

# **Predictors of new caries in children and adolescents**

An evidence based report.

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**Abstract-**

Dental caries is a multi factorial, chronic disease prevalent among all age groups, particularly affecting children and adolescents .The purpose of this study is to identify the best predictors of caries in this age group .A thorough and meticulous search of the electronic data base yielded 138 studies of which 42 were retrieved and reviewed; after which 16 articles were chosen and each was scored using “Diagnostic and Predictive Test” checklist. 8 articles met the score criteria and were included in this study. Studies showed that previous caries experience, diet, saliva and socio-demographic factor were strong predictors of future carious lesions .A new approach which used a computer software program called “Cariogram” was also studied and though it did predict caries increment quite accurately yet it had limitations and needs more research. Clinical evidence and studies showed that numerous factors need to be taken into account in predicting caries. And even though there are several strong factors but none could accurately predict caries and further research needs to be done.

Keywords/Key phrase: – predict, risk assessment, computer based or clinical exam, saliva test, cariogram, dental cavity, dental caries, tooth decay, dental decay, tooth cavity, tooth caries, which resulted.

## **Introduction**

Dental caries is a microbial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth. It has a multi factorial aetiology having factors like - host (saliva and teeth), the micro flora (bio film), the substrate (diet) and time. It is the most prevalent chronic disease affecting the human race of both genders in all races, across all socio-economic strata and every age group. It usually begins soon after the teeth erupt into the oral cavity. Numerous epidemiological studies have been carried out to establish baselines of caries experience, which show that caries occur in children soon after the eruption of the deciduous teeth and may continue to increase at a remarkable rate [1]. As children reach school age, they have a greater incidence of carious lesions mostly due to irregular and ineffective oral hygiene habits and of course not to say the least frequent snacking rich in carbohydrate and sugar. This problem needs to be addressed since children are the future of the nation.

To quote an old saying “Prevention is better than cure” which holds true for caries too. Thus it becomes empirical to find ways to predict new carious lesions so that we can prevent their progression and occurrence. But are caries predictable? To address this question we need to know first what caries prediction is. Caries prediction is being able to predict the incidence of caries in an individual ahead in time.

In the past dentists have relied heavily on clinical findings to detect caries both new and old which are imperfect because by the time they are detected there has

been already sufficient loss of tooth substance. Since the incidence and prevalence of caries is greater in children and adolescents, dentists need a head start in this field, which requires various tools and methods other than just clinical findings to predict the occurrence of new caries before frank cavitation occurs. There is also a need for clinical flexibility while predicting caries due to the reason that the DMFT scores at baseline and at the end of the study are subject to clinician bias. It is also impossible to compare to a competent gold standard for the simple reason that the gold standard for caries is histological. There are also variations in giving mathematical weight for every factor involved in prediction of caries, since it varies from population to population and differs with socio-economic backgrounds.

The purpose of this report is to review and study the articles, which highlight and advocate the best predictors of new caries in children and adolescents.

## **METHOD**

A systematic literature search was employed to identify, select, critically appraise and utilize relevant studies.

### *Search Strategy*

We used electronic data search engines –Ovid Medline, Cochrane Library, Pubmed and Embase to search for relevant articles pertaining to our report.

We included articles which were related to prediction / risk assessment of caries in children and adolescent. We excluded articles pertaining to other age groups and also studies which were conducted before 1966.

Keywords/Key phrase used were: –The first two sessions we focused on finding keywords or key phrases which were best related to the study, we discussed and finally agreed upon the following keywords, such as predict, risk assessment, computer based or clinical exam, saliva test, and cariogram, which, yielded 325757 articles. We searched other articles using another set of key words-- dental cavity or dental caries or tooth decay or dental decay or tooth cavity or tooth caries; which resulted in 72169 articles. On combining the above two searches so as to get articles concerning our report, we narrowed it to 536. On limiting the articles based on English language we got 495 and further limiting it to studies done on humans we got 489. Using local holdings as limit and removing all duplicate articles we arrived at 198 articles. Of these 60 articles were eliminated at the title stage resulting in 138 articles. Limiting these articles at abstract stage and review articles we narrowed it to 42. Of these we selected 16 articles which were distributed among the authors and scored using the checklist below [Check List 1]. The articles were scored twice by different authors and those meeting the cut off were selected. Articles which scored or met 7 or greater than 7 criteria on the checklist were selected for the report. The remaining were rejected based on their weakness and limitations [Table4]. The 8 articles were then divided between groups of 2 authors who studied them in detail and critically appraised them [Table 1].

## **Results**

Eight articles [2-9] met the criteria for the checklist that is these articles met 7 or more criteria on the checklist. The articles were distributed among the authors who studied the articles individually and gave a synopsis and critical appraisal of the article. The scores of DMFS/defs increment from baseline and at the end of the study was a strong predictor of caries occurrence. The studies were prospective studies and considered multiple logistic regressions, odds ratio estimation to determine the probability of the individual developing a new caries lesion. Sensitivity and Specificity for DMFS increment and final DMFS at various cut offs points were compared. The validation of the different models studied was carried out on randomly selected children. It was found that caries risk is not related to a single factor but related a number of risk factors, in total 34 factors were assessed in all the studies. They were divided into four major groups and arranged in descending order of risk as follows [Table 2] —

- (a) Intra-Oral Factors
- (b) Diet and Habits
- (c) Medical Conditions
- (d) Demographic Factors.

## **Multi factorial**

*Caries is a multi factorial chronic disease. In the course of our report we came across numerous factors, which were related to the risk of caries. Some of the important ones*

*were-- Age, Gender, Race, Diet, Habits, Demographic, Social, Past Caries, Immigration Status, Family Structure, Plaque Score, Lactobacillus Count, Streptococcus Count, Tooth Brushing, Dmfs/defs Scores, Mother's Education, and Dental Health Information*

Of the eight articles; seven articles [2,3, 5-9] were based on multi factorial risk factors, which could predict caries, and one article [4] was based on a computer programme called Cariogram. The seven articles were studied and of these two articles were found to be effective and precise in predicting caries and a synopsis and critical appraisal is given as follows. A tabulated summary highlighting the remaining five articles has been included. [Table 3].

Based on the design of the study we have briefly mentioned 2 studies in the descending order of strength. The study done by Abernathy et al [2] over a period of 4 years included 2637 individual between the age group of 4-14 years. A caries prediction model was developed and validated based on 13 sociodemographic and dental variables; on Grade 1 and Grade 5 children who were randomly selected .The study compared logistic and discriminant analysis in identifying high risk groups The sensitivity and specificity for DMFS increment and final DMFS were compared. After a 4 year follow up the results of Sensitivity for discriminant analysis were 0.48 for Grade 1 and 0.52 for Grade 5 children, and for logistic regression analysis was 0.48 for Grade 1 and 0.51 for Grade 5. The Specificity for discriminant analysis were 0.82 for Grade 1 and 0.84 for Grade 5 children, and for logistic regression analysis was 0.83 for Grade 1 and 0.84 for

Grade 5 [2]. The study showed that there was an increment in DMFS scores based on the sociodemographic and dental variables and it was a fairly good predictor of caries for each of the two grades of children. But the study had its limitations because the examination data were adopted without modification of the predictive variables. [Table 3]

A study done in Denmark by A. Foldspang[3] included 3705 individuals in the age group of 7-15 years of age .It was done over a period of 2 years .The study considered a multiple logistic regression and odds ratio estimation in determining the probability of development of new caries during that period. A ROC curve was used to illustrate the association between stratum-specific sensitivities and specificities. This pre-screening tool could predict caries incidence precisely based on demographic, social and dental health information. It took into account sensitivity and specificity at various cut-off points. At a cut off point of 20%, the sensitivity was 74.4, with a specificity of 66.7, Positive Predictive Value of 38.5 and a Negative Predictive Value of 90.3. Based on information from the Danish routine registers, children at low caries risk may be identified relatively precisely. This may form the basis for the continuous development and targeting of high-risk strategies, in which the screening for caries among children of estimated low risk might be postponed at least 1 year. [3][Table 3] .The study had its limitations in that it didn't consider the range of severity of the disease and it was done over a short period of time of 2 years.

### Cariogram

A recent approach in predicting caries is via the use of a computer-based programme called Cariogram, which is an interactive PC program. It takes into account the interactions between caries related factors and expresses a graphic assessment of the risk. The program compares the caries risk assessments with the actual change in DMF scores. Bartthall et al did an evaluation of the program for caries assessment in school children between the ages of 10-11. It was a 2-year prospective study on 446 school children in which baseline data on general health; diet, oral hygiene and use of fluoride were obtained. Saliva analyses included mutans streptococci and Lactobacilli counts, buffer capacity and secretion rate. DMFT and DMFs were calculated from records and bitewing radiographs. Scores were entered and caries risk assessed. Re-examination for caries was done after 2 years. The children were divided into 5 groups according to the assessed caries risk at baseline. Logistic regression analyses were carried out. When the cariogram was excluded, Lactobacillus count, mutans streptococci, diet intake frequency and DMFS at baseline were significantly associated with caries increment. The cariogram predicted caries increment more accurately than any included single factor model. The unique property of the cariogram is that each factor in each constellation, is “weighted” for its cumulative input, not just added [4]. The program contains about 5 million combinations of factors. Thus the cariogram considers the total pattern of risk factors. However this is a relatively new predictive criterion for caries and it didn't utilize sensitivity and specificity. Much more research needs to be done in order to prove its effectiveness. .

## **Discussion**

The review of the literature revealed that there was no single factor, which could accurately predict new caries in children and adolescents. Since caries are a multi factorial disease, numerous risk factors for caries should be taken into account for their role in making an individual susceptible to future caries incidence. Eight articles were studied and critically appraised and it was concluded that there is no single factor, which could predict the occurrence of new caries. Prediction of caries was dependent upon many factors, of which past caries occurrence, the diet of the individual, socio-economic status and geographical distribution were deemed important factors. Some of the recent studies showed the use of a computer based programme called “Cariogram” which weighed the cumulative input of various factors. Existing caries at baseline was a good predictor of subsequent caries activity and multi factorial tests would be more reliable. [5]. The risk factors which would make an individual more caries prone were many, intra-oral factors like the DMFS, Plaque Score, White Spot lesions, Tooth Morphology, Salivary Flow, Salivary Buffering Capacity, Fluorosis, Malocclusion, Lactobacillus and Streptococcus Mutans count. Diet and habits were also strong predictors for development of new caries, sugar intake, type and frequency were potent risk factors combined with poor oral hygiene habits. Demographic factors, which a clinician can often overlook, could also play a role in caries predictability, like age, race, gender, socio-economic status and education.

## **Conclusion**

Based upon the study of the articles, there is no single predictor of caries. Although past occurrence of caries is proven to be the most influential predictor, yet it can be further amplified by other factors. Different factors can be given mathematical weights according to their importance to determine specific predictors of caries. Thus a multi factorial test for caries risk will be more reliable than a single factor. But there is lack of evidence to support any particular test, which can accurately predict caries. Even though Cariograms predict caries, there needs to be more research and study done in order to prove its merits. Clinicians should use clinical judgment and not depend solely upon various tests alone to predict caries. The tests should be used as an adjunct to improve and support the ability of the clinician to predict caries in high-risk groups.

## **Acknowledgement**

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## **Reference:**

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- in caries risk prediction. [Journal Article] Community Dentistry & Oral Epidemiology. 20(2): 64-75, 1992 Apr.
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### **Checklist**

#### **Checklist for Assessing a Diagnostic or Predictive Test**

Citation: \_\_\_\_\_

- a) Was the study ethical?
- b) Is the test clearly described (including the cut-off values)?
- c) Was the test evaluated against a valid gold standard?
- d) Were the test results and disease status determined independently?
- e) Was the test evaluated using patients with a range of severity of disease?
- f) Was the test evaluated among patients with diseases that might be confused with, or are closely related to, the disease of interest?
- g) Is the test's performance reported using sensitivity/specificity, likelihood ratios?
- h) Is the effect of moving the cut-off reported, or is the ROC curve provided?
- i) Does this test give better results than the current or standard test?
- j) Is the test likely to be acceptable to patients?

#### **Checklist 1**

## **Tables**

<b>Review of Evidence</b>	<b>Number</b>
Abstracts matching search terms	536
Articles limited to English language, Human studies, Local holdings & Elimination of Duplicates	198
Articles at title stage	138
Articles at abstract stage (retrieved and copied for review)	42
Articles at first reading and scored	16
Articles meeting cut-offs	8

***Table 1***

**Risk Factors Assessed**

<p><b><u>Intraoral Factors</u></b></p> <ul style="list-style-type: none"><li>• DMFS</li><li>• Mean Plaque Score</li><li>• White Spot Lesions</li><li>• Teeth Morphology</li><li>• Gingivitis</li><li>• Salivary Flow</li><li>• Salivary Buffering</li><li>• Fluorosis</li><li>• Malocclusion</li><li>• Lactobacillus</li><li>• S. Mutans</li></ul> <p><b><u>Medical Condition</u></b></p> <ul style="list-style-type: none"><li>• Antibiotics</li><li>• Related Diseases</li><li>• Ear Infection</li><li>• Strep throat History</li><li>• Drugs &amp; Medications</li></ul>	<p><b><u>Diet and Habits</u></b></p> <ul style="list-style-type: none"><li>• Tooth Paste</li><li>• Oral Hygiene</li><li>• Breast feeding</li><li>• Beverages</li><li>• Drinks before going to bed</li><li>• Drinks during the night</li><li>• Fluoride Mouth rinses</li></ul> <p><b><u>Demographic Factors</u></b></p> <ul style="list-style-type: none"><li>• Age</li><li>• Race</li><li>• Sex</li><li>• Immigrant Background</li><li>• Income</li><li>• Education</li><li>• Number or other children in house</li><li>• Dental visits</li><li>• Place of Birth</li></ul>
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***Table 2***

**Table 3**

Author Location Date	Population Duration of Study	Predictive Tests	Compared Gold Standard	Results	Author's Conclusion & Critical Appraisal
Abernathy JR North Carolina USA, 1997	N = 3705 Grade 1: 1253 Grade 5: 1384  Age: 4-14yrs  Duration: 4yrs follow-up	13 Sociodemographic & Dental Examination Variables.	DMFS Increment	Cut off: 25% of Children with the highest discriminant score.  <b>Sens:</b> <b>Discriminant Analysis</b> 0.48 1 <sup>st</sup> Grade 0.52 5 <sup>th</sup> Grade  Logistic Regression 0.48 1 <sup>st</sup> Grade 0.51 5 <sup>th</sup> Grade  <b>Spec:</b> Discriminant Analysis 0.82 1 <sup>st</sup> grade 0.84 5 <sup>th</sup> grade Logistic regression 0.83 1 <sup>st</sup> grade 0.84 5 <sup>th</sup> grade ROC X	<ul style="list-style-type: none"> <li>•The model is effective is identifying high risk population</li> <li>•Defining the high-risk population as the upper 35% of the discriminant analysis will decrease the false negatives.</li> <li>•II-2, B</li> <li>•The study compares between logistic regression and discriminant analysis in identifying high risk groups</li> <li>•Validation of the model was carried out on randomly selected children.</li> <li>•Sensitivity and specificity for DMFS increment and final DMFS were compared</li> <li>•Limitations:</li> <li>•Examination data were adopted from the NPDDP (1971) without modification of the predictive variables</li> <li>•CA:8/10</li> </ul>
Foldspang A Aarhus Denmark 2006	N = 3705 F/M: 51.2:48.7  Age: 7-15yrs  Duration: 2yrs follow-up	<b><u>Multifactorial</u></b> DMFS/defs Age Gender Family Structure Immigration St. Social Demographic & Dental Health	DMFS Increment	Cut-off: 20% estimated probability of DMFS increase <b>Sens:</b> 74.4 <b>Spec:</b> 66.7 <b>PPV:</b> 38.5 <b>NPV:</b> 90.3 <b>ROC:</b> √	<ul style="list-style-type: none"> <li>•The-pre-screening tool could predict caries incidence relatively precisely based on demographics, social &amp; dental health information.</li> <li>•II-2, B</li> <li>•The study considers multiple logistic regression and odds ratio estimation to determine the probability of the individual child to develop new caries during that period</li> <li>•Considers sensitivity and specificity at various cut off points.</li> <li>•Limitations:</li> <li>•Does not consider range of severity of disease</li> <li>•The study was a single study carried out over only a period of two years (short period of time)</li> <li>•CA: 7/10</li> </ul>

Author Location Date	Population Duration of Study	<u>Predictive Tests</u>	Compared Gold Standard	Results	Author's Conclusion & Critical Appraisal
Disney JA Minnesota USA 1992	N = 4000 (1 <sup>st</sup> & 5 <sup>th</sup> graders)  Age: 7-12yrs Duration: 3 yrs follow-up	<b>Multifactorial</b> DMFS/defs Morphology score Sealants White spot lesions Fluorosis Sound permanent surfaces Plaque score Peripheral score Predicted caries Age Lactobacillus count S.Mutans count Race Tooth brushing	DMFS Increment	Aiken <b>Sens:</b> 0.59 1 <sup>st</sup> grade 0.62 5 <sup>th</sup> grade <b>Spec:</b> 0.83 1 <sup>st</sup> grade 0.81 5 <sup>th</sup> grade <b>PPV:</b> 0.49 <b>NPV:</b> 0.87 Portland <b>Sens:</b> 0.59 1 <sup>st</sup> grade 0.62 5 <sup>th</sup> grade <b>Spec:</b> 0.84 1 <sup>st</sup> grade 0.84 5 <sup>th</sup> grade <b>PPV:</b> 0.48 <b>NPV:</b> 0.89 <b>ROC:</b> X	<ul style="list-style-type: none"> <li>•Clinical variables are the most important group of variables</li> <li>•In the presence of clinical variables S.mutans, lactobacillus, sociodemographic &amp; dental behaviour contributed little to caries risk prediction over 3 years</li> <li>•II-2, B</li> <li>•Model has good specificity (0.85)</li> <li>•Was less successful in predicting high risk to caries</li> <li>•Reliability and consistency between examiners ensured</li> <li>•4 risk assessment models (2 grade cohorts at 2 sites)</li> <li>•Logistic regression for the variables</li> <li>•Limitations:</li> <li>•Some factors were excluded from the assessment because they were too costly and time consuming</li> <li>•Dental care to the children during the study lead to an increase in false positives</li> <li>•CA: 8.5/10</li> </ul>
M.Grindefjord Stockholm Sweden 1996	N = 692 F/M: 344:384  Age: 1, 2.5 & 3.5 yrs of age  Duration: 3 yrs follow-up	<b>Multifactorial</b> Initial Caries Immigrant Background Mother's Education S.Mutans Sugar containing beverages Consumption of candy Tooth brushing	DMFS Increment	<b>Sens:</b> 0.74 <b>Spec:</b> 0.63 Of the S. Mutans test in immigrant children & a mother with low education  <b>ROC:</b> X	<ul style="list-style-type: none"> <li>•A 2 step risk assessment before 3.5 years of age is valuable in targeting high risk children</li> <li>•At 2.5 years S.mutans improves the possibility of identifying children at high risk</li> <li>•II-2, B</li> <li>•Odds ratio for initial caries at 2.5 years is 8.8 &amp; at 3.5 years is 13.5</li> <li>•2 dentists calibrated with respect to consistency (r=0.91)</li> <li>•Logistic regression and cross tabulations of the variables</li> <li>•Limitations:</li> <li>•Sensitivity and specificity for the other factors of for the model as a whole was not supplied</li> <li>•CA: 7/10</li> </ul>

Author Location Date	Population Duration of Study	Predictive Tests	Compared Gold Standard	Results	Author's Conclusion & Critical Appraisal
W.P.Holbrook Amsterdam Netherlands 1993	n = 158 F/M: 90:68  Age: 4yrs  Duration: 2 yrs follow-up	<b><u>Multifactorial</u></b>  Caries baseline Bacteriological Salivary Dietary Medication	DMFS Increment	Cut off > 4 dmfs denoting high caries risk <b>Caries at baseline:</b> <b>Caries present:</b> <b>Sens:</b> 0.91 <b>Spec:</b> 0.61 <b>PPV:</b> 0.48 <b>NPV:</b> 0.94 <b>Caries free</b> <b>Sens:</b> 0.98 <b>Spec:</b> 0.82 <b>PPV:</b> 0.75 <b>NPV:</b> 0.98 All other variables combined: <b>Sens:</b> 0.80 <b>Spec:</b> 0.78 <b>PPV:</b> 0.76 <b>NPV:</b> 0.82 <b>ROC:</b> X	<ul style="list-style-type: none"> <li>•Existing caries at baseline was a good predictor of subsequent caries activity and no other single factor alone was accurate at predicting future caries</li> <li>•Multifactorial test will be more reliable than any single factor</li> <li>•II- 2, B</li> <li>•Stepwise regression analysis of the caries scores and measurements of caries-associated variables</li> <li>•DMFS increment were compared</li> <li>•Limitations:</li> <li>•The sample studied was quite less compared to other studies</li> <li>•C/A: 7/10</li> </ul>
M.Grindefjord Sweden Stockholm 1995	N = 786 F/M: 390:396 Age: 1yr Duration: 3.5 yrs follow-up	Multifactorial  Immigrant Background Social Class Mother's education Night meals & drinks Consumption of sugar- containing beverages Tooth brushing S.Mutans	DMFS Increment	<b>Sens:</b> 0.87 <b>Spec:</b> 0.83 <b>PPV:</b> 0.84 <b>NPV:</b> 0.87 When all variables were considered simultaneously <b>ROC:</b> X	<ul style="list-style-type: none"> <li>•Immigrant background was the strongest predictor (probably concealed a behavior characterized by unsuitable dietary habits, oral hygiene &amp; less frequent use of fluorides)</li> <li>•The presence of S. Mutans at 1yrs of age was the most effective predictor (PPV~0.61) for caries at 3.5 yrs of age</li> <li>•II- 2, B</li> <li>•Logistic multivariate regression analysis to determine children exhibiting dental caries or not at 3.5yrs of age</li> <li>•When all factors were present, the cumulative probability of manifest caries was 87%</li> <li>•Dentists were calibrated with respect to diagnostic criteria of caries (r=0.91)</li> <li>•CA: 7/10</li> </ul>

Author Location Date	Population Duration of Study	Predictive Tests	Compared Gold Standard	Results	Author's Conclusion & Critical Appraisal
<p>Nuttall NM Scotland, UK 2000</p>	<p>N = 403 F/M ratio: 1/1 Age: 11-13 Duration: 3yrs follow up.</p>	<p>The system of assessing at two thresholds D1. (All visible lesions affecting enamel) D3 (carious cavity into dentine or pulpal involvement)</p>	<p>The mean DMFT at baseline</p>	<p>Cut-off: 14 cut-off for D1 lesions. Cut-off: 4 cut off  ROC: √ AUC for D1: 0.781 AUC for D3: 0.670</p>	<ul style="list-style-type: none"> <li>•Standardized visual caries assessments can predict future experience of dentine caries in adolescent.</li> <li>• The purpose visually assessing enamel as well as dentinal lesions is more effective than assessing dentinal caries alone</li> <li>•II- 2, B</li> <li>•The study used one examiner.</li> <li>•The study did not explain, what the cut – off used are.</li> <li>•Cohort study.</li> <li>•CA: 7 /10</li> </ul>

**Table 4**

<b><u>Author, date, article.</u></b>	<b><u>Reason for rejection.</u></b>
<p>Van Palenstein Helderman WH. ter Pelkwijk L. van Dijk JW. Caries in fissures of permanent first molars as a predictor for caries increment. [Journal Article] Community Dentistry &amp; Oral Epidemiology. 17(6): 282-4, 1989 Dec.</p>	<ol style="list-style-type: none"><li>1.The test considered only caries in fissures of first molars as the predictor of dental caries.</li><li>2. Does not consider range of severity of disease.</li><li>3. Does not consider other diseases that could be confused with the disease of interest.</li><li>4. The no. of children examined were only 268.</li><li>5. It did not show the sensitivity and specificity at various cut off</li><li>6. No ROC curve.</li><li>7. No. Odds ratio.</li><li>8. No other risk factors were assessed simultaneously in multiple logistic regressions.</li></ol>
<p>Demers M. Brodeur JM. Mouton C. Simard PL. Trahan L. Veilleux G. A multivariate model to predict caries increment in Montreal children aged 5 years. [Journal Article] Community Dental Health. 9(3): 273-81, 1992 Sep.</p>	<ol style="list-style-type: none"><li>1.High drop out rate of participant in study from 428 to 302.</li><li>2.the test was not evaluated against a valid gold standard.</li><li>3.the test results did not determined independently.</li><li>4.ROC curve did not provided.</li><li>5.the test did not give better results than the current or standard test.</li></ol>
<p>Leverett DH. Proskin HM. Featherstone JD. Adair SM. Eisenberg AD. Mundorff-Shrestha SA. Shields CP. Shaffer CL. Billings RJ. Caries risk assessment in a longitudinal discrimination study. [Journal Article] Journal of Dental Research. 72(2): 538-43, 1993 Feb.</p>	<ol style="list-style-type: none"><li>1-the study period is one year</li><li>2-they did not start with range of disease (caries) severity</li><li>3-childern in fluoride- deficient received two to three examinations, the kids from fluoridate community received four examinations over one and one-half period.</li><li>4-the study did not have separate sensitivity and specificity for each variable.</li></ol>
<p>Schroder U. Edwardsson S. Dietary habits, gingival status and occurrence of Streptococcus mutans and lactobacilli as predictors of caries in 3-year-olds in Sweden. [erratum appears in Community Dent Oral Epidemiol 1988 Jun; 16(3): 192]. [Journal Article] Community Dentistry &amp; Oral Epidemiology. 15(6): 320-4, 1987 Dec.</p>	<ol style="list-style-type: none"><li>1. The predictors were generally more effective in selecting low caries risk cases.</li><li>2. It is probably only applicable to very young children</li><li>3. The last two predictive measures do not include all children.</li></ol>

<p>Wilson R.F, Ashley F.P. Identification of caries risk in schoolchildren: salivary buffering capacity and bacterial counts, sugar intake and caries experience as predictors of 2-year and 3-year caries increment, British Dental Journal 1989; 166:99</p>	<ol style="list-style-type: none"> <li>1.Six Variables (baseline caries experience, salivary buffering power, counts of salivary S. Mutans &amp; lactobacilli and 2 estimates of between meal sugar intake) were measured to predict children who would experience high caries increments during subsequent 2-3 years period</li> <li>2.None of the predictor variables achieved the target predictive value of 80%, either individually or in combination.</li> <li>3.The predictive values for baseline caries experience were 66%.</li> </ol>
<p>Crossner CG. Holm AK. Saliva tests in the prognosis of caries in children. [Journal Article] Acta Odontologica Scandinavica. 35(3): 135-9, 1977.</p>	<ol style="list-style-type: none"> <li>1.Epidemiological study</li> <li>2.No specificity and sensitivity values</li> <li>3.Results were variable and inconclusive</li> </ol>
<p>Seppa L. Hausen H. Frequency of initial caries lesions as predictor of future caries increment in children. [Journal Article] Scandinavian Journal of Dental Research. 96(1): 9-13, 1988 Feb</p>	<ol style="list-style-type: none"> <li>1.Small # 124 children</li> <li>2.Used initial caries score as a predictor &amp; proved it is not helpful. (One factor)</li> <li>3.No valid gold standard...didn't use DMFS, Used DS &amp; DF score only</li> </ol>