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# Teamwork Climate among Resident Physicians in Two Departments of an Egyptian Hospital

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## Abstract:

*Teamwork climate (TWC)is crucial for organizations' success, including healthcare organizations. Fourteen-itemed Team Climate Inventory(TCI-14) was used to measure TWC among resident physicians in two departments in an Egyptian University Hospital. Confirmatory factor analysis via structural equation modeling and exploratory factor analysis (in a confirmatory mode) were employed to construct validate the four-factor model of TCI-14. Factorial validity was established thru global and local fit diagnostics. Convergent validity was demonstrated via adequate subscales alpha coefficients, composite reliabilities, variances extracted, and weight and significance of item loadings. Discriminant validity was verified by moderate interfactor correlations and subscales composite reliabilities were greater than average variance extracted. The validated model was utilized to calibrate and grade the level of global TWC, its four subscales and indicators, which were found to belong to the "Good" category. TWC was not contingent upon physicians' personal characteristics like, age, sex, or length of employment. Specific and all-purpose educational and training programs were recommended to improve TWC.*

## Keywords:

*Teamwork Climate, Team Climate Inventory, Validation, Confirmatory Factor Analysis, Exploratory Factor Analysis, Healthcare organizations*

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**BACKGROUND OF THE STUDY**

Teamwork climate(TWC) is crucial for organizations' success (Patterson, Warr,& West, 2004), including healthcare organizations (HCOs) (Ouwens et al., 2008). TWC signifies shared perceptions of the manner of collective working behavior the group has evolved in an identified setting (Anderson & West, 1994). High-caliber TWC is associated with improved HCO's effectiveness (Lemieux-Charles & McGuire, 2006), efficiency (Wensing, Wollersheim,& Grol, 2006), clinical performance (Shortell et al., 2005);patient satisfaction(Meterko, Mohr, &Young, 2004), health professional job satisfaction (Körner, Wirtz , Bengel, &Göritz, 2015; Silva et al., 2016);diminished hospital employee turnover (Kivimäki,Vanhala, Pentti, & Lansisalmi, 2007);health outcomes (Shortell et al., 2004);reduced medical errors (Risser et al., 1999); patient safety (Baker, Gustafson, Beaubien , Salas, & Barach, 2005);accessibility (Reiss-Brennan et al., 2016), quality (Goh& Eccles, 2009), innovativeness of healthcare services (Proudfoot et al., 2007);and successful change management in HCOs(Queen's School of Business & The Monieson Centre For Business Research in Healthcare, 2014).

TWC is a prominent core competency scrutinized by multifarious accrediting, certifying and research agencies (Accreditation Council for Graduate Medical Education, 2008; American Board of Internal Medicine, 2017; Joint Commission, 2012; Institute of Medicine, 2003), in specie that TWC state is amenable to modification and improvement through practice-level organizational changes (Beaulieu et al., 2013). A measure of TWC is intended to assess teamwork underlying processes such as collaboration, task orientation, shared vision and innovation (Ouwens et al., 2007). A reliable and valid TWC measure is important to envisage the configuration (structure) and assess the caliber (magnitude) of TWC (Beaulieu, et al., 2013). Configuration concerns envisioning TWC factorial structure (Strating & Nieboer, 2009), while calibration pertains to numerically measuring and grading overall TWC, and its underlying dimensions and indicators(Beaulieu, et al., 2014). The structural configuration of standard TWC model is based on four underlying factors, namely, ''Vision,'' ''Participative Safety,'' ''Task Orientation,'' and ''Support for Innovation'' that are related to underlying manifest behaviors comprising the indicators of TWC (West, 1990).

Several versions of Team Climate Inventory (TCI) were developed to configure the structure and calibrate the magnitude of TWC. Prototype version of TCI consisted of sixty-one items (Anderson& West, 1998), which was abridged to a thirty-eight items version (Tseng, Liu, & West, 2009), which in turn was reduced to a 19-item version (Beaulieu, et al., 2014), that was further shortened to a 14-item version (Kivimäki & Elovainio, 1999). The robustness of the four factor structure of various versions of TCI have been demonstrated through legion studies in various countries including, U.S.A.(Anderson& West, 1996),Canada (Howard, Brazil, Akhtar-Danesh, & Agarwal , 2011), U.K. (Anderson& West, 1998), Germany (Brodbeck& Maier, 2001),Italy(Ragazzoni, Baiardi, Zotti, &West, 2002),Sweden (Agrell&Gustafson, 1994),Norway (Mathisen, Einarsen, Jørstad,& Bronnick, 2004), Denmark(Strating& Nieboer, 2009), Finland(Kivimäki et al., 1997),China (Yuan, Chaoying,& Peng, 2008), and Taiwan(Tseng et al., 2009). Although TCI is administered at the individual level, the instrument is meant to reflect a shared perspective about TWC (Beaulieu, et al., 2014).

Conventionally TCI measures proximal rather than distal TWC (Anderson & West, 1998); the former is concerned with workgroup level rather than organization-wide level TWC (Yuan, Chaoying, & Peng, 2008).It is notable that most studies of TWC have been conducted on the workgroup rather than organization-wide level (Bain, Mann, & Pirola-Merlo, 2001; Burningham & West, 1995).In spite of plethora of research employing various versions of TCI at various settings in diverse parts of the globe, additional research is called for to investigate the applicability, robustness and psychometric properties of TCI, particularly its short versions, (Beaulieu, et al., 2014), underscoring non-Western cultures(Tseng, et al., 2009).

The present study extends research on TCI-14 by empirically investigating its psychometric properties and employing it in an Egyptian socio-cultural context by measuring proximal TWC in surgical and medical departments in Alexandria Main University Hospital (AMUH), Egypt. Further, it was hypothesized that perceptions of TWC is not contingent upon age, gender, marital status, M.B.Ch.B. merit, work department or duration of employment in the study setting.

**Method**

An observational analytical cross-sectional study was conducted at surgical and medical departments in AMUH, Egypt, in the period from 6/8/2017 till 27/8/2017, after obtaining permission from hospital authorities. The study population included all resident physicians who worked in the study setting during the study period. The purpose of the study was explained to the study population, participation was voluntary and all participants gave verbal informed consent and were assured as regards the anonymity and confidentiality of the questionnaire. The researcher complied with International Guidelines for Research Ethics and Academy of Management (AoM) Code of Ethics. A specifically designed self-administered questionnaire (in English) was delivered - in person- to all members of the study population who totaled to seventy-seven residents.

Respondents filled in the questionnaire and recorded their responses individually and anonymously. Response rate was (61/77), i.e. 79.22 %.

The questionnaire contained three sections. The first section introduced the researcher to the participants, informed them of the purpose of the study and submitted instructions about how to complete the questionnaire. The second section encompassed items pertaining to some personal characteristics of participants including age, gender, marital status, attained M.B.Ch.B. merit, department of work, and duration of employment in the study setting. The third section encompassed the fourteen indicators of TCI-14. Respondents were asked to indicate - on a seven- point Likert scale- the extent to which they agreed/disagreed with each of the fourteen items, according to the following categories: *Completely Agree(AC)*, *Agree to a Great Extent(AG)*,*Agree to Some Extent(AS)*,*Neither Agree nor Disagree (NAD)*, *Disagree to some Extent(DS)*,*Disagree to a Great Extent(DG)*, and *Completely Disagree(DC)*.The categories of the scale were scored as follows: CA was assigned a score of six degrees; AG was assigned a score of five degrees; AS was assigned a score of four degrees; NAD was assigned a score of three degrees; DS was assigned a score of two degrees; DG was assigned a score of one degree; and CD was assigned a score of zero. Higher item score indicates a higher level (better attainment) on the distinct indicator. For purposes of this study, the measuring seven-point Likert scale was considered as an interval scale suitable for correlational analyses.

The fourteen items of the TCI-14 are presented with their contrived initial codes as follows:

**{T1}** *Agreement with objectives*;**{T2}***Clearly understood team's objectives*; **{T3}***Achievability of team's objectives*; **{T4}***Team's objectives' worth to the organization*; **{T5}***Togetherness attitude*;**{T6}***Keeping workmates informed*; **{T7}***Feelings of understanding and acceptance among teammates*;**{T8}***Sharing information among teammates*, **{T9}***Preparedness to basic questions*,

**{T10}***Critical appraisal of weaknesses*, **{T11}***Building on each other's ideas*, **{T12}***Search for new ways of looking at problems*,**{T13}***Enough time to develop ideas*,**{T14}***Cooperation in developing and applying ideas*. Items **{T1, T2, T3, T4}** are grouped under the subscale " Vision" coded as **(F1)**;

**{Items T5, T6, T7, T8}**are grouped under the subscale "Participative Safety" coded as **(F2)**; Items**{T9, T10, T11}**are grouped under the subscale "Task Orientation" coded as **(F3)**; Items **{T12, T13, T14}** are grouped under the subscale "Support for Innovation" coded as **(F4)**.Each subset of indicators was allowed to load only on its corresponding latent dimension. Correlations among errors terms, either within or across sets of items, would not be allowed in the model. Non-zero correlations among the four factors were permitted.

Preliminary screening of the 14-item dataset was conducted to assure the feasibility of carrying out factor analytic procedures. Internal consistency reliability and homogeneity of the scale were assessed using the next cutoff points:- .7 for Cronbach's ($\alpha$) reliability coefficient; .8 for Guttman reliability coefficient; .3 for corrected item-total correlation (CITC); .3 for mean interitem correlation (MIC); 30 for the Conditioned Index (CI); Kaiser-Mayer-Olkin (KMO)coefficient of .8 is considered meritorious; Measures of Sampling Adequacy (MSA) of individual elements on the anti-image correlation matrix above .5 are considered adequate; and an extraction communality – using Principle Components Analysis PCA - exceeding (0.3) threshold, justify the inclusion of the manifest variable in Factor Analysis FA. Critical ratios of skewness and kurtosis were obtained by dividing the skewness and kurtosis statistics by their corresponding standard errors . Critical ratios of skewness and kurtosis less than |3.29| signify that these parameters were not significant at .01 level and indicate that skewness and kurtosis values are statistically not different from zero.

Skewness indices less than |2| is an indication that skewness is not a problem for observed variables. Kurtosis indices less than |5| is an indication that kurtosis is not a problem for observed variables.

Mardia's kurtosis critical ratio<5.00 is indicative of non-violation of the assumption of multivariate nonnormality, however, a value from 5 to 10 is an sign of moderate deviation from the assumption of multivariate normality.

Generalized Least Squares estimator (GLS) was used as an estimation procedure and factorial validity of the model was assessed using the following seven fit indices, given with their threshold values:- Chi-square ($\chi^2$)($p > .05$); Normed Chi-square ($\chi^2$/df) < 2 ; Incremental Fit Index (IFI) > .95; Tucker-Lewis index (TLI) > .95; Comparative Fit Index (CFI)> .95; Standardized Root Means square Residual (SRMR) < 0.08, Root Means Square Error of Approximation (RMSEA)<

.06together with 90% CI (lower bound < .05 and upper bound < .08, PCLOSE > .05). A standardized item loading ≥ .6 was considered to be a good-sized regression path. Standardized covariance residual values < |3.0| are indicative of a locally adequate model fit. Residual and modification indices (MI) analyses were conducted to ascertain proper model fit at the individualized elements level.

Internal consistency and composite reliabilities (CR) of a construct were sized up via Cronbach's alpha and Raykov rho coefficients respectively. Convergent validity of the measurement model was appraised by virtue of Cronbach's alpha≥ .7, Raykov rho≥ .8, significant factor loadings with standardized values> .6, AVE ≥ .5, and positive significant moderate intercorrelations of indicators enclosed in a certain factor (interitem correlations).

Discriminant validity was supported through a number of procedures including:-(i) via the values of Pearson's moment factor pairwise correlations <|.95|, (ii) CR >AVE values of each factor,

(iii) EFA was run in a confirmatory mode to discern the felicitous number of factors, (iv) and CFA was run in an exploratory mode to discard the one-factor and three-factor solutions.

Additionally, the congeneric model was tested for tau-equivalence and parallelism. Tau- equivalent and parallel models assume independent error terms and are fitted to a covariance matrix. The validated standard four-factor model of TCI-14 was utilized to calibrate and grade the state of perceived TWC in the study setting. Frequencies and percentages of various levels of TCI- 14 items anchored on the seven-point Likert scale were figured out. Descriptive statistics of items, subscales and overall scale scores were portrayed. The gradient of each item was calculated based on the proportion ($\bar{X}_I$ /6), where ($\bar{X}_I$) is mean score for an item and (6) is maximal attainable item score. An item's gradient would be graded according to the following levels:-"Excellent" [1.0- .9]; "Very Good" [.8999- .8]; "Good" [.7999- .6]; "Satisfactory" [.5999- .5]; "Poor" [.4999- .25]; and "Very Poor" [.2499- 0]. Global TCI-14 score (G) for each case was calculated as the sum of fourteen items scores and man global scale score is designated $\bar{X}_G$. The maximal attainable score for a case is eighty four. The ratio (G/84) is employed to grade each case global scale score according to the following gradients:-"Excellent" [1.0- .9]; "Very Good" [.8999- .8]; "Good" [G/84

= .7999- .6]; "Satisfactory" [.5999- .5]; "Poor" [.4999- .25]; and "Very Poor" [.2499- 0].Subscale scores for each case was calculated as the sum of items comprising each subscale. Subscale scores are symbolized, $S_{F1}$, $S_{F2}$, $S_{F3,}$ $S_{F4}$. Subscale scores for each case was graded using a ratio analogues to the ratio used to grade G, however, the numerator of the ratio is the subscale score and the denominator is the maximal attainable score for the designated subscale. It is notable that the maximal attainable $S_{F1}$and$S_{F1}$ is 24 each; whereas the maximal attainable $S_{F3}$ and$S_{F4}$ is 18 each. A case subscales scores were graded using gradients' categories identical to gradient categories used for G. Analysis was conducted using Software Packages SPSS.25 (Statistical Packages of Social sciences version 25) and AMOS.24 (Analysis of Moment Structures-Version 24).Parallel Analysis (PA) was run using Parallel Analysis Calculator concocted by Department of Obstetrics and Gynecology affiliated to the Chinese University of Hong Kong & New Territories East Cluster.

Available at:http://www.obg.cuhk.edu.hk/ResearchSupport/StatTools/ParallelAnalysis_Exp.php

**Result**

Thirty seven participants (60.7 %) were males, whereas twenty four (39.3 %) were females. Forty-seven participants (77%) belonged to the age group (25-28) years, and the remaining fourteen (23%) belonged to age group (> 28-≤31) years. Maximum and minimum ages were 31 and 25 years respectively, with mean age of 27.43 ± 1.61 years. Forty-one participants (67.2 %) were single whereas twenty (32.8 %) were married. Thirty-six participants (59.0 %) worked in internal medicine department, while the remaining twenty-five (41.0 %) worked in the surgical department. Thirty physicians (49.2 %) worked in the study setting for a period < two years, while the remaining thirty-one (50.8 %) worked for a period ≥ two years. The minimum and maximum duration of employment in the study setting were one and sixty months respectively, with a mean of 24.00 ±17.60 months. Thirty-five residents (57.4 %) obtained an "Excellent" merit (i.e. from 100% to 85% of the total M.B.Ch.B. grade), while the remaining twenty six (42.6 %) got a "Very Good" merit(i.e. from < 85% to ≥ 75% to of the total M.B.Ch.B. grade).

Data entries pertaining to TCI-14 were screened and no missing data were detected entailing that sixty-one cases are usable for the analysis. Heuristically and before undertaking formal analytical tests of sampling adequacy (such as Bartlett's Sphericity and KMO tests), a sample size of sixty-one (N = 61) is contemplated sufficient for factor analytic procedures in the present study for several considerations. First, sample size to number of items ratio is (61/14 = 4.36), a ratio that is in concert with a rule-of- thumb (heuristic) accepting a sample size that is not less than three times the number of scale items (Catell, 1978; Hatcher, 2005; Knafl, 2017; Williams, Brown, & Onsman, 2010; ). Item-to-response ratio of 1:4 could be satisfactory in a considerable number of studies (Costello & Osborne, 2005;Rummel, 1970). Second, communalities extracted - using PCA- are sizeable as they range between .866 and .589 and have a mean of .751± 0.079 (see Table 1), a finding that countersigned the adequacy of sample size because when communalities are high, recovery of factors from the data is normally very good, almost regardless of sample size. Last but not least, it is to be recounted that sixty-one cases was the maximum number of participants who would participate in the present study, and a sample is considered sufficient as long as it includes all cases that could contribute to the study.

All measures of central tendency (mean, median, and mode) for all items had a value≥ 4 except item (T13) whose mean was 3.7869±1.63416 (see Table 1).There were no univariate outliers among fourteen indicators since the maximum obtained score was six and the minimum was zero(see Table 1).Internal reliability analysis of the 14-item inventory disclosed that Cronbach's ($\alpha$) and Guttman's split-half reliability coefficients exceeded .8 with values of .893 and .854 respectively, well- surpassing a .7 cutoff point and giving evidence of adequate internal consistency reliability and homogeneity of TCI-14 scale.

For TCI-14 items all CITCs were highly significant ($p < .001$) and exceeded the .3 threshold as their values ranged between .408 and .705 (see Table 1).The array of CITC values present further evidence of the internal consistency reliability and homogeneity of the scale. Additional evidence of the internal consistency reliability and homogeneity of the TCI-14 scale was maintained by finding that Chronbach's ($\alpha$) if item deleted values nestled in the range of 0.879 to 0.894 (see Table 1). All Chronbach's ($\alpha$) if item deleted values were less than the value of Cronbach's reliability coefficient ($\alpha$= 0.893), except that of item T4 which was trivially higher than Chronbach's ($\alpha$) that is [.894>.893] (see Table 1) and the researcher found no need to eliminate any item from the scale.

MIC among fourteen manifest variables was0.384± .134 (see Table 2). A MIC value that exceeds the 0.3 threshold is a signal for the internal consistency reliability, homogeneity and factorability of a scale. The linearity assumption was maintained since most items were moderately (Pearson's r >|0.3|) and significantly correlated with each other. Table 2 shows that Pearson's correlation coefficients ranged between (.740 and .058) and more than 90 %(71/78=91.03%) were significant ($p < .05$, one-tailed). More than four fifths (58/71 = 81.69 %) of the significant interitem correlations were of moderate magnitude (Pearson's |.74| >r>|0.30|). The linearity assumption was further assured using graphical methods since scatterplots relating pairs of the fourteen observed variables displayed linear homoscedastic (even or cigar-shaped outline) relations. However, the fourteen manifest variables were not excessively correlated since the highest correlation coefficient was .740 (see Table 2).Interitem correlations lower than |.9| threshold are signposts of the absence of multicolinearity and singularity.

The determinant of the interitem correlation matrix was .001 (see Table 2).A determinant of (.001) does not approach zero since its value exceeds the minimal acceptable value of .00001. The value of the determinant presents a clue that the interitem correlation matrix is not an identity matrix and that the dataset of TCI-14 indicators is not afflicted with multicolinearity or singularity problems. Under collinearity diagnostics tolerance values for each manifest variable were checked. Tolerance values ranged between .308 and .612, i.e.no tolerance values were zero or close to zero, serving an extra evidence of the absence of singularity or multicolinearity. Furthermore, all CI values, but one, were below thirty and ranged from (1 to 28.492). Only one CI value pettily exceeded the thirty mark (CI = 30.024), a value that is triflingly higher than thirty and the researcher assured the conclusion that there was no evidence of multicolinearity or singularity. A significant Bartlett's Sphericity Test(Approximate Chi-square = 396.167, df = 91, p = 0.000) provided a favorable eloquent global diagnostic cue that the fourteen items of the TCI-14 were sufficiently correlated, the interitem correlation matrix was a factorable non- identity matrix and that the sample size was adequate for conducting FA.

Residual analysis (Extraction method: PAF) flaunted no problem carrying out factor analytic procedures since inspecting the fourteen items correlation matrix residuals (see Table 3) showed that most correlations residuals were zero or close to zero. The average of correlations residuals was. 000308, the maximum was .158 and the minimum was –.089. The values of absolute residuals ranged between a maximum of |0.158| and a minimum of 0.00. Average of absolute residuals was |.036176|. The small values of residuals (most residuals were close to zero) forestalled a good model fit. Besides residual analysis submitted twenty-four (i.e. only 26.0%) nonredundant residuals with absolute values greater than 0.05 (see Table 3), giving further evidence of the presence of a patterned relation among the fourteen items of TCI-14 since a good model fit requires less than 50% of non-redundant residuals to be greater than |0.05|. A histogram of residuals disclosed that they were normally distributed. A normal Q-Q plot of residuals presented an approximately straight line denoting that residuals are coming from a normal distribution with a mean of approximately zero.

A KMO coefficient was found to be .847, a meritorious value that attested to the global sampling adequacy of the 14-itemed scale. MSA were in the range from .917 to .737, indicating sampling adequacy at the individual items level and supporting the inclusion of all 14 indicators in FA. Extraction communalities - using PCA- were in the range [.589 - .810], topping a .3 threshold and giving extra justification of the inclusion of all 14 indicators in the factor analytic procedures.

The assumption of univariate normality was initially assessed by histograms, stem-and-leaf diagrams and box-plots of the fourteen manifest variables. These graphical devices put on view the symmetrical distribution and the appropriate proportion of distributional height to width of scores of all TCI-14's indicators and provided a pictorial substantiation of the univariate normality of the fourteen manifest variables. Data univariate normality was more rigorously gauged by scrutinizing skewness and kurtosis indexes and their critical ratios. Table 4 reveals that all skewness and kurtosis critical ratios were less than |3.29|, except those belonging to items T6, T7, and T14.

However, concern about skewness of these three items is alleviated by observing that all skewness indices were <|2| [ as they ranged from |1.81| - |.136| ], which is an indication that skewness is not a problem for observed variables. Additionally, inspecting kurtosis indices assuaged most concerns about the assumption of univariate normality since all kurtosis indices, but three, were less than |2| (see Table 4). Kurtosis indices less than |2| is an indication that kurtosis is not a problem for observed variables. Still, concern may arise about items T6, T7 and T14 whose kurtosis indices exceeded |2|, 2.305, 4.040 and 4.296 respectively (see Table 4). However, the researcher resolved that these three variables are not afflicted with a serious kurtosis problem since items T6, T7 and T14 kurtosis indices were less than |5|. Based on the above findings, the researcher maintained that the assumption of univariate normality is not violated. The assumption of bivariate normality was assured by inspecting pairwise scatter plots among fourteen items which put on show the linear relationship between each pair of observed variables and absence of bivariate outliers.

Multivariable outliers were assessed using Mahalanobis distance where a multivariate outlier can be defined as a case that is associated with a Mahalanobis distance greater than a critical distance specified typically by a $p < .001$. For the 14-itemed scale, the highest Mahalanobis distance for one case was (38.276), a value that is more than the critical $\chi2$ value ($\chi2$= 36.12;df =14, p<0.001), disclosing that this case is a multivariate outlier. The next highest Mahalanobis distance for a case was (33.133), a value that is less than the critical $\chi2$ value ($\chi2$= 36.12; df =14, p<0.001), indicating that there was only one case that comprised a multivariate outlier. The researcher contemplated that this outlying case did not constitute a serious multivariate outlier and would not distort the results and all cases were retained for FA.

In this study, Mardia index equaled (45.719) and its standardized value was (8.435) (see Table 4), which raises concerns about multivariate non-normality of the 14-itemed dataset.

Nonetheless, a Mardia's kurtosis critical ratio of (8.435) does not constitute a severe deviation from multivariate normality, expressly with the virtual absence of multivariate outliers. The assumption that multivariate normality was not severely violated was bolstered by graphically assessing multivariate normality using a scatterplot of Mahalanobis distances and paired $\chi^2$-values where the plot approximated a straight-line indicating a high level of multivariate normality. Non-severe deviation from the assumption of multivariate normality, does not prohibit carrying out factor analytic procedures using conventional estimation procedures such as Maximal Likelihood Estimator (MLE) and GLS which are reasonably robust to moderate deviations from multivariate normality.

Based on understanding of how the data set looks like as regards univariate, bivariate and multivariate normalities the researcher decided to carry out FAand the standard TCI-14 model was specified as shown in the methodology section. The "Standard Model" was identified by fixing factor loading of T1, T5, T9 and T12 on F1, F2, F3 and F4 respectively to one. Regression weights of fourteen error terms on their respective items were also fixed to one. All other parameters of the "Model" were freely estimated. The model was estimated and a minimum was achieved (see Figure 1). The "Model" exhibited acceptable fit indices measured up against the standard cutoff points presented in the methodology section. Chi-square value was statistically insignificant (p > 0.05) [$\chi2$= 71.560, df = 71, p= 0.459]. Normed-chi-square value < 2, [$\chi^2$/df = 1.008].SRMR < .08 (SRMR =.0746). CFI> 0.95 [CFI = 0.977]. TLI > 0.95 [TLI = 0.971].IFI> 0.95 [IFI = 0.988].RMSEA < 0.05 [RMSEA = 0.011, 90% confidence interval of 0.000 to .076] where the upper bound of 90% C.I. is well below 0.08 and the lower bound is zero, in addition to a non-significant PCLOSEwith a valuegreater than 0.50 (PCLOSE = .764).Generated values of the seven fit indices collectively impart a clear verification of an adequate overall fit of the "Standard Model". A sign of absence of local areas of misfit was the finding that values of standardized covariance residuals were less than|3.0| as they ranged from |2.766 | to 0.000(see Table 3). Mean standardized covariance residual and mean absolute standardized covariance residuals were .3548 and |.8149| respectively. Additionally, the normal Q-Q plot of the standardized covariance residuals produced an approximately straight line testifying that the residuals are coming from a normal distribution with a central tendency towards zero, a finding that adds extra evidence to the adequacy of model fit.

In the specified model, all unstandardized item loadings were statistically significant (p <.05, two-tailed) (see Table 5). Standardized item loadings of the TCI-14model were sizable and lied in the range of [.897 to .625] then exceeding the .6 cutoff point counseled as a threshold for a good- sized regression path. Local fit of the model elements was also ascertained by examining modification indices and finding out that the specified model had no missing parameters.

It is discernable from Table (6) that the covariances of the four factors (subscales) of the TCI-14model were significant at (p < .05, one-tailed) for all covariances except covariance between F1 and F4 which was significant at (p < .1, one-tailed). Interfactor correlations ranged from.932to.529 (see Table 6). Positive, moderate and significant interfactor correlations give an extra evidence of the robustness of the "standard" TCI-14 model. Shared variance among factors ranged between (0.280 and 0.869) values that are not high enough to warrant a problem of overlap or halo effect among factors. Adequate fit of the TCI-14 model warranted its factorial validity (see Figure 1).

Further analysis headed to establish the two other components of construct validity, namely, convergent and discriminant validities. Convergent validity was authenticated by the following techniques: (i) respectively, Cronbach's alphas of F1, F2, F3, F4 were (0.753,0.716, 0.825, 0.788) handsomely outstripping a .7 threshold;(ii)in turn, CRs of F1, F2, F3, F4 were (.800, .829, .875, .854) befittingly attaining the .8 threshold; (iii) all factor loadings are significant with substantial standardized values higher than .6, (iv) one by one, AVE for F1, F2, F3, F4 were (.502, .549, .702, .661), values that are > .5; (iv)positive significant moderate intercorrelations of indicators reflecting a certain factor (see table 2, for the magnitude of interitem correlations); (v) MICs within subscales F1, F2, F3 and F4 were .452, .385, .615 and.580 respectively. MICs within each subscale were sizable as they all exceeded the 0.3 threshold commended as a signal for the internal consistency reliability and homogeneity of a subscale; as well (vi) CITCs within sub-scale F1 were in the range (.495-.608), within sub-scale F2 were in the range (.315 - .602), within sub-scale F3 were in the range (.591 - .765), within sub-scale F4 were in the range (.623 - .663). It is plain that CITCs within the four subscales well-exceeded the 0.3 cutoff point indorsed as evidence of internal consistency reliability and homogeneity of a subscale.

Discriminant validity was endorsed by the following procedures: (i) interfactor correlations are not excessive (i.e. <|0.95| since correlations among constructs range between.529 and .932 manifesting adequate discriminant validity (see Table 6); (ii) CR is greater than AVE for each factor, which is conspicuous given that CRs of F1, F2, F3, F4 were (.800, .829, .875, .854) respectively and AVE for F1, F2, F3, F4 were (.502, .549, .702, .661) in the same sequence; clearly, for all constructs CR is >AVE signifying acceptable discriminant validity of TCI-14; (iii) EFA was run in a confirmatory mode to discern the felicitous number of factors, (iv) CFA was run in an exploratory mode to discard the one-factor and three-factor solutions.

Table (7) shows total variance explained using PAF extraction and direct oblimin rotation.

The 4-factor solution explained about 70% of the cumulative variance in the EFA, lending partial support for the construct validity of the scale. A four-factor unrotated solution was found to explain (70.241 %) of variance, compared to (75.102%) for the five-factor unrotated solution. Thus, the fifth factor explained only 4.861% (i.e. less than 5%) of the variance of the unrotated solution, a finding that confirms the robustness of the four-factor solution. In a parallel vein, a four-factor rotated solution was found to explain (60.419 %) of variance, compared to (63.161%) for the five-factor rotated solution. The fifth factor explains only 2.743 % of the variance of the rotated solution (see Table 7). Therefore, it is clear that it is not especially useful to retain a fifth factor, since the fifth factor does not add noteworthy incremental variance explained.

Additionally, using the scree-plot of eigenvalues, displayed four factors above the inflexion point and confirmed the adoption of the four-factor model as the most appropriate solution.

Table (7) shows that initial EVs ranged between 6.097 and .176. Applying Kaiser criterion (i.e. retaining factors with EVs > 1) yield a three-factor solution, however, the three factor solution is not supported by theory. Then again, applying Jolliffe's criterion (i.e. retaining factors with EVs> .7) generates a four factor solution. Running exploratory CFA (ECFA) with the three-factor solution (merging F2 and F3), unveiled that the three-factor model is a poor solution.

Parallel analysis (Table 7) suggested a one-factor solution, however, a one-factor solution is not backed by theory and some studies averred that parallel analysis has a tendency toward factor underextraction (Beauducel, 2001; Yang & Xia,2015).Running ECFA disclosed that the unidimensional solution was a thoroughly non-fitting structure. Also, previous research is anonymous in maintaining that TWC is a multidimensional concept (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008).

As the fourteen-item measurement model met the condition of congenerity, the investigation proceeded to assess it for tau-equivalence and parallelism. Tau-equivalence was tested by imposing equality constraints on the unstandardized factor loadings, i.e., they were all fixed to 1.0 and factor variances were freely estimated. It was realized that the fit of the tau equivalent model was not significantly worse than of the congeneric model. For the congeneric model: $\chi^2_{(71)}$= 71.650,p = .459; for the tau-equivalent model: $\chi^2_{(81)}$= 79.375, p = .530. ◎2diff. =◎2 (81) - ◎2 (71) = $79.375_{(81)}$ - $71.650_{(71)}$ = $7.725_{(10)}$, *ns*. Calculated chi < critical chi, at .001; ( i.e., 7.725<29.5883).Because tau-equivalence was established, the analysis proceeded to evaluating the condition of parallel indicators. The model was tested for parallelism by constraining error variances to equality and it was discerned that the fit of the model with parallel indicators (i.e. with equality-constrained residuals) was not significantly worse than that of the tau equivalent model, and the indicators are proved to be parallel. For the tau-equivalent model: $\chi^2_{(81)}$= 79.375, p = .530; for the parallel model, $\chi^2_{(94)}$= 96.073, p = .421. ◎2diff. = ◎2 (94) - ◎2 (81) = $96.073_{(94)}$ – $79.375_{(81)}$ = $16.697_{(13)}$,*ns*. Calculated chi < critical chi, at .001; (i.e., 16.697<34.5282). The fulfillment of the conditions of tau-equivalence and parallelism capacitated the option of assigning indicators equal weight when calculating scale and subscale TWC scores.

As the psychometric properties of the specified model are assured, then it can be employed to calibrate and grade the state of TWC in the study setting. Frequencies and percentages of various degrees of agreement/disagreement on TCI-14 items are shown in Table 8. Percentages not belonging to the uppermost three categories of AC, AG, and AS were:-21.3 %, 18 %, 14.7 %, 24.6%, 23.0 %, 13.1 %, 11.4 %, 16.4 %, 36.0 %, 24.6 %, 9.8 %, 21.3 %, 32.7 %, 11.4 % for fourteen items from T1 to T14 respectively. All items belonged to the "Good" grade since their gradients ranged from [0.795083 to 0.631150] as shown in table 8.

Table (9) displays the gradient and the calculating procedure of overall TCI-14 scale and subscales for the entire study setting. The gradient of the overall TCI-14 scale is .734192 which corresponds to a "Good" grade. The gradients of all subscales ranged between [.700367 and.754783] which similarly correspond to a "Good" grade.

Associations between overall TCI-14 scores and some personal and vocational characteristics of resident physicians including age, sex, marital status, merit obtained in M.B.Ch.B., work department and duration of employment in the study setting were investigated using the t-test for mean comparisons and no statistically significant differences were revealed (table 10). Associations between overall TCI-14 scores and residents' age and period of work in the department were investigated, using Pearson's correlation coefficients and, once again, no statistically significant associations were detected. Person's coefficient of correlation between TWC score and residents' age equals 0.074 (p = .572, two-tailed).Person's coefficient of correlation between TWC score and residents' work period equals - 0.090 (p = .492, two-tailed).

**Discussion**

TWC management is the intentional introduction and application within a group of ideas, actions, processes, and procedures planned to significantly enhance group or organizational collective functioning(El-Kot & Leat, 2005; Lipman-Blumen & Leavitt, 1999).TWC, as measured by the TCI, is one of the priority indicators for providers in the Canadian Institute for Health Information's Pan-Canadian Primary Health Care Indicator Update Report (CIHI, 2012). The psychometric properties of various versions of the TCI have been confirmed through application in sundry studies- including the present study- in organizations throughout the globe, including healthcare organizations.

It is imperative to determine the psychometric characteristics of TCI before using it to measure TWC in a specified setting (Ouwens, e tal., 2008). A range of earlier studies have validated and used TCI-14 to measure TWC; however, shortened versions of TCI, notably TCI-14, need further testing in diverse settings including healthcare settings (Kivimäki & Elovainio, 1999; Ouwens, et al., 2007).The present study validated TCI-14 and used it to measure TWC, various dimensions and manifest actions. A study conducted by El-Kot & Leat (2005) provided evidence of the utilization of teamworking in a sample of employing organizations in Egypt. To the extent of the researcher’s knowledge, TCI-14 has not been previously tested nor applied in an Egyptian healthcare setting.

The response rate in the present study was nearly 80%, a percentage that is very close to similar studies carried out in other healthcare settings. A response rate of 78.6%wasrecorded in a study executed in general practice in South Tyneside northeast England. (Goh, et al., 2009).In a similar vein, a study carried out in primary care settings in Quebec, Canada reported a response rate of 76.2 % (Beaulieu et al., 2014).Though, a response rate as low 63.2% has been reported in a study among quality improvement teams in the Netherlands(Strating & Nieboer, 2009).

Although a 5-point Likert scale is not infrequently applied when completing TCIs, the present study favored a 7-point one. A 7-point scale has been recommended and used by recent studies (Beaulieu, et al., 2014). Moreover, It was indicated that a 7-point scale is preferred among respondents with more cognitive ability (Weijters, Cabooter, & Schillewaert, 2010), whereas a 5- point scale is preferred among the general public (Revilla, Saris,& Krosnick,2014).

The present study assured the reliability and validity of TCI-14 in the specified setting. In spite of the small number of items in each subscale, the internal consistency reliability and homogeneity of the overall scale and subscales have been assured. The alpha coefficients for the four subscales were in the range [0.716 – 0.825] and were comparable to those reported by other studies in various parts of the globe. Reported ranges of subscales ($\alpha$) coefficients include:- [.75 –.82.](Boada-Grau, et al., 2011);[0.79 – 0.86.](Kivimäki & Elovainio, 1999); [0.70 – 0.82] (Loo & Loewen, 2002);[0.73 and 0.80](Strating & Nieboer, 2009).Subscales alpha coefficients reported by some studies were somewhat higher than those reported in the present study. For example:-[0.81– 0.84] (West – as cited by Beaulieu, et al., 2014), [.88 – .95] (Andreson & West, 1988), [.88 – .94] (Yuan, et al., 2008), [0.86–0.91] (Agrell & Gustafson,1994), [0.83–0.93] (Ouwens, et al., 2007), and [0.83–0.94] (Mathisen et al., 2004), [.83 – .94](Kivimäki, et al., 1997), [0.88 –0.93] (Beaulieu, et al., 2014),and [0.81–0.89] (Brodbeck & Maier, 2001).However, subscales alpha coefficients reported by some studies,(e.g. Ragazzoni, et al., 2002) ranged between 0.56–0.91 and were somewhat lower than those reported in the present study. Overall scale and subscales alpha coefficients – in the present study- were well below the .9 mark, indicating no overlap between scale items, a finding that is comparable to that documented by Yuan, et al., 2008. Notwithstanding, scale or subscale Cronbach's alphas more than 0.95, suggest an overlap among scale or subscale items and warrants further shortening of the scale (Beaulieu, et al., 2014).

CFA results of the present study confirmed the robustness of the correlated four-factor structure comprised of “Vision”, “Task Orientation”, “Participative Safety” and Support for Innovation”, a finding that is in harmony with previous several studies (Agrell & Gustafson, 1994; Brodbeck & Maier, 2001; Kivimäki & Elovainio, 1999; Loo& Loewen, 2002; Mathisen et al., 2004; Ragazzoni et al., 2002; Strating & Nieboer, 2009;

Tseng et al., 2009; West, 1990).The hypothesized model presented adequate fit indices, a finding that is also sustained by earlier numerous studies (Agrell & Gustafson, 1994; Anderson & West; 1998;Boada-Grau, et al., 2011; Brodbeck & Maier, 2001;Kivimäki & Elovainio, 1999; Kivimäki M, et al., 1997; Loo & Loewen, 2002; Strating & Nieboer, 2009; Tseng, et al., 2009).In line with previous studies (Anderson & West, 1998; Kivimäki, et al., 1997; Mathisen, et al, 2004; Ragazzoni, et al., 2002; Tseng, et al., 2009; Yuan, et al., 2008), an adequate model fit on the global and local levels asseverated the factorial validity of the standard four-factored model of TCI-14. Interfactor correlations were positive, sizable and statistically significant as they ranged between .932 and .529andthese findings are comparable to those revealed by Tseng et al., 2009, who acknowledged that all four subscales were significantly and positively correlated. In the present study, inter-subscale correlations ranged between (.932 and .529) compared to inter-subscale correlations ranging between (.848 to .577) for the four-factor model reported by Tseng et al., 2009, who showed that correlation between "Vision" and "Task Orientation" was .622; between "Vision" and "Support for Innovation" was .622; between "Vision" and "Participative Safety" was .577; between "Task Orientation" and "Support for Innovation" was .633; between "Task Orientation" and "Participative Safety" was .650; and between "Participative Safety" and "Support for Innovation" was .848.

According to Tseng et al., 2009, the degree of subscale intercorrelation between "Support for Innovation" and "Participative Safety" was ($r$ = .848), and correlation between "Support for Innovation" and "Vision" ($r$ = .544). These findings are remarkably analogous to the results of the present study where correlation between "Support for Innovation" and "Participative Safety" was ($r$ = .823) and between "Support for Innovation" and "Vision" ($r$ = .529).

According to Tseng et al., 2009, the highest degree of subscale intercorrelation existed between "Support for Innovation" and "Participative Safety"($r$ = .848), and the lowest was between subscales "Support for Innovation" and "Vision" ($r$ = .529). In the present study, the highest degree of subscale intercorrelation existed between "Participative safety" and "Task orientation" ($r$ = .932); and the lowest degree was between subscales "Vision" and "Support for innovation" ($r$ = .535).in the same vein, It is worth noting that in the present study the correlation between "Support for Innovation", and "Participative Safety" was ($r$ = .823), a value that is very close to ($r$ = .85) recorded in an earlier study by Mathisen et al., 2004.The highest interitem correlation occurred between "Participative Safety" and "Task Orientation" ($r$ = .93),a value that signified the discriminant validity of the model. An interfactor correlation coefficient of .93 corresponds to a shared variance of ($r2$ = 0.869), a value that does not warrant an overlap or halo effect among the underlying dimensions (Mathisen, et al., 2004).

EFA and ECFA were conducted to assure that the correct number of factors has been specified and ratify the four-factor structure of the standard model. In the present study it was found that the four-factor rotated solution explained (60.419 %) of total variance, compared to (63.161%) for the five-factor rotated solution. These results are almost identical explained variance reported by Tseng, et al. (2009) who found that the four-factor model accounted for 60.2% of the total variance, whereas the five-factor model accounted for 63.2%.EFA in the present study and other studies e.g.

(Agrell & Gustafson , 1994; Kivimäki, et al., 1997) demonstrated that the four-factor solution explained a major proportion of the total variance. It is noteworthy, that eigenvalues recorded by EFA in my study were superior to 1 for the first three components (i.e. 6.097, 1.588, 1.222) and very close to 1 (i.e. 0.921) for the fourth component, a finding that is similar to another study by Beaulieu, et al. (2009).Additionally, a scree test in the present study revealed that the analysis should retain no more than four factors, a finding that is identical to that revealed by Tseng, et al., 2009.

Convinced of factorial, convergent and discriminant forms of validity, the TCI-14 model was applied to calibrate the magnitude of the overall TWC, its four subscales as well as its fourteen indicators. Gradient of global scale score was ≈ .7342, a gradient which is roughly identical to a.74 recorded in another study that employed TCI-14 in an integrated care setting (Ouwens, et al., 2007).In a related vein, a study conducted in five Belgian general hospitals revealed that teamwork within hospital units registered a score of .70 (Hellings, Schrooten, Klazinga,& Vleugels,2007).

Gradients of subscale scores were (≈ .7377, ≈ .7548, ≈ .7359, ≈ .7004) for subscales F1, F2, F3, F4 respectively. Indicator gradients ranged between ≈.6312 and .7951. In this way, overall scale score, subscale scores and all individual items scores realized a "Good" grade which is a sign that there is ample room for continuous improvement of TWC in the study setting.

Calibration of TWC should not be restricted to gauging global (overall) TCI score. Calibration needs to differentiate among separate dimensions of TWC. Taking into consideration a number of factors rather than an overall TWC score increases the practical diagnostic value of the measuring tool(Loo & Loewen 2002).Directing the TCI survey feedback toward specific factors and manifest actions is more effective than a nebulous composite approach adopting an overall TWC scale score(Tseng, et.al, 2009).Fine calibration of TWC at the indicator level provides an opportunity for accurate diagnosis and precise intervention educational and training programs directed at particular items; and inspires managers and employees to promote critical awareness about particularized actions conducive to continuous upgrading of TWC in a specified setting.

Research experience put on view that well-directed improvement actions generate significant improvements in TCI scores and overall team performance (Loo, 2003; Strating & Nieboer, 2009).

The depicted configuration of the concept of TWC together with uttered calibration procedures are practical means that can facilitate the formulation, implementation and assessment of evidence-based policies, programs and interventions distinctively tailored to address identified and quantified needs vis-à-vis continuous improvement of TWC.TWC can be promoted by broad processes such as ''adding extra teamwork experts'', " sharing information", " communication skills training, "making effective use of communications technologies", and " setting clear organizational objectives". Until recently, however, the majority of health care professionals received little or no training in effective teamwork (Clancy, Tornberg,2007). TeamSTEPPS (Team Strategies and Tools to Enhance Performance and Patient Safety), is an evidenced-based system that has been used in healthcare organizations to improve teamwork using a thorough set of training curricula gleaned from operative practices to boost TWC(AHRQ, 2006; Clancy&Tornberg,2007).

Definite actions that could be effected to bring about improvements at the manifest action plane include:- establishing specific, worthwhile, achievable team objectives; devising regular scheduled meetings meant to build cohesion among team members (such as celebrating successes); sponsoring informal events that can foster team members acceptance and understanding (such as getting together after hours, or celebrating a team member's birthday); communicating sentiments of caring, understanding and acceptance among team members; having everyone on the team informed of all relevant information; guaranteeing a free flow of communication and an exchange of ideas among team members; sponsoring team members who do not participate willingly, keeping any single person or point of view from dominating the team consultations, asking pointed questions to team members; seeking input from every single team member; preparing team members to answer basic questions; nurturing critical and lateral thinking skills; developing creative problem solving abilities including brainstorming sessions; and instigating autonomous teams with sufficient time to cultivate and realize innovative ideas.

Overall TWC, four dimensions, and specific actions can be monitored based upon item scores so as to enforce and positively reinforce actions that are working well in a team, while unfavorable actions reflecting a problem on overall TWC or one of its dimensions can be accurately diagnosed and reduced through specific remedial action.

The robust replication of the four-factor model in an Egyptian socio-cultural context implies that TCI-14scale items display cross-cultural similarities and underpins an insight into the transferability and opportunities for adaptation of TCI-14 across cultures and countries. The present study contributed appreciated knowledge about the validity, reliability robustness and applicability of TCI-14 in a country where the body of research on TWC is very thin. The current study constitutes a rung in the cross-cultural validation of TCI-14 using rigorous methods.

Findings of the present study denoted that perceptions of TWC by resident physicians is not contingent upon their personal characteristics such as age, sex, marital status merit obtained in M.B.Ch.B., department, or duration of employment in the study setting.

A limitation of the present study is that the number of cases is less than 100, yet it should be recounted that sixty-one cases is the maximal number of participants who could contribute to the present study in the designated setting and a sample is pondered adequate as long as it includes all cases that can contribute to the study (Kenny, 2015). According to Kline (2005), SEM is a large sample technique; nevertheless, quite small "sample" size of the study does not detract from the soundness of study results since strict rules regarding sample size for factor analysis have mostly disappeared (Costello & Osborne, 2005).A number of studies certified that adequate sample size is partly determined by the nature of data (Fabrigar, Wegener, MacCallum, & Strahan, 1999; MacCallum, Widaman, Zhang, & Hong, 1999).Research make clear that when communalities are high, recovery of population factors in sample data is normally very good, almost regardless of sample size (MacCallum, et al., 1999). Thus, samples somewhat smaller than traditionally recommended by rules of the thumb are deliberated sufficient when communalities are high(MacCallum, et al., 1999).

Moreover, conclusions extrapolated from the study model cannot be considered unreliable so long as the assumptions of conventional estimators such as MLEand GLS are not challenged (de Carvalho & Chima, 2014). Currently, it is commonly accepted that in some situations SEM can be run with smaller samples (Babin, & Svensson, 2012). Sapnas and Zeller(2002),assert that even fifty cases could be sufficient for FA. Still more, quite a lot of studies have tackled the role of sample size less than 50 in FA in terms of parameter recovery (Jung & Lee, 2011). de Winter, Dodou, & Wieringa (2009) lately contended that under the conditions of high communality, high number of manifest variables, and small number of factors, FA can yield robust estimates of population loadings for sample sizes less than 50. In the same vein, MacCallum et al., 1999, evinced that level of communality is the principal determinant of factor recovery concerning the issue of sample size. According to Babin and Svensson (2012) small samples may detract from the generalizability of results; notwithstanding, the results of the present study are not meant to be generalized beyond the stated study setting.In general, the stronger the data, the smaller the sample can be for an accurate analysis. According to Mulaik, 1990 and Widaman, 1993, "strong data" in FA connotes uniformly high communalities without cross loadings, plus several variables loading strongly on each factor, conditions that are paraded in the present study.

Another limitation of the present study is that it focused on assessing factorial, convergent and discriminant aspects of validity and did not include an evaluation of other aspects such as concurrent or criterion-related (predictive) types of validity. Concurrent validity may be assessed through correlations of TCI-14 scores with analogous scales such as TCI-19, TCI-38.In a parallel vein, predictive validity may be assessed by determining correlations of TWC-14 and its dimensions with some outcome measures such as customer satisfaction, employee satisfaction, innovation-related group processes, the number of innovations, perceived innovativeness, and technical quality of care as measured, for instance, by the Quality and Outcome Framework (QOF). It is acknowledged that high scores on 'external' measurement instruments are positively related to high scores on TCI. However, it has not been an objective of this study to perform a comprehensive assessment of all types of validity of TCI-14 as it would have been too demanding for this piece of research. A third limitation is that temporal stability of the scale has not been tested as the present study did not include a test-retest evaluation of the scale; and follow-up studies incorporating test- retest assessment are counseled to test temporal stability of the scale. Fourthly the present study results cannot be generalized to other Egyptian healthcare settings since it was just confined to two departments in one governmental university hospital. There is a need to replicate the study in other clinical departments in AMUH as well as in other public and private Egyptian clinical healthcare settings. Lastly the present study has the limitation that it is based on self-report results that may be biased according to what individuals are willing to report (McCarthy, 2012).

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