Examiners' Ratings of Color Transparencies of Clinical Signs Associated with Vitamin Deficiencies

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IN ORDER to diagnose and treat, or prevent vitamin deficiencies, it is necessary to have some means of measuring the incidence and severity of such deficiencies. Tissue changes specific for the severe forms of certain avitaminoses such as scurvy, beri-beri, pellagra, rickets, etc. are well established. In 1945, the Council on Food and Nutrition of the American Medical Association[1] published a description of the currently accepted stigmata, symptoms, and therapy for vitamin deficiencies. For some time these stigmata have been used by physicians in evaluating the nutritional status of groups and individuals. There appears to be, however, considerable dissatisfaction with the reliability and validity of these signs in establishing relationships between mild tissue abnormalities and nutritional status. The validity or specificity of those signs will not be considered in this report which deals only with the differences between examiner ratings of Kodachrome slides showing tissue changes ascribed to vitamin deficiencies.

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The subjectivity of examiners seems to be a major cause of variation in the appraisal of early or mild clinical manifestations of nutritional deficiency. The seriousness of this problem has not only been recognized,[2,3] but conclusively demonstrated by actual studies. Bransby and Hammond,[4] in a study utilizing 14 clinicians and 301 children found that there was considerable lack of agreement between clinicians on their findings of clinical grades and incidence of clinical signs for individuals and groups. Bean[5] reported a study involving a total of 513 men and 14 physicians trained in clinical nutrition. Significant variations were found in the observations when a set of objective standards were used in examining soldiers for early or mild signs possibly indicative of nutritional deficiency. Considerable variability in the findings obtained by different physicians was also noted in the Co-operative Nutritional Status Studies in the Northeast Region.[6]

METHODS

In the present study, Kodachrome slides were utilized as a means of investigating further the variations in appraisals made by different examiners of selected physical signs frequently associated with vitamin deficiencies. Forty-eight slides were used, including twelve of the eyes, eleven of the skin (limbs), thirteen of the gums, three of the lips, and nine of the tongue. Pictures were taken under controlled conditions with a model 300 Coreco camera* which is

* Coreco Research Corporation, 159 West 25th Street, New York 1, N. Y.

especially adapted for this type of photography.

The examiners were seven physicians and one dentist who had taken part in the NE-4 and NE-16 Northeastern Regional Nutritional Status Projects. Each one independently rated each slide according to the following criteria.[7]

PHYSICAL SIGNS

Eyes

Lids:

Edema (generalized without redness).....0 1 2 3
0. None
1. Swelling without obvious narrowing of palpebral fissure
2. Swelling with obvious narrowing of palpebral fissure
3. Swelling with obliteration of palpebral fissure

Marginal Blepharitis.....0 1 2 3
0. None
1. Redness
2. Redness and scaliness
3. Severe inflammation including swelling

Outer Canthi Lesions.....0 1 2 3
0. None
1. Scaliness, dried exudate
2. Preceding plus inflammation (indicated by redness)
3. Inflammation and fissuring

Lower Lids (conjunctiva):

Follicular Hypertrophy.....0 1 2 3
0. None
1. Only on lateral aspect lower lid
2. Punctate, discrete, granular elevations resembling sand on the conjunctiva
3. Same as 2 and inflammation

Inflammation (indicated by redness).....0 1 2 3
0. Normal salmon tint
1. Dull red
2. Scarlet red
3. Beefy red

Bulbar Conjunctiva:

Circumcorneal Injection.....A P (0,2)*

Thickening:† General (use Magni-focuser‡).....0 1 2 3
0. Bluish transparent except at extreme inner and outer borders, smooth
1. Slightly translucent, slightly opalescent, smooth
2. Translucent, opalescent, slightly irregular surface
3. Opaque, irregular surface

Thickening: Localized (number of raised areas).....(0–6)

Lips

Cheilosis, as indicated by:
Swelling.....A P (0,2)
Maceration.....A P (0,2)
Fissures.....A P (0,2)
Shininess.....A P (0,2)
Thinning.....A P (0,2)
Scaling.....A P (0,2)
Vertical markings increased.....A P (0,2)
Vertical markings decreased.....A P (0,2)

Gums

Examine at least the labial surfaces of upper and lower gums from mid-line to and including both sets of canine teeth. If data are based on more extensive examination, then state extent of examination.

Color.....0 1 2 3
0. Normal pale pink
1. Dull red
2. Scarlet red
3. Beefy red

Bleeding.....A P (0,2)

Swelling (spongy).....0 1 2 3
Puffy, smooth, plump, spongy appearance. May be tested by temporary pitting following momentary firm pressure with bare tip of wood applicator stick (flat end).
0. None
1. Puffiness evident in papillary gingiva
2. Puffiness evident in papillary and marginal gingiva
3. Puffiness evident in papillary, marginal, and alveolar gingiva

Thickening (firm).....0 1 2 3
Enlargement giving a very firm, hard, tight appearance. May be tested by absence of temporary pitting following momentary firm pressure with bare tip of wood applicator stick (flat end). The sensation is one of hardness of gum tissue.
0. None
1. Enlargement in papillary gingiva (perhaps giving collar effect)
2. Enlargement in papillary and marginal gingiva (perhaps giving collar effect)
3. Enlargement in papillary, marginal, and alveolar gingiva (perhaps giving wide, straight band appearance)

Blunting of interdental papilla (ae).....0 1 2 3
Shown by rounded point or no point and/or loss of height. Blunting is disregarded if spacing of teeth is 1 mm. or more at sites of their marginal gingivae.
0. Normally a papilla extends between two teeth for about half the distance of their normally exposed length

* Numbers in parentheses indicate the numerical value assigned or the statistical analysis in this study.

† Medical Evaluation of Nutritional Status IV. The ocular manifestations of avitaminosis A, with especial consideration of the detection of early changes by biomicroscopy. H. D. Kruse, *Pub. Health Rep.* 56 (No. 26): 1301–1324, 1941. See pages 1303–1305 for gross changes.

‡ Magni-focuser, Binocular Loop. Model No. 7, Edroy Products Co., 480 Lexington Ave., New York 17, N. Y.

1. Papillae reduced in height to one-fourth normally exposed surface of adjacent teeth
2. Papillae reduced from one-fourth to just above normal baseline of marginal gingiva
3. Papillae reduced to or beyond level of normal marginal gingiva

Recession (marginal or marginal and attached gingiva).....0 1 2 3
0. None
1. Into marginal gingiva
2. Beyond marginal gingiva
3. Into and possibly throughout alveolar gingiva

Retraction (gum is detached so that a space is present between gum and tooth).....0 1 2 3
0. None
1. Detachment of papillary gingiva
2. Detachment of papillary and marginal gingiva
3. Detachment of papillary and marginal gingiva greater than 2

Tongue

Color (underline).....
.....Normal (0) Reddened (2) Magenta (2)

Swelling.....0 1 2 3
0. None
1. Puffy appearance noted after careful examination
2. Puffy appearance obvious at first glance
3. Puffy appearance greater than 2

Fissuring.....0 1 2 3
0. None (normal)
1. Central or central with branches
2. Multiple (central fissure with one or more parallel with it, including branches if present)
3. Cobblestone, etc.

Papillae, Fungiform: Enlargement.....0 1 2 3
0. None
1. Slight on tip or tip and margins
2. Anterior third and margins
3. Anterior plus middle third or more

Papillae, Fungiform: Atrophy.....0 1 2 3
Shown by a shift toward smooth tongue.
0. None
1. Slight on tip or tip and margins
2. Anterior third and margins
3. Anterior plus middle third or more

Papillae, Filiform: Enlargement.....0 1 2 3
0. None
1. Slight on tip or tip and margins
2. Anterior third and margins
3. Anterior plus middle third or more

Papillae, Filiform: Atrophy.....0 1 2 3
Shown by a shift toward smooth tongue.
0. None
1. Slight on tip or tip and margins
2. Anterior third and margins
3. Anterior plus middle third or more

Skin

Xerosis (Upper limbs and mid-thigh regions down):
Dryness.....0 1 2 3
0. Normal oily sheen of skin
1. Slight grayish powdery appearance lacking normal sheen
2. Obvious definite powdery appearance
3. Intensity greater than 2

Crinkling.....0 1 2 3
0. Normal smooth skin
1. Faint alligator scale-like pattern
2. Well defined pattern
3. Well defined pattern with easily observed grooved boundary markings

Scaling.....0 1 2 3
0. Normal smooth skin
1. Skin beginning to scale
2. Scales with flakes shedding
3. Intensity greater than 2 with free shedding

Follicular Hyperkeratosis (excluding elbows and knees).....0 1 2 3
0. None
1. A few scattered hyperkeratotic follicles present (not receding following contact with warm hand)
2. Moderate number of hyperkeratotic follicles with rough, grater-like surface easily palpable
3. Large number of protruding, rough, horny, keratotic follicular plugs

Perifollicular Petechiae.....A P (0,2)
Purpura.....A P (0,2)
Dermatitis (pellagrous).....A P (0,2)

The ratings given each of the slides for a particular sign were averaged for individual examiners and are presented in Table I. Here the variation among examiners can be seen. One should keep in mind that not all of the ratings had the same range of values. The analysis of variance offers a statistical test of agreement among examiner averages, using as the criterion the consistency of the differences between examiners from slide to slide. In 30 of the 38 signs, differences between examiners were found to be significant at the 5 per cent level. These results are summarized in Table II under the column of F ratios[8] for examiners.

DISCUSSION

How can these results be applied to the question of how precise the evaluations need to be for clinical (photographic) assessment of nutritional status? One kind of answer can be suggested by considering these results with

TABLE I

Examiner Averages in Rating of Physical Signs

Physical signs	Examiners							
	1	2	3	4	5*	6	7	8
Eyes								
Lids:								
Edema	0.67	0.75	0.42	0.92		0.58	0.00	0.33
Marginal Blepharitis	0.50	1.00	0.33	1.17		0.50	1.50	0.83
Outer Canthi Lesions	0.17	0.17	0.17	0.75		0.25	0.17	0.17
Lower Lids:								
Follicular Hypertrophy	0.17	0.33	0.42	0.83		0.92	1.08	0.08
Inflammation	1.17	0.58	0.75	0.50		0.58	0.42	0.42
Bulbar Conjunctiva:								
Circumcorneal Injection	0.33	1.00	0.83	0.67		0.83	0.17	0.17
Thickening								
General	0.42	0.58	0.50	0.50		1.17	1.92	0.25
Localized	0.00	0.58	0.08	0.25		0.75	3.00	0.00
Lips								
Swelling	2.00	1.33	1.33	1.33	1.33	1.33	2.00	0.00
Maceration	0.67	1.33	0.00	2.00	2.00	1.33	0.00	0.00
Fissures	2.00	1.33	1.33	2.00	1.33	1.33	0.67	0.67
Shininess	2.00	0.67	0.00	2.00	1.33	0.67	2.00	0.67
Thinning	0.67	1.33	0.00	2.00	2.00	2.00	2.00	0.67
Scaling	1.33	0.67	1.33	1.33	2.00	1.33	0.00	0.00
Vertical Markings								
Increased	0.00	1.33	2.00	2.00	2.00	2.00	2.00	2.00
Decreased	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.00
Gums								
Color		1.31	1.25	1.08	1.08		2.31	0.38
Bleeding		0.62	1.85	0.92	1.54		0.31	0.62
Swelling		1.31	0.77	1.54	1.08		2.67	0.92
Thickening		1.85	0.69	1.77	1.31		3.00	0.62
Blunting		1.62	0.46	1.69	0.31		1.69	1.15
Recession		2.15	0.62	1.77	0.62		3.00	0.69
Retraction		1.15	0.54	1.77	0.85		0.62	0.92
Tongue								
Color								
Reddened	1.33	0.89	0.67	0.89	1.11	1.11	0.67	0.44
Magenta	0.22	0.44	0.44	0.22	0.67	0.22	0.00	0.00
Swelling	0.78	0.67	0.22	0.89	1.89	1.00	0.44	0.67
Fissuring	0.89	0.67	0.44	0.67	0.89	1.11	1.22	0.22
Papillae, Fungiform								
Enlargement	0.78	1.22	1.22	1.56	1.78	1.44	2.33	0.67
Atrophy	0.22	0.56	0.11	0.44	0.00	0.22	0.00	0.44
Papillae, Filiform								
Enlargement	0.67	1.44	1.22	0.00	1.67	0.78	3.00	0.11
Atrophy	0.22	0.33	0.11	0.56	0.11	0.22	1.22	0.00
Skin								
Dryness	2.36	2.09	1.18	2.00		2.27	1.82	1.27
Crinkling	1.55	1.36	0.91	1.73		1.73	2.00	0.91
Scaling	2.09	1.91	0.91	1.45		2.09	1.27	1.00
Follicular Hyperkeratosis	1.36	1.27	1.00	2.55		2.09	1.91	1.00
Perifollicular Petechiae	0.73	1.27	0.36	0.18		0.55	0.00	1.27
Purpura	0.18	0.18	0.55	0.00		0.55	0.00	0.18
Dermatitis	0.36	0.00	1.27	1.64		1.64	0.00	0.36

* Dentist.

TABLE II

Evaluation of Differences Among Examiners

Physical sign	Number slides	Number of examiners	F ratio examiner*	N†
Eyes				
Lids				
Edema	12	7	3.19‡	3
Marginal Blepharitis	12	7	4.55‡	4
Outer Canthi Lesions	12	7	2.42§	2
Lower Lids				
Follicular Hypertrophy	12	7	5.24‡	4
Inflammation	12	7	2.31§	3
Bulbar Conjunctiva				
Circumcorneal Injection	12	7	2.51§	3
Thickening: General	12	7	7.35‡	5
Thickening: Localized	12	7	19.01‡	8
Lips				
Swelling	3	8	3.08§	2
Maceration	3	8	5.65‡	2
Fissuring	3	8	1.61 NS	3
Shininess	3	8	2.70 NS	4
Thinning	3	8	3.88§	3
Scaling	3	8	2.31 NS	4
Vertical Markings: Increased	3	8	9.67‡	1
Vertical Markings: Decreased	3	8	1.00 NS	1
Gums				
Color	13	6	11.17‡	5
Bleeding	13	6	10.79‡	3
Swelling	13	6	16.50‡	4
Thickening	13	6	18.19‡	6
Blunting	13	6	10.58‡	5
Recession	13	6	34.72‡	6
Retraction	13	6	4.42‡	4
Tongue				
Color: Reddened	9	8	1.08 NS	4
Color: Magenta	9	8	1.14 NS	3
Swelling	9	8	4.47‡	4
Fissuring	9	8	3.32‡	3
Papillae, Fungiform: Enlargement	9	8	7.00‡	4
Papillae, Fungiform: Atrophy	9	8	2.42§	2
Papillae, Filiform: Enlargement	9	8	15.37‡	7
Papillae, Filiform: Atrophy	9	8	3.42‡	3
Skin				
Dryness	11	7	0.89 NS	2
Crinkling	11	7	5.08‡	3
Scaling	11	7	6.91‡	3
Follicular Hyperkeratosis	11	7	4.79‡	6
Perifollicular Petechiae	11	7	5.00‡	3
Purpura	11	7	1.76 NS	2
Dermatitis	11	7	12.19‡	3

* F ratio of examiner mean square/examiner × slide mean square.

† N = number of examiners needed to declare 85 times in 100, a difference of two steps in severity rating as significant at the 5% level.

‡ Significant at the 1% level.

§ Significant at the 5% level.

NS not significant.

respect to the survey type of nutritional status study. Suppose it is desired to compare clinical results obtained photographically from a survey on a subject-to-subject basis. The clinical results should be sufficiently precise to differentiate 85 times out of 100 between severity ratings of two-step intervals (or between "absent" and "present" if all signs were rated in only two categories) at the 5 per cent level of significance. Postulate further that the examiners in this referee slide study could be considered as a representative group of physicians likely to participate in a field survey—not an unreasonable assumption.

The results here indicate that the number of examiners needed to appraise each subject's color slide for a particular sign would be four or less for 30 of the 38 signs included here, as can be seen in Table II under the column headed N. Only eight signs required more than four examiners. To detect differences of one-step intervals would require approximately four times as many examiners as indicated in the table.

When applying these findings to a clinical situation there are several factors which should be considered. Although further study would be necessary to determine the relationship of examiner ratings on slides versus ratings of subjects, experience has shown that these slides provide a reasonably accurate clinical record of tissue. Furthermore, the slide provides for more objective evaluation of the tissue as it is dissociated from the subject. On the other hand, exact color reproduction offers some difficulties, especially when the exposure or processing of the film has resulted in a faulty tint or when reflections cause high lights. Inexperienced examiners may find such distortions disturbing. By far the greatest advantage of color slides is that they provide actual pictures of tissue that can be observed by many examiners and compared with subsequent examinations of the same tissue in contrast to the written record or memory of the examiners.

Previously, there had been no satisfactory method of recording incidence of tissue abnormalities and tissue changes associated with mild forms of vitamin deficiency. Kodachrome slide records may very well be the answer to this problem. Inexperience in the use of slides is by no means an insurmountable difficulty. As color photography improves and standard conditions of film exposure and projection are achieved, we should be able more fully to exploit the potential value of this new tool.

SUMMARY

Kodachrome slides of selected physical signs frequently associated with vitamin deficiencies were examined by seven physicians and one dentist, and independently rated according to written criteria. The results showed significant differences between examiners. In order to differentiate between severity ratings of two-step intervals 85 times out of 100, the findings indicated that the number of examiners needed to appraise each subject's color slide for a particular sign would be four or less for 30 of the 38 signs studied. Factors to be considered when utilizing Kodachrome slides in a nutrition study were reviewed.

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