



EFFECT OF CHEWING GUM ON XEROSTOMIA, THIRST AND INTERDIALYTIC WEIGHT GAIN IN PATIENTS ON HAEMODIALYSIS.

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ABSTRACT **Background:** Patients on maintenance intermittent haemodialysis (IHD) have a high prevalence of xerostomia (dry mouth) and difficulty in fluid restriction. Excess fluid intake leads to increased interdialytic weight gain (IDWG), which necessitates greater fluid removal during each haemodialysis session, contributing to inadequate fluid removal, fluid overload, and increased mortality risk. **Aim:** To investigate the effect of sugar-free chewing gum on the xerostomia inventory score, dialysis thirst inventory score, and interdialytic weight gain (IDWG) in patients who were on maintenance intermittent haemodialysis. **Methods:** This study was a prospective single group intervention study. Xerostomia and thirst were assessed by validated questionnaires like xerostomia inventory (XI) and dialysis thirst inventory (DTI), at baseline and after two weeks of sugar free chewing gum use, interdialytic weight gain (IDWG) was calculated by using the average of three IDWG values at baseline and after two weeks of chewing gum use. **Results:** 89 IHD patients (63 men, 49.5 ± 12.24 years; 26 women, 50 ± 13.69 years) were included in the study, use of chewing gum reduced XI from 16.18 ± 10.55 to 13.02 ± 8.06 (P < 0.001), DTI from 4.69 ± 3.73 to 2.45 ± 0.59 (P < 0.001). IDWG did not show any significant reduction (2.45 kgs ± 0.58 to 2.38 kgs ± 0.54). XI showed a significant minimal clinically important difference (MCID) value of ≥ 6 in 28% of patients. **Conclusion:** The use of sugar-free chewing gum may help in reducing subjective thirst and xerostomia in the majority of patients and significant improvement as per minimal clinically important difference in > 25% of patients, although without clinically significant change in interdialytic weight gain.

KEYWORDS : Chewing gum, Xerostomia, Interdialytic weight gain, Dialysis thirst inventory

INTRODUCTION

Patients on intermittent haemodialysis (IHD) have to be on strict salt and fluid restriction, to prevent uncontrolled hypertension and fluid overload in the interdialytic period. Greater fluid intake will cause large interdialytic weight gain (IDWG). Poor adherence to salt and fluid restriction can lead to complications like acute pulmonary oedema, hypertensive emergency, congestive heart failure and mortality (1,2). Prevalence of xerostomia is high in IHD patients and ranges between 32 and 81%. (3)

Several strategies like use of angiotensin converting enzyme inhibitors (ACEIs), restricting food rich in salt and/or sugar, sucking on frozen fruits, freezing water in an ice cube and consuming like a popsicle and chewing gum use have been suggested for IHD patients to alleviate xerostomia and restricting fluid intake (4,5). In this study we evaluated the impact of the use of sugar free chewing gum on thirst and IDWG. Thirst was assessed by subjective questionnaires like xerostomia inventory (XI) and dialysis thirst inventory (DTI). IDWG was assessed by average interdialytic weight value of 3 haemodialysis sessions before and after taking chewing gum.

METHODS

Participants:

One hundred and twenty patients with end stage kidney disease

(ESKD) on maintenance intermittent haemodialysis (IHD) for at least three months were screened for the study. 89 patients met the inclusion criteria and were allowed to participate in the study.

Inclusion criteria were ESKD patients on

- IHD for ≥ 3 months,
- Age ≥ 18 years
- Physically and mentally being able to participate and complete the study

Key exclusion criteria were those with

- Oral cavity malignancies
- Periodontal diseases,
- Oral cavity infections
- Hemodynamic instability preventing sufficient ultrafiltration,
- Dementia or terminal diseases
- Use of chemotherapy or radiotherapy or both or use of medications like anticholinergic, antidepressants, antipsychotics, antihistamines, antiparkinsonian agents

The study design was a prospective single group intervention study and was approved by Institutional Review Board of Christian Medical College, Vellore, Tamil Nadu, India.

The low-tack sugar free chewing gum used was Orbit Wrigley,

sweetened with sorbitol and maltitol. Sweet mint flavour was used to maintain uniformity. Participants were instructed to *chew one or two pieces of chewing gum gently for ≥10 mins, six times a day* and as required when they feel thirsty throughout the day. Demographic and clinical data were presented in Table 1.

Table 1. Demographic And Clinical Data At Baseline (n = 89)

Characteristics	Frequency/Percentage
Mean Age (years)	48.7(12.8)
Gender	
Male	70.3% (63)
Female	29.2% (26)
Time on HD (years)	3.8 (2.7)
HD sessions per week	
2	29.2% (26)
3	70.3% (63)
Patients with Residual urine output	
Present	39.3% (35)
Absent	60.7% (54)
IDWG (kgs)	2.45 (0.58)

Primary outcome:

To analyse effect of sugar free chewing gum on Dialysis thirst inventory in haemodialysis patients

Secondary Outcomes:

- To measure the effect of sugar free chewing gum in decreasing the interdialytic weight gain in haemodialysis patients
- To measure the effect of sugar free chewing gum in decreasing the Xerostomia inventory in haemodialysis patients

Sample Size Calculation and Rationale

To assess the quantitative change in IDWG (Interdialytic Weight Gain), XI (Xerostomia Index), and DTI (Daily Thirst Index), we determined the required sample size based on pre- and post-intervention mean values. The calculations were performed considering a 5% error ($\alpha = 0.05$) and a correlation of 0.8, as the measurements are paired.

Sample Size Calculation for a Paired Study Design

To determine the required sample size for a paired study design, we used a standard formula that accounts for the correlation between pre- and post-intervention measurements. The calculation considers a 5% significance level ($\alpha = 0.05$) and 80% power ($\beta = 0.20$, $Z\beta = 0.84$) to detect a meaningful change in the outcome variables.

The required sample size was determined using the following formula: This formula accounts for the paired nature of the measurements, reducing variability and increasing statistical power.

$$N_{paired} = \frac{(z_{\alpha/2} + z_{\beta})^2 \sigma_d^2}{\Delta^2} + \frac{z_{\alpha/2}^2}{2}$$

$$\sigma_d = \sqrt{\sigma_1^2 + \sigma_2^2 - 2\rho\sigma_1\sigma_2}$$

Variable	Baseline Mean (SD)	Post-Intervention Mean (SD)	Sample Size Required
IDWG	2.09 (0.9)	2.07 (0.9)	6360
XI	29.9 (9.5)	28.1 (9.1)	87
DTI	7.5 (2.5)	6.7 (2.3)	58

These calculations indicate that a significantly larger sample size is required to detect a small change in IDWG, whereas XI and DTI require comparatively smaller sample sizes.

Xerostomia inventory (XI), Dialysis thirst inventory(DTI):

At baseline and after 2weeks of intervention (Sugar free chewing gum intake) participants were assessed by standardized Xerostomia inventory, Dialysis thirst inventory questionnaires. The xerostomia inventory (XI) is a validated questionnaire with 11 questions, each with a five-point Likert-type scale (never=1 to very often=5). The scores are summed and provide an individual XI score ranging from 11 (no dry mouth) to 55 (extremely dry mouth). Dialysis thirst inventory (DTI) is a similar type of questionnaire, which has additional questions related to dialysis sessions. It is a 3 point Likert-type scale (never=0,occasionally=1,fairly often=2). Summed scores of 7 individual questions provide an individual DTI score ranging from 0(no dry mouth) to 14 (extremely dry mouth).

Assessment of interdialytic weight gain (IDWG):

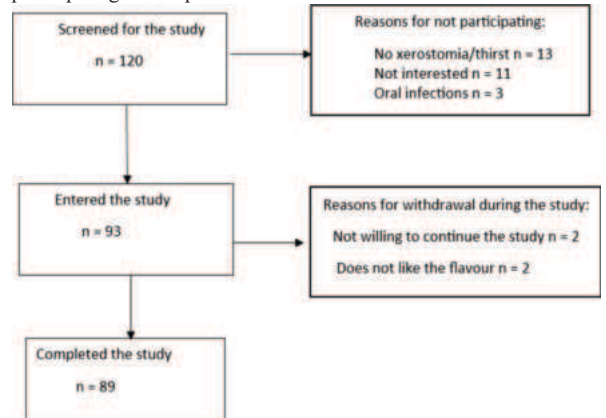
Interdialytic weight gain (IDWG) is calculated as the difference between the predialysis weight and the weight at the end of the previous dialysis session. (6) We calculated the average IDWG of 3 haemodialysis sessions at baseline and after 2 weeks of chewing gum intake.

Statistical Methods:

The data at baseline was stratified according to gender, age group, residual urine output, frequency of haemodialysis. The statistical analysis was performed using the statistical software package SPSS (version 21); All data are presented as means ±SD and levels of significance were set at P<0.05. Data at baseline and after two weeks of intervention were compared using Wilcoxon Signed rank test.

Patient demographics and profile of the study:

One hundred and twenty participants were screened, 93 participants entered study. 89 participants completed the study. Reason for not participating and drop outs are mentioned in the flowchart.



Flowchart-Patient enrolment and outcomes:

RESULTS:

At baseline XI, DTI, IDWG were compared for gender, age group (<50,≥50 years), residual urine output(present or absent), frequency of haemodialysis(twice or thrice weekly). There was no significant difference at baseline assessment of thirst using XI, DTI. IDWG was also similar in all groups (table 2).

Table 2: Baseline XI, DTI and IDWG: Subgroup categorization

Characteristics	XI (11-55)	DTI (0-14)	IDWG (kgs)
Age (years)			
<50	15.94(±9.53)	7(±3)	2.5(±0.62)
≥50	16.45(±11.8)	7.1(±3)	2.4(±0.55)
Gender			
Male	16.4(±10.65)	7.4(±3.06)	2.45(±0.57)
Female	16.2(±10.5)	7.2(±3.05)	2.4(±0.58)
HD sessions per week			
Two	17.2(±10.45)	7.5(±3.1)	2.5(±0.55)
Three	16.1(±10.55)	7.1(±3.2)	2.4(±0.5)
Residual urine output			
Absent	17.2(±10.6)	7.8(±2.9)	2.5(±0.55)
Present	16.1(±10.2)	7.1(±3.1)	2.45(±0.45)

After 2 weeks of intervention, there was statistically significant reduction in XI and DTI as shown in table 3 and figures 1-3. Patients in all groups irrespective of age, residual urine output, frequency of dialysis, and gender, were found to have significant improvement in XI and DTI, as shown in table 4. Although IDWG showed statistically significant reduction after intervention, but there was no clinically significant difference in IDWG after 2 weeks of intervention as shown in table 3 and 4.

Table 3: Comparison Of XI,DTI and IDWG At Baseline And At 2weeks Of Intervention

Variables	At Baseline (n=89)			At 2 weeks (n=89)			p-value
	Mean (SD)	Median (p25, 75)	Min, Max	Mean (SD)	Median (p25,p75)	Min, Max	
XI	16.18(10.55)	15(11,20)	11, 42	13.02(8.06)	12(11,17)	11, 40	<0.001
DTI	4.69(3.73)	4(2, 6)	0, 16	2.45(0.59)	2.5(2, 3)	0.9,3.5	<0.001

IDWG	2.37(0.58)	7 (5, 9)	1, 13	2.32 (0.55)	2.4(2, .9)	1, 3, 4	0.025
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Table 4: Xerostomia Inventory (XI), Dialysis Thirst Inventory (DTI) And Interdialytic Weight Gain (IDWG) After 2weeks Of Intervention –Subgroup Categorization

	XI (11-55)	DTI (0-14)	IDWG (kgs)
Age (years)			
<50	13.49 (±8.1)	5 (±2.6)	2.46 (±0.57)
≥50	12.5 (±8.2)	5.12 (±2.65)	2.31 (±0.51)
Gender			
Male	13.1 (±8.1)	5.2 (±2.6)	2.31 (±0.57)
Female	13 (±8.1)	5.23 (±2.6)	2.35 (±0.54)
HD sessions per week			
Two	12.9 (±8.45)	5.1 (±2.7)	2.42 (±0.55)
Three	13.2 (±8.5)	5.3 (±2.5)	2.4 (±0.5)

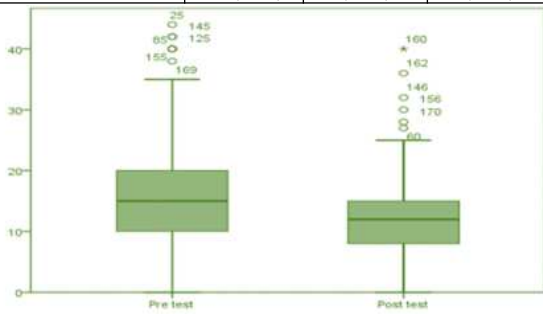


Figure 1: Comparison of Xerostomia inventory(XI) pre and post intervention

Pre-test – XI at baseline, post-test – XI at 2weeks

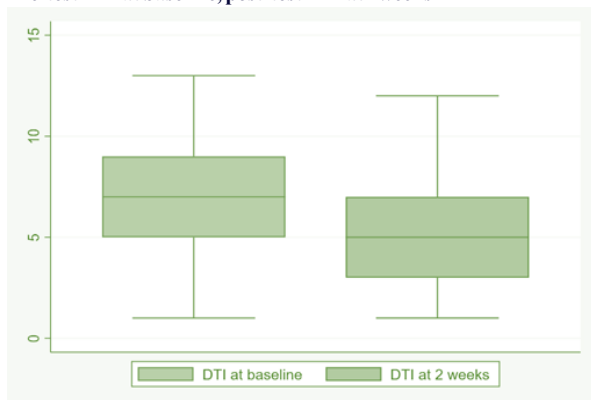


Figure 2: Dialysis thirst inventory (DTI) comparison:

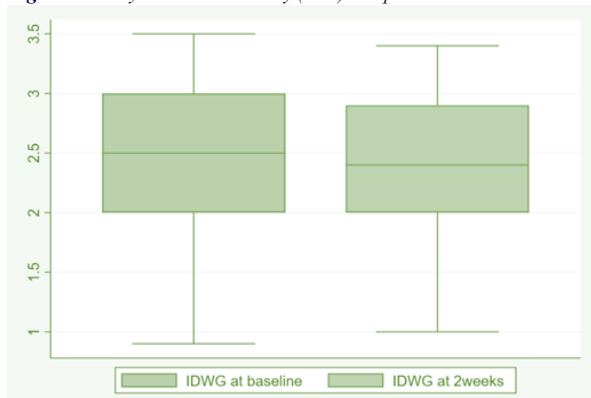


Figure 3: Interdialytic weight gain (IDWG) comparison

DISCUSSION:

Xerostomia and thirst are major problems for maintenance IHD patients (7). Fluid restriction is one of the major cornerstones in the management of IHD patients. Many strategies like saliva substitutes, the use of ACEIs and chewing gum have been tried with mixed results. The use of chewing gum is a reasonable and cost-effective strategy for alleviating dry mouth.

This is the first large-scale study in India to investigate the effect of chewing gum on Xerostomia inventory, Dialysis thirst inventory and Interdialytic weight gain in IHD patients. Overall, the effect of chewing gum usage for two weeks in IHD patients reduced subjective thirst significantly. This is in accordance with other studies that investigated the effect of chewing gum on xerostomia in other patient populations, such as rheumatic patients (8) or in patients with a malignant disease (9).

Similarly there was a study done by Casper P Bots et al that investigated the effect of chewing gum on IHD patients. (10) It showed a significant reduction in thirst in IHD patients with usage of chewing gum or saliva substitutes. (10) Similar to Casper et al results, this study also showed significant reduction in thirst among MHD patients with chewing gum intake. Contrary to Casper et al study which showed higher thirst among the elderly (>65 years) and those without residual urine output at baseline, there was no significant difference at baseline with regard to age and residual urine output. This study categorized patients into <50 years and ≥ 50 years, as the study population had a smaller number of patients older than 65years.

Minimal clinically important difference (MCID) for xerostomia inventory has been validated as clinically significant for a change in score of ≥6 (11). In this study 28% of patient were satisfied with a MCID value of ≥6, which showed that a significant proportion of patients felt clinically significant differences in addition to statistical differences.

IDWG showed a statistically significant reduction, but clinically it was not significant. IDWG depends on multiple factors other than thirst like salt intake and residual urine output. An intervention period of only 2 weeks may not be adequate to assess the change in IDWG in MHD patients. Hence a longer intervention period and also a larger sample size may be needed to assess the efficacy of chewing gum in reducing IDWG.

CONCLUSION:

Using sugar free chewing gum in IHD patients showed a significant reduction in subjective thirst as assessed by XI and DTI. >25% showed clinically significant improvement in thirst in addition to statistical significance. However, IDWG does not show a clinically significant reduction with chewing gum intake, which needs a longer period of intervention and perhaps a larger sample size.

Limitations Of The Study:

- Single-Group Design – The study lacked a control group, making it difficult to attribute observed effects solely to the chewing gum intervention. A randomized controlled trial would provide stronger evidence.
- Short Duration – The intervention lasted only two weeks, limiting the ability to assess long-term effects of chewing gum on xerostomia, thirst, and interdialytic weight gain (IDWG).
- Small Sample Size for IDWG Assessment – Although the study included 89 patients, the sample size calculation indicated that a much larger cohort would be needed to detect a statistically significant change in IDWG, potentially limiting the power of this outcome.
- Subjective Assessment of Xerostomia and Thirst – The use of self-reported questionnaires for xerostomia and thirst introduces the possibility of response bias, as patients' perceptions may be influenced by external factors.
- Uncontrolled Dietary and Fluid Intake – The study did not control for individual variations in fluid and dietary intake, which could have influenced IDWG results.
- Potential Placebo Effect – The act of chewing itself, rather than the specific effect of gum, may have contributed to the perceived reduction in thirst and dry mouth. A placebo-controlled study would help clarify this effect.

This study had approval of the Institutional ethical Committee vide minute number 14565 dated 22/3/2022.

Acknowledgement: We gratefully thank all dialysis nurses and therapists at our institution for their strict follow-up of patients during the study period.

Conflict of interest: Authors have no conflict of interest and no funding received from any agency

Glossary of Abbreviations

1. **ACEIs** – Angiotensin-Converting Enzyme Inhibitors
2. **DTI** – Dialysis Thirst Inventory
3. **ESKD** – End-Stage Kidney Disease
4. **HD** – Haemodialysis
5. **IDWG** – Interdialytic Weight Gain
6. **IHD** – Intermittent Haemodialysis
7. **MCID** – Minimal Clinical Important Difference
8. **SD** – Standard Deviation
9. **SPSS** – Statistical Package for the Social Sciences
10. **XI** – Xerostomia Inventory

REFERENCES:

1. Kimmel PL, Varela MP, Peterson RA, Weihs KL, Simmens SJ, Alleyne S, et al. Interdialytic weight gain and survival in hemodialysis patients: effects of duration of ESRD and diabetes mellitus. *Kidney Int.* 2000 Mar;57(3):1141–51.
2. Szczech LA, Reddan DN, Klassen PS, Coladonato J, Chua B, Lowrie EG, et al. Interactions between dialysis-related volume exposures, nutritional surrogates and mortality among ESRD patients. *Nephrol Dial Transplant Off Publ Eur Dial Transpl Assoc - Eur Ren Assoc.* 2003 Aug;18(8):1585–91.
3. López-Pintor RM, López-Pintor L, Casañas E, Arriba L de, Hernández G. Risk factors associated with xerostomia in haemodialysis patients. *Med Oral Patol Oral Cir Bucal.* 2017 Mar;22(2):e185.
4. Tips for Dialysis Patients With Fluid Restrictions - Journal of Renal Nutrition [Internet]. [cited 2024 Sep 26]. Available from: [https://www.jrnjournal.org/article/S1051-2276\(17\)30143-7/fulltext](https://www.jrnjournal.org/article/S1051-2276(17)30143-7/fulltext)
5. Influence of dual blockade of the renin-angiotensin system on thirst in hemodialysis patients - PubMed [Internet]. [cited 2024 Sep 26]. Available from: <https://pubmed.ncbi.nlm.nih.gov/19546583/>
6. López-Gómez JM, Villaverde M, Jofre R, Rodríguez-Benitez P, Pérez-García R. Interdialytic weight gain as a marker of blood pressure, nutrition, and survival in hemodialysis patients. *Kidney Int.* 2005 Jan 1;67:S63–8.
7. Bots CP, Brand HS, Veerman ECI, Valentijn-Benz M, Van Amerongen BM, Valentijn RM, et al. Interdialytic weight gain in patients on hemodialysis is associated with dry mouth and thirst. *Kidney Int.* 2004 Oct;66(4):1662–8.
8. Risheim H, Arneberg P. Salivary stimulation by chewing gum and lozenges in rheumatic patients with xerostomia. *Scand J Dent Res.* 1993 Feb;101(1):40–3.
9. Björnström M, Axell T, Birkhed D. Comparison between saliva stimulants and saliva substitutes in patients with symptoms related to dry mouth. A multi-centre study. *Swed Dent J.* 1990;14(4):153–61.
10. Bots CP, Brand HS, Veerman ECI, Korevaar JC, Valentijn-Benz M, Bezemer PD, et al. Chewing gum and a saliva substitute alleviate thirst and xerostomia in patients on haemodialysis. *Nephrol Dial Transplant Off Publ Eur Dial Transpl Assoc - Eur Ren Assoc.* 2005 Mar;20(3):578–84.
11. Thomson WM. Measuring change in dry-mouth symptoms over time using the Xerostomia Inventory. *Gerodontology.* 2007 Mar;24(1):30–5.