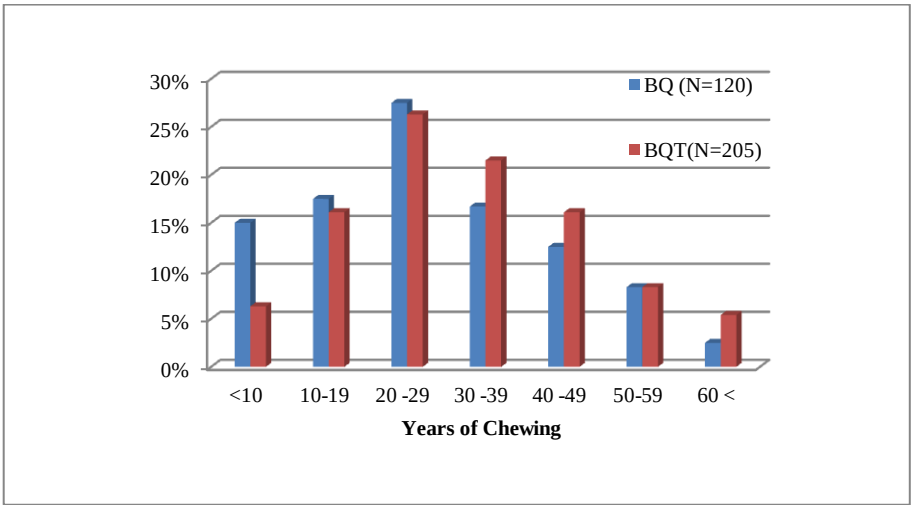

Fig 2. Years of chewing by BQ and BQT people

Opinion of BQ and BQT chewers on the effects of chewing on their health: Of the total 325 chewing people surveyed, 60 gave their opinion on the health issues of chewing BQ and BQT. No adverse health remarks were made by any one of them, but gave several beneficial effects of such chewing (Fig 3). As much as 19% of chewers felt that chewing BQ (5%) or BQT (14%) reduced tooth problem, 7% (BQ 6% and BQT 1%) felt that chewing improved digestion and 5% (BQ 3% and BQT 2%) perceived that chewing helped them to remain active and do more work.

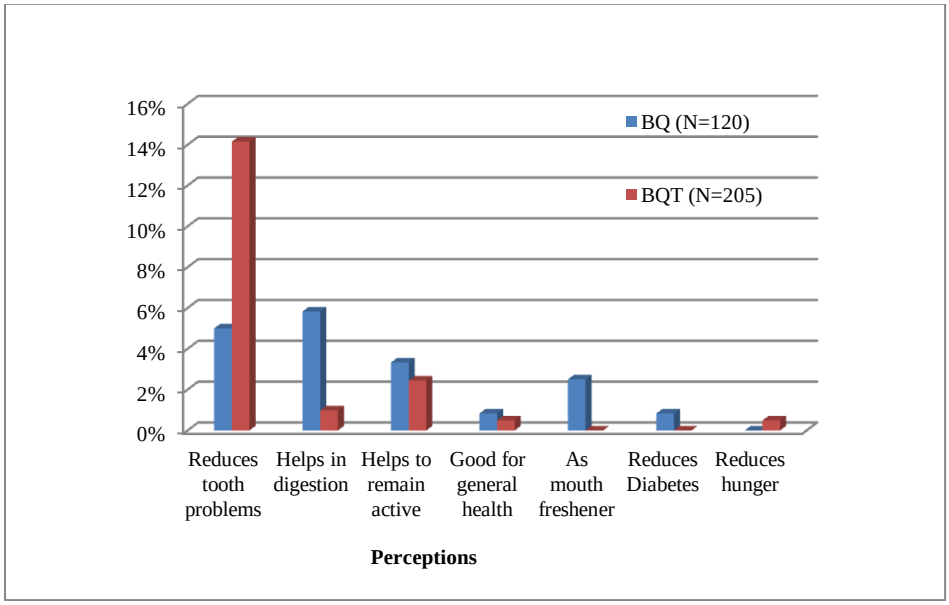

Fig 3. Opinion of BQ and BQT chewers on the health effects of chewing

Reported health status of non chewers and chewers of BQ and BQT: Among the 522 people surveyed, 120 (22.99%) people reported one or the other health problems. There was a marked reduction in health problems reported by both BQ and BQT chewers when compared to non chewers. Of the 197 people surveyed in non chewers, 61 (30.96%) reported one or the other health problems in them, whereas, in BQ chewers, out of 120 people 22 (18.33%) and in BQT chewers out of 205 people 40 (19.51%) reported such problems (Table no 2).

Table no 2. Health of non chewers and chewers as reported by individuals

Health of people	Chewing habits					
	Non chewers(N=197)		BQ (N=120)		BQT (N=205)	
	Number	%	Number	%	Number	%
People without any health complaints	136	69.04	98	81.67	165	80.49
People with health complaints	61	30.96	22	18,33	40	19.51
Chi-square = 10.4, D.F = 2, p< 0.05						

Multiple (more than one type) health problems were also more in non chewers when compared to either BQ or BQT chewers. Of the 61people who have reported health problems in non chewers 17 people (27.87%) suffered from more than one health problems, whereas only 22.73% of such BQ chewers and 17.50% of such BQT chewers suffered from multiple health complications (Fig 4). When individual health problem was observed it was

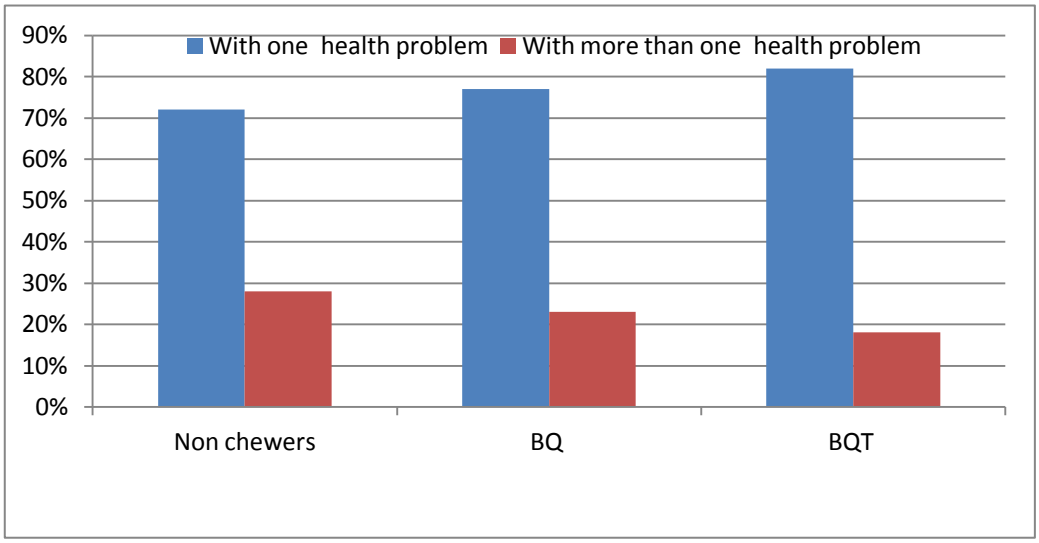

Figure 4. People suffering from one or multiple health problems in non chewers and chewers

seen that tooth problem was much more in non chewers than in BQ and BQT chewers (Fig 5). Not a single instance of cancer was reported in chewers of farm fresh BQ or BQT, but there were three such reports (one liver, one breast and one colon cancer) in non chewers. None of the chewers reported that they have any problem for speaking or opening their mouth normally.

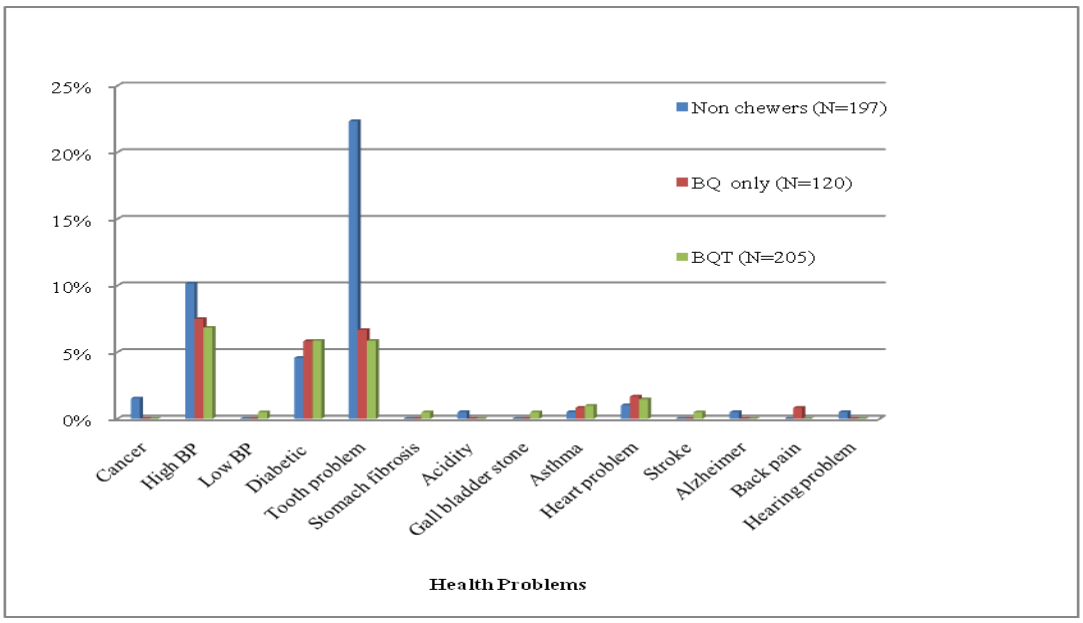

Fig 5. Health problems reported by non chewers and chewers of BQ and BQT

Family history: Information on the cause of death of 74 family members was supplied by their family members (Fig 6). Out of this, 17 were for non chewers, 11 were for BQ chewers and 46 were for BQT chewers. Death due to old age (without any reported disease) was 45.45% and 67.39% in BQ and BQT chewers, respectively, whereas in non chewers it was only 23.53%. Reported mortality due to certain diseases / disorders was 76.47% in non chewers, 54.55% in BQ and 32.61% in BQT chewers. In non chewers, six (35.29%) people died out of cancer, whereas in chewers of farm fresh BQ and BQT only one each (9.09% and 2.17%, respectively) died out of this disorder. Reported death due to heart problem was 17.65% in non chewers and nil in BQ and 10.87% in BQT chewers.

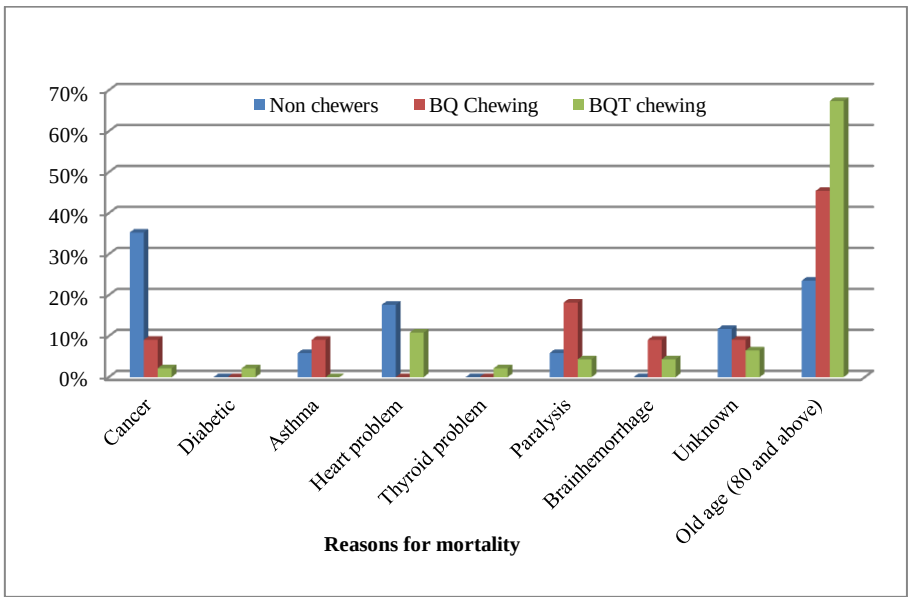

Fig 5. Reported reasons for mortality in family members

IV. Discussion

In the study area, number of people who chewed arecanut alone was very negligible (less than 1.0%) to come to any definite conclusion on its chewing on human health. Hence, only the non chewers and chewers of farm fresh BQ and BQT were considered for further study. The frequency of chewing BQ shows that majority (64%) of such people chewed less than 5 times per day, whereas majority (92%) of BQT chewers chewed 5 times or more per day (Table no1). This shows that betel quid with tobacco is more addictive than that without tobacco. Chewing tobacco is already noted for its addictive character[49]. The results of the present study are in conformity with such observations.

The age distribution of non chewers and chewers of BQ and BQT in the present study reveals that non chewers were more than BQ and BQT chewers in less than 60 years of age, but in seniors category (60 years and above) both BQ and BQT chewers outnumbered non chewers (Fig 1). It is clearly evident in very senior people (90 years and above) where there were none in non chewers whereas there were 1(0.83%) and 4 (1.95%) individuals in BQ and BQT chewers, respectively. As per the world data atlas of India, total population aged 90 years and above as on 2018 was around 1313 thousand persons[50]. This comes to be about 0.1% of the total Indian population. The figures reported in the present study for such super seniors in both BQ (0.8%) and BQT (1.95%) chewers are much above the figure reported for national average (0.1%). It is quite interesting to note that even after chewing farm fresh BQ and BQT 20-30 times per day for more than 50 years, these chewers survived for 90 years and more without any serious health complaints. In a study conducted on arecanut chewers of Sriperambudur Taluk of Tami Nadu the older people believed that the use of arecanut products could cause no harm as they themselves have been pursuing such chewing habits for a long time without any health problems[51]. The results of the present study are in conformity with this. It is already reported that both arecanut[14,19,26-28,52] and the betel leaf [53-58], the two major ingredients of BQ and BQT, possess lots of medicinal properties which might have contributed to the beneficial effects of these chewing products on human health.

During this study it was also observed that healthy people were more in BQ and BQT chewers than in non chewers. Of the 197 people surveyed in non chewers 30.96% people reported some sort of health problems, whereas, in BQ chewers, out of 120 people only 17.50% and in BQT chewers out of 205 people 19.51% reported such problems (Table no 2). Incidence of multiple (more than one) health problems were also more in non chewers as compared to those in chewers of BQ or in BQT (Table no 3). As much as 27.87% of unhealthy people in non chewers reported more than one health problems whereas only 19.05% of unhealthy BQ chewers

and 17.5% of unhealthy BQT chewers reported such multiple health complications. This again confirms that both BQ and BQT have lots of medicinal properties which improved the overall health conditions of both BQ and BQT chewers.

In the present study, not a single instance of cancer, whether it is in mouth or in any other body parts, was reported either in BQ or in BQT chewers, but there were three such cases (one each in liver, breast and colon) reported in non chewers (Fig 4). The data on the mortality of family members were also in conformity with this. The percentage of mortality due to cancer was more in non chewers when compared to chewers of either BQ or BQT (Fig 5). Further, mortality due to old age (without any reported health complaints) was more in BQ and BQT chewers when compared to non chewers. Almost similar observation was made in an earlier study conducted on arecanut chewers in a South Indian community where not even a precancerous lesion was noticed in the mouth of pure arecanut chewers[59]. In the present study arecanut chewers did not experience any oral problem but in some earlier studies it was presumed that those who chewed pan masala or Gutkha might develop some problem for opening their mouth and for eating or speaking[51]. In a laboratory study made earlier by inserting BQ components on the buccal epithelium of golden hamsters no malignant tumor was developed[60]. In another study, when the extracts of BQ containing 50g cured arecanut, 100g betel leaf and 4g lime when applied to the bare skin of laboratory mice neither any lesion nor any tumor was developed[61]. There were also reports that arecanut, the major ingredient of BQ, has inhibitory property on the growth and development of tumors as well as cancer cells[61-63]. Betel leaf, another important constituent of BQ and BQT is also having anticancer property[64-67]. Smokeless tobacco is already known to cause several health problems including cancer in human being[68]. But, it is reported that the hydroxychavicol, a phenolic component of betel leaf, has a protective effect against the tobacco-specific carcinogens[69,70]. In an earlier study it was noticed that arecanut when used in conjunction with tobacco smoking reduced the bad effects of smoking on several aspects of human health[71]. It was also reported that arecanut husk has cyto-protective effect to a certain extent against tobacco induced cytotoxicity[72]. All such cancer preventing effects of both arecanut and betel leaf might have nullified the cancer promoting effects of tobacco in BQT, thereby reducing the incidence of cancer even in BQT chewers when compared to non chewers.

Ironically there are so many publications highlighting chewing arecanut is dangerous and even cause cancer[30-45]. On close examination of such reports, it is seen that there are so many pitfalls or lacunae in the methodology[46,47,73]. In some of the research papers there was no clarity on the materials studied. The title of the paper was on arecanut but the study was mostly undertaken not on arecanut but on certain chewing products such as betel quid, pan masala, gutkha, etc in which arecanut is one of the components. In most of such papers, the effects of other components of the chewing mixture or their synergistic actions on human health were not at all discussed but simply blamed arecanut for all the ill effects[41-43]. It is sad to note that even certain review papers did not critically discuss these aspects at all[74-76]. It is a known fact that the property of an individual component changes when it is mixed and used along with other materials. For example, in a study conducted on the effects of betel quid components, individually as well as in combinations on the kinetics of salivary amylase it was clearly noticed that when arecanut alone was mixed with the saliva it reduced the amylase activity by 800%, whereas the amylase activity was increased by 30% when arecanut was mixed with betel leaf and lime[77]. In some countries such as Taiwan, Papua New Guinea, etc., the betel quid is generally prepared by mixing the inflorescence of *P. betle*, instead of its leaf [2]. It is reported that the inflorescence of *P. betle* contains a chemical compound called safrol, a known carcinogen, but its leaf contains hydroxichavicol, an anti carcinogen[35]. Accordingly it was noticed that in Taiwan, the people who chewed arecanut with *P. betle* inflorescence developed 24.4 times more oesophageal cancer than those who chewed arecanut with betel leaf [35]. Hence, it is necessary to study the effects of all the ingredients of the chewing material together rather than blaming a single component for the entire effect.

In the present study, there was a clear indication of better health among the chewers of farm fresh BQ and BQT when compared to non chewers. The quality of arecanuts used for preparing the chewing material will definitely have a paramount effect on the health of chewers. Substandard or poor quality arecanuts are commonly found infested with aflatoxin producing fungus such as *Aspergillus flavous* and *A. parasiticus*, much above the permissible limit of 15-30 ppm[78,79]. Such poor quality arecanuts are found in plenty in the market[80,81]. There are even reports of insecticide contaminations in certain products of pan masala much above the tolerance limit[82]. Continuous chewing of such poor quality and contaminated chewing products will have lots of adverse effects on human health. These factors might have projected arecanut as bad. In the present study the villagers used farm fresh, unadulterated arecanut and betel leaf for preparing betel quid and such villagers did not experience any adverse effects of chewing BQ or BQT, rather they projected such chewing as good for their health.

Certain researchers projected arecanut as carcinogenic by injecting arecanut extracts to lab animals, that too in very high dose[83]. They injected subcutaneously 0.2ml of arecanut extract prepared from 50g of arecanut in 100ml water to Swiss mice and reported development of tumors in 60% of the treated animals.

When the dose is calculated per kg body weight of the animal, it comes to 3.33g of arecanut. At this dose a normal human being weighing 60kg should be injected with the extract from 200g of arecanut to get tumors[73]. This quantity of arecanut is much more than the reported use of arecanut for preparing BQ or BQT in the present observation. Further, the effect of injection is totally different from oral chewing and the results cannot be the same. Further, no human being is in the habit of injecting himself with arecanut extract. Certain researchers even used arecoline alone and reported arecanut chewing is dangerous as if arecanut contains only arecoline!. In a study conducted on Swiss mice by feeding 1.5mg of arecoline by intra gastric tube directly into the stomach, 58% of the animals developed tumors in internal organs[84]. Here also the dosage used was much on the higher side. As per the arecoline content of arecanut which is about 0.24%[85,86], to get 1.5mg of arecoline one has to use 625mg of arecanut. This comes to about 20g of arecanut/kg bw or 1,200g of arecanut for an adult human being weighing 60kg[73]. Apart from this, arecoline is not the only one component present in arecanut, but this nut contains so many other chemicals as well[85,86]. Further, it is unscientific to infer the results obtained on one chemical component of arecanut such as arecoline to the whole nut which contains multiple chemicals apart from arecoline. It is suggested that the work should be carried out on arecanut as a whole and not on any single component[87]. One should remember that arecanut is not arecoline or vice versa!

Most of the BQ and BQT chewers believed that such chewing habits reduced tooth problem in them. This is again confirmed by the reports that tooth problem was much less in both BQ and BQT chewers when compared with non chewers (Fig 4). In a similar study conducted on pure arecanut chewers, the chewers perceived that arecanut chewing provides good dental health including reduction in tooth pain as well as strengthen teeth and prevent tooth decay[59]. Several scientific reports also showed that arecanut chewing gave substantial protection against dental caries. The stain caused due to arecanut chewing acted as protective varnish on tooth surface[88]. The extract of arecanut was also found to be very effective against the growth of several oral pathogens such as *Escherichia coli, Klebsiella pneumoniae, Proteus vulgaris, P. aeruginosa, Salmonella non-typhi, S. typhi, S. flexneri* and *Vibrio cholera*[89]. The aqueous extract of arecanut effectively inhibited the growth of the primary cariogenic bacterium, *Streptococcus mutans*[90] and the periodontal pathogen *Eikenella corrodens*[91]. Apart from arecanut, the betel leaf also reported to contain good anti bacterial and anti fungal properties[92- 94]. Even chewing betel leaf as such was also reported to reduce the percentage infestation of oral microbial flora considerably[95].

Improvement in digestion is another common belief of BQ chewers (Fig 3). Studies carried out earlier on BQ and BQT chewers also reported the same[96]. Results on some scientific observations on the actions of BQ on carbohydrate digestion are in conformity with this. It has been reported that the enzyme salivary amylase, which is responsible for carbohydrate digestion increases by 30% when arecanut was chewed along with betel leaf and lime[77]. It is already reported that feeding arecanut powder or its extract was reported to eliminate both the adults and eggs of the gastrointestinal nematodes and cestodes in animals[97-101]. Further, arecanut extract was also reported to improve gastrointestinal motility in animals[102].

Both BQ and BQT chewers also believed that chewing kept them in alertness and helped to do more work. Results on certain earlier studies are in conformity with this[59, 96]. This must be due to the stimulating effect of arecanut on the central nervous system[103]. Chewing betel leaf also reported to improve physical and mental stamina[104]. Mouth freshness is another perception of BQ chewers. Even pure arecanut chewers also perceived the same[59]. It is reported that both arecanut[90, 91,105] and betel leaf[93- 95] have good anti bacterial and anti fungal properties. Eradication of germs by chewing BQ and BQT might have removed the foul smell generated by such microbes, thereby feeling freshness in the mouth of BQ chewers.

V. Conclusion

The results of the present study revealed that both BQ and BQT chewing in their farm fresh form, without any adulterations or contaminations, were really good for human health as highlighted in ancient Sanscrit literatures. The presence of good number of survivors, even much more than the national average, reportedly without much health problems, even after chewing BQ or BQT 3 to 10 times a day for 50 to 70 long years shows that such chewing practices are not at all deleterious but beneficial to human being on all health aspects. The adverse health effects reported in recent times on chewing arecanut or betel quid might be due to several other factors as discussed in this paper. These observations may be taken care of seriously in future research.

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